Morning and Afternoon Swimming Session: Fluid Loss Of Sub-Elite Para Swimming Athletes In General Preparation Periodization

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Abstract. Monitoring hydration balance during exercise athletes is crucial. The study aimed to analyze changes athlete's body fluid loss in general preparation periodization. The research method used is quantitative research which is presented descriptively. The research design used is an experimental pre and post-test design that examines five para-swimming athletes, four male and one female disabled swimmers. Measurements of the weigh before and after exercise in the pool were used to determine changes in body weight during the general preparation period. The data analysis used non-parametric (Wilcoxon test and the Mann Whitney test). This study's results show a significant difference between exercise in the morning and afternoon in the loss of body fluids ($p<0.05$). Athletes who exercised in the morning session had more loss of body fluids than in the afternoon session. This study concludes that intense exercise in a hot environment with high air temperature and relative humidity increases the loss of body fluids.

Keywords: Fluid, Hydration, Heat Environment, Paralympic, Athletes, Swimming.

1 Introduction

Creating athletes who excel requires training programs carried out systematically and continuously and the application of various aspects such as physiological, psychological, and biomechanics, that aim to obtain functional training results [1]. The

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inhibiting factors for the exercise process in the training environment are very diverse, including environmental factors, namely temperature and humidity conditions [2]. A hot environment can affect the athlete's condition because a hot training environment becomes an additional training burden for athletes, requiring more incredible energy than athletes who train in a comfortable environment [3]. Core body temperature is strongly influenced by environmental temperature, and exercise intensity also directly affects body temperature; the higher the intensity of the exercise, the higher the body temperature [4].

The consequences of a person doing sports or physical activities in hot temperatures are not only affecting the decrease in the achievement of these activities but also increasing the risk of developing one or several types of diseases caused by hot temperatures [5]. These conditions include heat cramps, heat syncope, heat exhaustion (there are two types: exhaustion of water, the exhaust of salt), and heat stroke (heart attack) [6]. Excessive sweating when we do sports can also cause dehydration. Dehydration occurs when body fluid expenditure exceeds intake [7].

Exercise in a hot environment increases physiological stress. Physical activity in a hot environment is known to reduce exercise capacity significantly and has the potential to cause fatigue, injury, and hyperthermia [8]. A study conducted by [9] showed that athletes who exercised in hot environmental conditions experienced a decrease in exercise performance which was followed by an increase in skin temperature and core body temperature, the cause of the decline in performance caused by cardiovascular tension and changes in body temperature. It can change the function of the heart and blood vessels [3]. Physical activity in a hot environment can increase the metabolic rate, thereby quickly increasing lactic acid accumulation in the blood 5]. Therefore, research conducted by [10] states that hot environmental conditions are positively related to increased levels of lactic acid. It can be concluded that environmental conditions significantly impact the loss of body fluids. Therefore a hydration strategy must be applied to avoid dehydration. If dehydration or excessive loss of body fluids continues and fluids are not replaced with water and electrolytes, it can cause headaches, fatigue, and heat exhaustion [11]. Water contributes 50–70% of the total body mass and is divided into intracellular (65%) and extracellular (35%) spaces [12].

The novelty of this study compared to previous research has been explained that this study analyzes the exercises carried out by para-swimming athletes who carry out training in two different training environmental conditions, including the environmental conditions of the exercise carried out in the morning and the environmental conditions carried out in the afternoon in general preparation phase. Research data was collected in training conditions in the form of temperature and relative humidity of the air. It aims to prove the effect of environmental conditions that can affect sweating in athletes. Based on this, it is hoped that it will be helpful in the community and sports players to avoid dehydration during and after exercising.

2 Method

This study aimed to analyze the weight in the morning and sessions in the afternoon. In addition, it compared the exercises performed in the morning and afternoon sessions on the fluid expenditure of swimming athletes. The difference in this study compared to previous studies is to analyze the effect of the training load and the conditions of the exercise environment together to affect fluid expenditure.

The research method used is quantitative research which is presented descriptively. The research design used is an experimental pre and post-test design that examines five swimming athletes, four male and one female athlete. The age range of the athletes studied was from 19 years to 33 years. The limited body mass index data is due to the fact that the para-swimming athletes studied are swimming athletes who have limitations in their bodies (disability athletes).

Data collection lasted for three weeks. The data collected includes pre-test weight data before exercise, post-test weight after exercise, temperature, and humidity during exercise. Athletes carry out two training sessions a day. In the morning training session, athletes carried out swimming exercises at a distance of 2600 meters and 1600 meters. During the afternoon training session, athletes carry out exercises at a distance of 1600 meters. Data about the conditions of the exercise environment in the form of data on temperature and relative humidity of the air is always measured in each exercise. In contrast, the loss of body fluids data was obtained through the difference in body weight before and after exercise. This research is a non-parametric study because of the small sample size used. Therefore, the data analysis techniques used are as follows;

a. Wilcoxon test, to test the pre and post-test data on body weight (fluid output).
b. The Mann-Whitney test examines the difference in fluid output between morning and afternoon training sessions.

