MJSS

Akdeniz Spor Bilimleri Dergisi

Mediterranean Journal of Sport Science

ISSN 2667-5463

The Effects of Dehydration Resulting from Basic Endurance Training (End-1) on Performance and Examination of Body Hydration Level on Swimmers[i]

Ayşegül YAPICI

DOI: https://doi.org/10.38021asbid.1202395

ORIJINAL ARTICLE

Pamukkale University, Faculty of Sport Sciences, Denizli/Türkiye

Coorresponding Author: Ayşegül YAPICI
ayapici@msn.com

Received: 10.11.2022

Accepted: 08.12.2022

Online Publishing: 19.12.2022

Abstract

The purpose of this study, basic endurance training in swimming is the evaluation of the resulting dehydration and its effects on performance. 14 male swimmers from Pamukkale University Swimming Sports Clup team participated voluntarily in this study. 7 athletes took liquid supplement and 7 athletes continued to practice without liquid supplement and the same protocol were repeated after 48hours. Tanita measurements, urine specific gravity, heart rate, blood pressure, body temperature, swimming performance (100m and 400m) measurements was applied. T-test was used for the difference between the pre-test and post-test values in the group, and t-test analysis was used for the differences between the groups in the independent groups. There was no statistically significant difference between in the pre-test values of the swimmers with and without liquid supplementation ($p>0.05$). There was a statistically significant difference in the urine density values between in the post-test values of the swimmers with and without liquid supplementation ($p<0.05$). There was a statistically significant difference in the body temperature, total body fluid percentage, body fat percentage, fat free mass percentage, heart rate, diastolic blood pressure, 100m free swimming performance measurements between the pre-test and post-test values of the group that trained by taking liquid supplements ($p<0.05$). There was a statistically significant difference in the body weight, body mass index, urine density, total body fluid percentage, body fat percentage, fat free mass percentage, heart rate, 100m free swimming performance measurements between the pre-test and post-test values of the group training without fluid supplementation ($p<0.05$). As a result, it was observed that the body weight decreased and dehydration increased in the training without fluid supplementation in swimmers.

Keywords: Dehydration, Urine Density, Hydration, Swimming

Yüzücülerde Temel Dayanıklılık Antrenmanı (End-1) Sonucunda Oluşan Dehidrasyonun Performans Üzerine Etkileri ve Vücut Hidrasyon Düzeyinin İncelenmesi

Öz

Bu çalışmanın amacı; yüzücülerde temel dayanıklılık antrenmanı sonucu oluşan dehidrasyonun değerlendirilmesi ve performans üzerindeki etkilerinin incelenmesidir. Çalışmaya Pamukkale Üniversite Yüzme spor klübünden14 erkek yüzücü katılmıştır. 7 sporcu sıvı takviyesi almış ve 7 sporcu sıvı takviyesi almadan antrenmana devam etmiştir ve 48 saat sonra aynı protokol tekrarlanmıştır. Çalışmada tanita ölçümleri, idrar özgül ağırlığı, kalp atım hızı, kan basıncı, vücut sıcaklığı, yüzme performansı (100m and 400m) ölçümleri uygulanmıştır. İstatistiksel analizde grup içi ön-test son-test farkına bağımlı gruplarda t-test, gruplar arasındaki farklar için bağımsız gruplarda t-test analizi yapılmıştır. Sıvı takviyesi alan ve almayan yüzücülerin ön-test değerleri arasında istatistiksel olarak anlamlı bir fark bulunamamıştır ($p<0.05$). Sıvı takviyesi alan ve almayan yüzücülerin idrar dansitesi son-test değerleri arasında istatistiksel olarak anlamlı bir fark bulunmuştur ($p>0.05$). Yüzücülerin sıvı takviyeli antrenman öncesi ve sonrası bulgularında; vücut sıcaklığı, toplam vücut sıvı yüzdesi, vücut yağ yüzdesi, yağ dışı ağırlık yüzdesi, kalp atım sayısı, diastolik kan basıncı, 100m serbest yüzme performansı ölçümleri arasında istatistiksel olarak anlamlı bir fark bulunmuştur ($p<0.05$). Yüzücülerin sıvı takviyesiz antrenman öncesi ve sonrası bulgularında; vücut ağırlığı, vücut kütle indeksi, idrar dansitesi, toplam vücut sıvı yüzdesi, vücut yağ yüzdesi, yağ dışı ağırlık yüzdesi, kalp atım sayısı, 100m serbest yüzme performansı ölçümleri arasında istatiksel olarak anlamlı fark bulunmuştur ($p<0.05$). Sonuç olarak, yüzücülerde sıvı takviyesiz antrenmanda vücut ağırlığının düştüğü ve dehidrasyonun arttığı görülmüştür.

