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"Hydration – Current Trends in India" A study highlighting importance of science of hydration by assessing impact of water workouts on loss of blood plasma content in athletes

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Abstract
Background: Hydration is vital to performance and recovery but if we observe the understanding of athletes and coaches of developing countries like India then their ignorance in this context will astonish everyone. Swimming not being considered a "sweaty sport" is ignored ever further when it comes to hydration.
Purpose of the Study: To compare the amount of blood plasma content lost among swimmers of Indian origin during different duration water workouts.
Methodology: Fifteen swimmers with the mean age 20.13 and sd 2.06 studying Sports Science were selected. Plasma content lost during workouts was assessed using Wintrobe test.
Results and Discussion: ANOVA showed that as the intensity of workout increased the loss of plasma content increased. The amount of plasma content lost during 12 and 24 minutes water workouts was significant.
Conclusion: Swimmers loose more fluid while practicing anaerobic and high intensity workouts and if lost fluids are not replenished on time it may lead to dehydration and impaired performance and recovery.

Keywords: Fluid loss, plasma content, hydration, dehydration, Indian swimmers

1. Introduction
The importance of hydration and its impact on performance and recovery cannot be underestimated. Vitality of this aspect has been highlighted from time to time by nutritionists and sports scientists from all over the world. But these awareness trends are more prominent and religiously followed in international sports arena. If we observe the knowledge and understanding of athletes and coaches of countries where sport is in its developmental stages, then their ignorance in this context will astonish everyone.
Swimming is usually not considered to be a "sweaty sport" since the surrounding water can mask the effects of any water loses. However, since the atmosphere in most swimming pools is extremely hot and humid, training and competing in such conditions can lead to large sweat loss and dehydration.
Water is main solvent of the body; it provides the medium for biochemical reactions within cell tissues. It is essential for maintaining blood volume, acid-base balance, kidney and heart function as well as the regulation of body temperature. When a person exercises, total metabolism is typically increased to 5-15 times the resting rate. Approximately 70-90% of this energy is released as heat, which needs to be dissipated to achieve body heat balance [1].
It is the sweat and water vapor from increased respiration that causes a reduction in body fluid. The rate at heat obstructs this process as do, and individual fitness and acclimatization. This is variable from person to person. It is most easily measured by weight lost during exercise. The role of sweating during exercise is heat dissipation. As sweat evaporates from the body it cools the surface of the skin which in turn cools the body. Radiant heat obstructs this process as do dark colored clothing and non-breathable fabrics. Wind expedites heat dissipation. That is why cyclists have fewer problems with overheating.

Blood flow to the muscles must be maintained at a high level to supply oxygen and fuel substrates (glucose and fatty acids), but a high blood flow to the skin is also necessary to transport heat to the body surface where it can be dissipated [2]. Dehydration also poses a serious health risk in that it increases the risk of cramps, heat exhaustion and life threatening heat stroke.

Drinking right fluid during exercise can help restore plasma volume to near pre exercise levels and prevent the adverse effects of dehydration on the muscle strength, endurance and co-ordination. To make sure athletes fuel themselves with enough carbohydrates and properly replace the electrolytes lost in sweat three types of sports drink all of which contain various levels of fluid, electrolytes and carbohydrate are created after extensive research and studies. The osmolality of a fluid is a measure of the number of particles in a solution. In a drink, these particles will comprise of carbohydrate, electrolytes, sweeteners and preservatives. Blood has an osmolality of 280 to 330mOsm/Kg. drinks with an osmolality of 270 to 330mOsm/kg are said to be in balance with the body's fluid and are called isotonic. Hypotonic fluids have fewer particles than blood and hypertonic have more particles than blood. Consuming fluids with a low osmolality, e.g. water, results in a fall in the blood plasma osmolality and reduces the drive to drink well before sufficient fluid has been consumed to replace losses. Drinking plain water also causes bloating and stimulates urine output [3].

1.1 Purpose of the Study

The purpose of the study was to compare the amount of blood plasma content lost during different duration water workouts in swimmers of Indian origin.

2. Methodology

Fifteen swimmers (10 males and 5 females) of age range between 18 to 25 years with a mean age of 20.13 and sd 2.06 specializing in swimming from Lakshmibai National Institute of Physical Education, Gwalior, India were randomly selected as subjects for the study. Institutional review board approval was granted for the same and participant consent was taken. In order to obtain the amount of blood plasma content lost during workouts Wintrobe test was used. A blood sample was collected from each participant by a certified Pathologist before and after water workouts of 12 minutes, 18 minutes and 24 minutes duration. These tests were conducted on 3 different days and a gap of 1 day was given in between all 3 different duration workouts in order to ascertain full recovery of the participants. The water temperature remained between 15-17 ^{o}C for all experiments. The swimmers were expected to put in maximum possible effort during water workouts.

SPSS was used for analysing the raw data and statistical method for Analysis of Variance ANOVA was applied in order to understand the variation between the amounts of blood plasma content lost during different duration of water workouts.

2.1 Wintrobe Test

It is a macro method of hematocrit determination. This method is performed using a wintrobe tube which is 100 mm long. EDTA anti coagulated blood without extra diluents is drawn into the tube, and the rate of fall of red blood cells is measured in millimeters after 40 minutes treatment in centrifugal machine which separates the components of blood into specific layers according to the density of each of the components. The difference between the pre and post blood samples is expressed in terms of number of plasma content, white blood cells and red blood cell [4].