3 Results

Table 1. The description of the conditions of the exercise environment in the form of temperature and relative humidity of the air

	Training session	*Mean* *Std. Deviation*	*p*
Temperature	Morning	34,8°C ± 0,83	0,000
	Afternoon	24,98°C ± 0,77	
Relative humidity	Morning	60% ± 1,87	0,000
	Afternoon	50,8% ± 1,3	

Based on the data shown in Table one, it is explained that there are significance differences in temperature and humidity in each training session. In the table, it is explained that the conditions of the exercise environment in the morning have a hotter

temperature than the conditions of the exercise in the afternoon. In addition, the humidity in the morning is higher than the humidity in the afternoon.

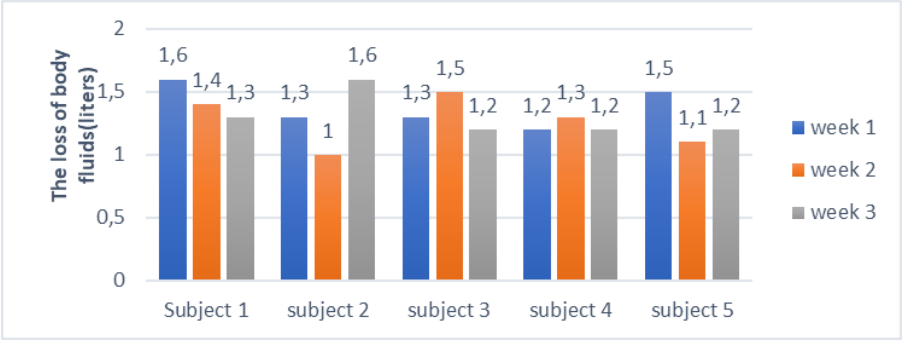

Figure 1. Fluid loss from week one to week two in each subject was measured during the morning training session

Based on the data shown in Figure one, it is the average loss of body fluids data from the first to the third week for each subject measured in the morning exercise session. Facts show athletes apply an unplanned drinking pattern (ad libitum) when training. The data shows that the average consumption of mineral water during exercise is 600ml.

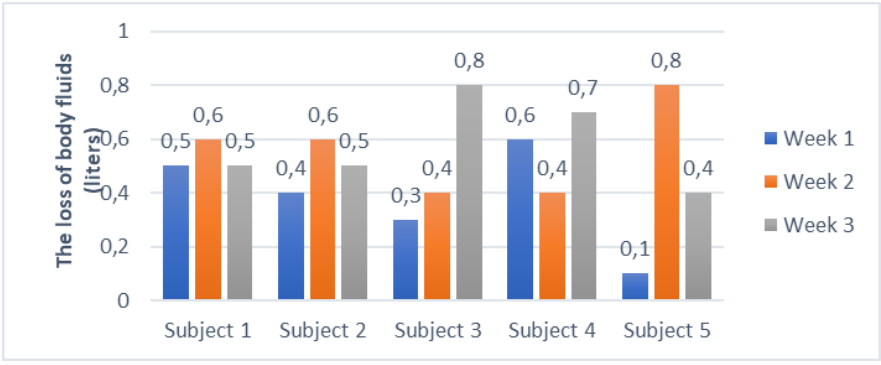

Figure 2. Fluid loss from week one to week two in each subject was measured during the afternoon training session

Based on the data shown in figure two shows the average loss of body fluids each week in the afternoon training session. It is the same as the exercise done in the morning. The athlete applies an ad libitum drinking pattern when practising in the afternoon. Coaches and athletes should apply a planned drink drinking pattern to avoid dehydration considering that athletes have carried out intense training in the morning.

Table 2. The description of the loss of body fluids

	Bodyweight	*Mean* *Std. Deviation*	*p*
Pair 1 Morning session	Pre-test	50.02 kg ± 11,09	0,00
	Post-test	48.7 kg ± 11,07	
Pair 2 Afternoon session	Pre-test	50.69 kg ± 11,04	0,00
	Post-test	50.18 kg ± 11,02	

Based on Table two, the description data of loss of body fluids in swimming athletes is displayed. The difference between body weight can determine fluid loss before and after exercise. It is explained that there is a difference between body weight before exercise and after exercise. So it can be concluded that the morning and afternoon exercise affect the athlete's loss of body fluids.

Table 3. The difference between morning and afternoon training sessions of fluid expenditure

Training sessions	*Mean* *Std. Deviation*	*Mann Whitney test*
Morning session	1,31 litres ± 0,07	0,00
Afternoon session	0,5 litres ± 0,04	

Table 3 shows the different tests between fluid loss that occurs in the exercise session in the morning and the afternoon. Based on the difference test, it is explained that the value of Sig. (2-tailed) of 0.00, which means there is a difference between training sessions conducted in the morning and the afternoon on the fluid loss of swimming athletes. The mean difference of 0.8 litres further strengthens this. The conclusion of this study is that intense exercise in a hot environment with high air temperature and relative humidity increases body fluid loss.