Anahtar Kelimeler: Dehidrasyon, İdrar Dansitesi, Hidrasyon, Yüzme

Introduction

Replenishment of fluid in the body before, during and after exercise is important. The athlete starts the exercise in the hydration state, during the exercise avoiding dehydration and replacing the lost fluid before the next workout must be put. With the loss of fluid, an increase in blood density occurs, the fluidity of the blood is decreasing. The effects that occur with fluid loss cause the heart to work harder than normal, it causes difficulty in breathing, fatigue and working time is shortened, reflexes slow down (Knechthle et al., 2008; 2009). The danger of water loss in the body is that it takes longer for nutrients to reach the muscles. The result is a negative impact on performance. Cells as a result of ongoing water deficiency dehydration occurs due to loss of water. Adequate replacement of fluid loss in the body not only does not reduce the performance, but also seriously affects the athletes cause health problems and even death (Maughan, 2003). During energy generation for exercise, 75% of the energy is released as heat and 25% is used for mechanical work (in intense exercise heat production is 20 times higher than at rest too many). In order to continue the activity, the generated heat must be dissipated. The main mechanism for dissipating body heat is sweating body formed in exercise. Its heat is carried to the skin by the circulating blood. The brain, especially the hypothalamus, senses increased heat in the blood and stimulates the sweat glands to create more sweat. Disappearing from muscle cells water replaces water in blood. Dehydration if no external fluids are taken takes place. Swimming; high-level aerobic and anaerobic endurance, strength, flexibility, speed, quickness, rhythm, including sports performance and technical skills such as coordination is a sport (Yapıcı and Cengiz, 2015). Fluid balance also affects swimmers' performances occupies an important place among the many factors affecting. In swimming, where fluid loss in water is ignored, athletes' evaluation of post-workout fluid losses; fluid intake and fluid loss it is important to reveal the effects on performance. The aim of this research is to evaluate the dehydration that occurs as a result of basic endurance training in swimmers and to evaluate the performance examination of its effects.

Materials And Methods

Participants

14 male swimmers from Pamukkale University Swimming Sports Clup team participated voluntarily in this study. Swimmers were informed about water consumption and fluid losses during exercise 1 week beforehand. Before the measurements, they were told to note their food, liquid and drug consumption for 5 days. Subjects who do not smoke and do not have a chronic disease (cardiovascular) or infectious condition were included in the study.In these records, swimmers who used drugs and whose body fluids were not at an optimal level (1.020 g/cm³ and lower value) were

not included in the study. The subjects consisted of players of the same team who trained for 2 hours a day, five days a week. The subjects were informed about the advantages and possible risks that they may encounter in this study. Subjects signed informed consent forms. In order to carry out the study, the ethics committee approval of Pamukkale University Faculty of Medicine "Non-Invasıve Clinical Research Ethics Committee" was obtained (Date: 18/10/2022, decision no: 15).