4 Discussion

The monitoring of exercise variables, including exercise frequency, exercise intensity, exercise volume, which are collected into one and called the training load, is essential to know the training progress of athletes [13]. However, physiological changes caused by environmental conditions are still not noticed [14]. The intended environmental conditions are the temperature and relative humidity of the air when carrying

out the exercise [15]. The conditions of the training environment significantly affect the performance and condition of the athlete's body after exercising [16]. Environmental conditions also significantly affect the smooth running of training activities and competitions [17].

Training in hot environment conditions can affect the training load [18]. In addition, exercise in hot environments significantly affects the loss of body fluids [12]. Based on the data obtained, it shows that athletes who exercise in the morning session lose more body fluids than athletes who exercise in the afternoon session. The mean difference in loss of body fluids is indicated by 0.8 litres. Environmental in the morning have a hotter temperature of 34 degrees Celsius and relative humidity of 60%. Based on the Web Bulb Globe Temperature Index (WBGT), the morning's environmental conditions are categorized as dangerous. If an athlete performs intensive training activities and does not apply a good hydration strategy, he will automatically experience a condition of dehydration to heat exhaustion [19].

Based on these conditions, to avoid prolonged dehydration, it is necessary to fulfil the needs of body fluids to avoid the negative impacts caused. Hydration is an important thing to pay attention to in sports because almost 70% of the body consists of fluids [20]. Therefore, for the body to function optimally, the fluid needs in the body must be appropriately met (Giersch et al., 2020). The sweating process involves water and electrolyte losses, which can be detrimental to exercise performance if not replaced accordingly [21]. Physiologically, when the body loses 2-3% of body fluids, there will be a decrease in physical function; also, losing only 1% of fluid due to dehydration will harm regulating body temperature during exercise [22].

The impact of dehydration on sports performance is that athletes can experience a decrease in the ability of body reactions and concentration, delays in decision-making, and an increased risk of sports injury [23]. It has been proven by the fact that in the field, it is known that 3-4% dehydration causes a decrease in power by 3% [24]. Research states that the temperature and relative humidity of the air significantly affect the loss of body fluids [25]. In addition, athletes and coaches do not apply a strategy of drink or more popularly called a planned drink. The drinking pattern used is based on the intuition of thirst, an ad libitum drink. Based on the data obtained, each athlete's average water consumption during exercise is 600 ml.

The athletes' water consumption is considered less because the athletes carry out intense training in a hot environment. In these conditions, the body performs a physiological response in the form of sweating, which is an attempt by the body to achieve homeostasis [26]. The metabolic process that occurs when athletes do sports causes an increase in body temperature which is a burning process and produces energy, and in the burning process, the body excretes sweat which is the rest of the combustion [27]. Sweat from the body caused by sports activities consists of water and electrolytes. A study states that athletes who do sports in hot environmental conditions and enter the training zone will automatically sweat as much as 0.5 to 1.5 litres/hour [9]. Based on the facts, it is shown that athletes who carry out training in the morning session lose an average of 1.3 litres of fluid.

Based on these conditions, a hydration strategy is needed to avoid the effects of dehydration [28]. A study states that a planned hydration strategy (planned drink) is better at preventing dehydration conditions than an unplanned hydration strategy (ad libitum drink) [29]. Proper hydration strategies during the preparation phase, competition, and match training can improve sports performance, reduce the potential for injury due to rising body temperature and increase the speed of body recovery [11]. Therefore, a hydration regulation or strategy (planned drink) is needed to prevent athletes from becoming dehydrated [7]. A good hydration strategy is to consume as much as 400 to 600 ml of water for 10 to 15 minutes before doing sports activities [30].

Drinking adequate water is essential for health, energy, recovery, and performance. With good fluid adequacy, nutrient absorption will be more efficient, and stress levels will be low [31]. The simplest way to check hydration is to look at the colour urine [32]. If urine looks pale yellow, then are dehydrated. The more concentrated and darker the urine's colour indicates a lack of body fluids. It is a signal to immediately meet fluid needs by drinking water as soon as possible with the correct dose. Athletes can use this simple method to determine hydration status and reduce the risk of dehydration. If the colour of the urine looks pale, the athlete can take steps to treat it by drinking water gradually so that the body reaches a good level of hydration [7].

5 Conclusion

Based on the data and facts obtained, it can be concluded that the exercise carried out in the morning and afternoon sessions affects fluid loss. In addition, there is a significant difference between the exercises performed in the morning and afternoon sessions on losing body fluids. The conclusion of this study is an intense exercise in a hot environment with high air temperature and relative humidity increases the loss of body fluids. The training load and the conditions of the training environment affect the loss of body fluids.

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