Procedures

The study was completed during a 2-week pre-season period. Before the experimental period, the anthropometric data of the swimmers were taken (body weight and height). Measurements were performed on two different days. All measurements were made while subjects were in swimsuits. In the study, tanita measurements, urine specific gravity, heart rate (HR), blood pressure, body temperature, swimming performance (100m and 400m) measurements was applied. Swimmers were given 6-week basic endurance training (End-1). For both measurement days, before the training, ACSM's (American College of Sports Medicine) exercise and water consumption strategy was sufficient (5-7 mL water per body weight 4 hours before the training and 3-5 mL water 2 hours before the training) (Ferguson, 2014). They were asked to come to the training in a given condition. On the first measurement day, 7 athletes randomly determined before training took liquid supplement and 7 athletes continued training without taking any liquid supplement. On the second measurement day, the group that received fluid supplementation on the first day continued training without fluid supplementation, and the group that did not receive fluid supplementation continued training by taking fluid supplementation. Water (14-15°C) was preferred as a liquid supplement. A 48 hours rest was given between measurements. Fluid supplementation was administered as half a liter at the end of each hour, a total of 1 liter throughout the training. All measurements were repeated before and after the training on both days. In order to measure the degree of difficulty of loading; after the training of the subjects, the Borg scale (1-10) was used (Borg, 1982).

Anthropometric Measurements

The subjects' height (sensitivity ±0.01 m) and body weight (sensitivity ±0.01 kg) were measured with a Seca stadiometer. Height measurements were made in bare feet. Height was measured in an upright position with the head in an upright position, the soles of the feet flat and the heels together, without bending the knees. Body weights were done without shoes and in a comfortable outfit.

Heart Rate, Systolic and Diastolic Blood Pressure Measurement

For each athlete, a digital sphygmomanometer (Microlife) was connected to the left arm and blood pressure and heart rate measurements were made and recorded according to the instructions shown by the device.

Body Temperature Measurement

The measurement was taken with a measuring device Fire from swimmers' ears (Braun Thermo Scan IRT 4520).

Percent Body Fluid, Body Weight, Percent Body Fat, Percent Non-Fat Weight Measurement

The subjects were barefoot in their swimsuits (Tanita SC 330-S Bodyless Professional Body Analysis Monitor) measurements were taken and recorded.

100m and 400m Free Swimming Degrees Measurement

100m and 400m free swimming degrees were taken with a Casio stopwatch. For both measurement days, the pool environment was fixed at 28°C temperature and 52% humidity. Preliminary measurements of swimming performance were taken after snow warming. The last measurements were taken 10 minutes after the end of the training.

Urine Density Measurement

The urine sample taken from the subjects is inside the device (ATAGO™ digital urine refractometer) was waited for 2 seconds and the value on the screen was recorded as g/cm^3. The device was calibrated with distilled water between each measurement. Measurements were taken 15 minutes before the start of training and 5 minutes after the end of training.

Basic Endurance Training (END-1)

High-intensity 3000m distance basic endurance for swimmers training program implemented. In the warm-up, they swam 1000m freestyle and 400m medley swimming were performed. In the main set, 10x300m, 30 seconds rest between sets, 200m slow pace free in the cool-down swimming was done.

Statistical Analysis

All data in this study are given as mean ± standard deviation. Shapiro Wilk analysis was used to test the normality of the data. Since the normal distribution was determined, the intra-group pre-test post-test difference was examined with the t-test in dependent groups and t-test analysis was

performed in independent groups for the differences between groups. Data were analyzed using SPSS version 22 (SPSS Inc., Chicago, IL, USA) and the level of significant differences was set at $p<0.05$.

Results

All the subjects completed the test protocols without any problems. Descriptive characteristics of the participants are shown in Table 1.

Table 1
Descriptive characteristics of the participants

Variables	**x ± Sd**
Age (years)	16.42±1.42
Height (cm)	173.01±0.05
Weight (kg)	65.23±6.49
Training Age (years)	9.44±2.41

Table 2
Analysis of the pre-test values of the swimmers with and without liquid supplementation

Measurements	**With Liquid Supplement x±Sd**	**Without Liquid Supplement x±Sd**	**t**	**p**
Body Weight (kg)	49,70 ± 9,89	49,90 ± 10,02	-0,06	0,96
Body Mass Index (kg/m^2)	18,52 ± 1,44	18,64 ± 1,45	-0,22	0,85
Body Fluid Level (%)	64,76 ± 3,32	64,41 ± 3,33	0,25	0,78
Body Fat Percentage (%)	10,30 ± 4,51	10,76 ± 4,53	-0,24	0,83
Fat Free Mass (%)	89,70 ± 4,52	89,54 ± 4,54	0,24	0,82
Urine Density (g/ml)	1,016 ± 0,001	1,017 ± 0,002	-0,64	0,51
Heart Rate (bpm)	88,40 ± 10,61	85,63 ± 11,27	0,58	0,57
Systolic Blood Pressure (mmHg)	121,53 ± 14,19	122,62 ± 12,17	-0,21	0,86
Diastolic Blood Pressure (mmHg)	71,27 ± 10,27	69,18 ± 7,59	0,57	0,59
Body Temperature (°C)	36,21 ± 0,41	36,15 ± 0,42	0,31	0,77
100 meters freestyle swimming (s)	66,06 ± 5,65	68,12 ± 5,49	0,01	1,00
400 meters freestyle swimming (s)	300,42 ± 26,00	304,41 ± 25,64	0,00	1,00

*p<0,05

There was no statistically significant difference between in the pre-test values of the swimmers with and without liquid supplementation ($p>0.05$).

Table 3

Post-Test Values of the Swimmers with and without Liquid Supplementation

Tests	With Liquid Supplement x±Sd	Without Liquid Supplement x±Sd	t	p
Body Weight (kg)	49,60 ± 9,88	49,16 ± 9,80	0,07	0,96
Body Mass Index (kg/m^2)	18,40 ± 1,45	18,30 ± 1,46	0,17	0,87
Body Fluid Level (%)	63,58 ± 3,86	63,89 ± 3,45	-0,22	0,83
Body Fat Percentage (%)	10,32 ± 4,53	12,68 ± 4,76	0,26	0,80
Fat Free Mass (%)	86,82 ± 5,25	87,34 ± 4,78	-0,26	0,80
Urine Density (g/ml)	1,018 ± 0,002	1,021 ± 0,002	-2,16	0,04*
Heart Rate (bpm)	107,5 ± 14,8	107,15 ± 11,52	0,43	0,67
Systolic Blood Pressure (mmHg)	123,76 ± 10,54	122,65 ± 13,26	0,22	0,83
Diastolic Blood Pressure (mmHg)	78,15 ± 5,26	76,93 ± 13,95	0,29	0,77
Body Temperature (°C)	35,56 ±0,36	35,91 ± 0,51	-1,79	0,09
100 meters freestyle swimming (s)	65,32 ± 6,04	68,17 ± 6,54	-0,3	0,77
400 meters freestyle swimming (s)	305,42 ± 24,15	306,41 ± 25,67	0,12	0,91
Borg Scale	7,56 ± 1,83	7,84 ± 1,85	-0,34	0,75

*p<0,05

There was a statistically significant difference in the urine density values between in the post-test values of the swimmers with and without liquid supplementation ($p<0.05$).

Table 4

Pre and Post-Test Values of With Liquid Supplementation Group

Tests	Pre x±Sd	Post x±Sd	t	p
Body Weight (kg)	49,70 ± 9,89	49,60 ± 9,88	0,55	0,57
Body Mass Index (kg/m^2)	18,52 ± 1,44	18,40 ± 1,45	0,01	1,01
Body Fluid Level (%)	64,76 ± 3,32	63,58 ± 3,86	10,17	0,00*
Body Fat Percentage (%)	10,30 ± 4,51	10,32 ± 4,53	-10,67	0,00*
Fat Free Mass (%)	89,70 ± 4,52	86,82 ± 5,25	10,47	0,00*
Urine Density (g/ml)	1,016 ± 0,001	1,018 ± 0,002	0,16	0,86
Heart Rate (bpm)	88,40 ± 10,61	107,5 ± 14,8	-5,42	0,00*
Systolic Blood Pressure (mmHg)	121,53 ± 14,19	123,76 ± 10,54	-0,42	0,71
Diastolic Blood Pressure (mmHg)	71,27 ± 10,27	78,15 ± 5,26	-2,56	0,03*

Body Temperature (°C)	36,21 ± 0,41	35,56 ±0,36	7,01	0,00*
100 meters freestyle swimming (s)	66,06 ± 5,65	65,32 ± 6,04	-2,32	0,04*
400 meters freestyle swimming (s)	300,42 ± 26,00	305,42 ± 24,15	-2,19	0,06

*p<0,05

There was a statistically significant difference in the body temperature, total body fluid percentage, body fat percentage, fat free mass percentage, heart rate, diastolic blood pressure, 100m free swimming performance measurements between the pre-test and post-test values of the group that trained by taking liquid supplements (p<0.05).

Table 5

Pre and Post-Test Values of Without Liquid Supplementation Group

Tests	**Pre x±Sd**	**Post x±Sd**	**t**	**p**
Body Weight (kg)	49,90 ± 10,02	49,16 ± 9,80	6,85	0,00*
Body Mass Index (kg/m^2)	18,64 ± 1,45	18,30 ± 1,46	8,06	0,00*
Body Fluid Level (%)	64,41 ± 3,33	63,89 ± 3,45	13,42	0,00*
Body Fat Percentage (%)	10,76 ± 4,53	12,68 ± 4,76	-12,64	0,00*
Fat Free Mass (%)	89,54 ± 4,54	87,34 ± 4,78	12,64	0,00*
Urine Density (g/ml)	1,017 ± 0,002	1,021 ± 0,002	-16,24	0,00*
Heart Rate (bpm)	85,63 ± 11,27	107,15 ± 11,52	-5,26	0,00*
Systolic Blood Pressure (mmHg)	122,62 ± 12,17	122,65 ± 13,26	0,05	0,96
Diastolic Blood Pressure (mmHg)	69,18 ± 7,59	76,93 ± 13,95	-1,94	0,07
Body Temperature (°C)	36,15 ± 0,42	35,91 ± 0,51	2,06	0,05
100 meters freestyle swimming (s)	68,12 ± 5,49	68,17 ± 6,54	-4,42	0,00*
400 meters freestyle swimming (s)	304,41 ± 25,64	306,41 ± 25,67	-1,51	0,15

*p<0,05

There was a statistically significant difference in the body weight, body mass index, urine density, total body fluid percentage, body fat percentage, fat free mass percentage, heart rate, 100m free swimming performance measurements between the pre-test and post-test values of the group training without fluid supplementation (p<0.05).

Discussion

Fluid balance is an important factor among many factors that affect swimmers' performance is ranked. Swimming in which fluid loss is ignored because it is done in water in sports, to reveal the importance of fluid consumption during training, fluid-reinforced and body hydration levels of swimmers training without liquid supplementation compositions and changes in some physiological

parameters were observed and the same the effects on performance were also examined. Changes in body fluid balance body weight, body mass index, total body fluid percentage, body fat percentage, non-fat weight percentage, urine density, heart rate, systolic and diastolic blood pressure, body temperature, 100m and 400m free swimming performance, borg scale test parameters were measured. In our study, body weights were approximately 0.04 kg after liquid-reinforced training decreased by approximately 0.63 kg after training without supplementation. According the Knechthle et al., (2011), ultra-swimmer a decrease in 1.6 kg total body mass (- 1.7 % total body mass) and a constant urinary specific gravity of 1.015 g/ml pre race compared to post race. In the study of Maughan and Nadel (2005) when 1.8% of body weight is lost during exercise, tolerance to exercise decreases, 2% when 2,5% of it is lost, the performance decreases, and when 2,5% of it is lost, the working capacity is 30%. and when 5% of body weight decreases, working capacity decreases by 45%. The results of exercise-induced weight loss in our study are comparable to those of other studies in the literature similar to the results.

In our study, the percentage of total body fluid of the swimmers was determined after the fluid-reinforced training decrease 2.23%, decrease in total body fluid after training without supplementation 1.54%. The results show that in-water exercises, as well as out of water, cause body fluid loss. It points out that the liquid supplement before the water exercises reduces the loss to a minimum shows the level of reduction. In our study, post-training temperature without liquid supplementation while the difference was not found to be statistically significant, the temperature difference in the fluid-reinforced training the reason why it is significant; this is because the response to fluid-reinforced training is of better quality.

Stover et al., (2006) urine in regular fluid consumption in American football players examined the intensity of the training and the regular fluid consumption during training. They observed that after a decrease in urine density. Ertaş (2010) did in swimmers' urine in both girls and boys after a fluid-supplemented workout urine density did not increase in both sexes in training without fluid supplementation was found to increase. In our study, urine in swimmers after liquid supplementation training while the intensity does not increase (1.017g/ml pre-liquid supplementation training 1.018g/ml post-workout), in training without liquid supplementation (1.018g/ml pre-training, training after 1.020 g / ml) was observed to increase. Regular fluid consumption during training It can be said that it has a positive effect on urine density after training. Blood pressure, the pumping of blood from the heart, the resistance of the arterioles and the resistance of the arterial walls depends on its flexibility. In our study, there was no difference between pre and post-exercise systolic blood pressure. The rise in diastolic blood pressure makes the blood volumetric is pressure. The reason for the difference in diastolic blood pressure in the fluid-supplemented group it can be caused by fluid

consumption during training. When we look at the 100 m freestyle swimming performance in our study, liquid supplementation training compared to pre and post, there was a deterioration of 1.26 seconds in performance, while without liquid supplementation there was a 2.85 second deterioration in performance in training. 400m freestyle swimming no significant difference was found in performance. In various studies, performance, while a decrease was observed with the effect of dehydration, some changes were not found. Body decreased muscle strength in dehydration resulting from a 5% or more weight loss it is reported to be seen (Yıldız and Arzuman, 2009). In fluid-reinforced training, fluid the reason for the increase in performance compared to training without supplementation is that there is no loss of fluid from the body by the fact that the stimulus transmission rate in the muscles does not decrease and the body is sufficiently can be explained by the fact that it is overheated.

Conclusion

As a result, the body weight decreased and dehydration was increased, in the training without fluid supplementation. Swimming performance in the training without liquid supplementation is higher than the liquid supplemented training there has been a large decrease. Regular and correct fluid intake before, during and after exercise and blood volume increases, the risk of dehydration decreases, thermoregulation improves, extracellular fluid volume and the continuation of athletic performance are provided. The results of this study will help the trainers in the planning of the trainings in terms of the results to be obtained in the competition, since the liquid consumed during the trainings before the competition will directly affect the competition performance. It can be recommended that the test results obtained should be evaluated well and transferred to practice, as it will provide significant positive effects on the long-term health and performance levels of the athletes.

Ethics Committee Permission Information

Ethics review board: Pamukkale University Non-Invasive Clinical Research Ethics Committee

Date of ethics evaluation document: 18.10.2022

Issue number of the ethics evaluation document: 020-279057

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[i] Bu çalışma 6. Uluslararası Akademik Spor Araştırmaları Kongresi'nde özet bildiri olarak sunulmuştur.