3. Results of the Study

The results show that there is difference between the amount of blood plasma content lost during 12 minutes, 18 minutes and 24 minutes water workouts. P Value is found to be less than .05 (table 1) and hence, the hypothesis that there will be no difference between the amounts of blood plasma lost during different duration water workouts is rejected.

Further the difference between the amounts of plasma content lost during 12 minutes and 24 minutes water workout is found to be significant as the P Value is less than .05 (Table 2). In order to test if the observed difference is statistically significant, contrast between means of 12 and 24 minutes workouts was assessed. P Value for the test of contrast is found to be less than 0.10 (Table 3). This indicates that the amount of blood plasma content lost during 12 minutes workout is significantly more than the plasma content lost during 24 minutes workout.

No major difference was found between the amount of plasma content lost during 12 minutes and 18 minutes or 18 minutes and 24 minutes water workouts.

4. Discussion of Findings

The purpose of the current study was to compare the amount of blood plasma content lost during different duration water workouts in swimmers of Indian origin. The results of the study show that as the duration of water workout increased (aerobic) the drop in blood plasma content decreased where as the duration of water workout decreased (anaerobic) the drop in blood plasma content increased. If we compare the characteristics of 12 minutes and 24 minutes continuous swimming we can assume that 12 minutes workout is more anaerobic in nature as compared to 24 minutes workout. And this can be a reason for the nature of obtained results. Thus, upon assessment of obtained results the researcher would like to assume that a water workout which is anaerobic in nature leads to greater amount of fluid loss as compared to an aerobic water workout. Hence, swimmer must take proper steps in order to stay hydrated especially during anaerobic water workouts or high intensity interval training.

4.1 Practical Application

The results of this research endeavor have significant implications in the sports training science and overall preparation for achievement of optimal performance during competition. Rarely national and state level sport team athletes and coaches in India place importance on science of hydration. Earlier only intake of water was used for hydration but as times have changed and sports drinks are widely available in Indian markets, athletes have replaced water with drinks like Glucose, Gatorade, Powerade etc. But this trend is more common in athletes who represent the country at international level.

Though athletes and coaches have started to understand the vitality of replacement of lost fluids and electrolytes with sports drinks; they are yet to understand the science which governs the benefits behind their use. Also better awareness needs to be created for them to understand the frequency and type of sports drink that should be taken before, during and after workouts or competition.

This study will help coaches and athletes understand the magnitude of this gap in knowledge and take corrective steps to incorporate plans for proper hydration during regular training and competitions. They need to understand that not all sports drinks are the same. Not all sports drinks perform the same task. Hence, specific knowledge of science of hydration is of vital importance if one intends to succeed in competition.

This study's biggest limitation is the number of participants which were available at the time of testing. Another study testing fluid loss during land workouts can be done. Hence, the researcher suggests that this study must be repeated on a larger sample for a better understanding and cross checking of the inferences made.

5. Conclusion

Finally, though swimming is a wet sport and fluid loss from body is not visible as water hides the presence of sweat. Dehydration impairs performance and reduces swimmer's ability to work hard. It is found that swimming training also produces similar effects to those of land training. Body temperature becomes elevated during longer hours of swimming training.

Studies on exercise have shown that dehydration, or inadequate fluid intake, can lead to diminished performance and premature exhaustion. Weight loss of 3% or greater has been shown to result in reduced performance levels. The most serious effect of dehydration is impaired heat dissipation, which can elevate body core temperature to dangerously high levels, resulting in heat exhaustion and potentially fatal heat stroke.

Ideally, swimmers and all other athletes should learn to consume adequate fluids during training so that their body weight remains constant before and after exercise. Because muscles are working at such high levels during intense interval sessions in the pool, muscle glycogen store (stored carbohydrate) is gently depleted and muscle cells are also traumatized by the high stress placed on them, which leads to muscle fatigue and soreness. The ability to train at a high level several days per week is limited by how well the body recovers its glycogen stores and repairs muscles tissues after strenuous training [5].

The latest research on muscle performance and recovery shows that carbohydrate replacement 30-60 minutes after exercise can have an enormous impact upon your next day's performance. This is called the "glycogen window". Ideally, the post exercise recovery drink should be high in simple carbohydrates. Swimmers and athletes of other sports, who wait more than one hour to consume carbohydrates, restore about 50% less muscle glycogen than those who consumed carbohydrates during the one hour period [5].

The results of the present study show that swimmers loose more fluid while practicing anaerobic and high intensity workouts and if lost fluids are not replenished on time it may lead to dehydration and impaired performance and recovery. And it should be understood that not all sports drinks are the same and not all sports drinks perform the same task but it is of vital importance that athletes hydrate themselves properly before, during and after workouts. Hence, Indian athletes and coaches should give due attention to hydration.

It needs consideration of Indian athletes and coaches that when a water workout of less than 30 minutes duration can lead upto 7ml reduction in plasma content of blood than what impact a 2-3 hour workout on land can have on performance. Hence, it's important that athletes and coaches understand that consuming plain water or some sport drink in order to hydrate is not sufficient and the key to maximizing recovery is to consume the right fluid in the right proportions and at the right time to ensure muscles health and to improve performance.

Tables

Table 1: ANOVA Table Showing the Significance of Difference between the Pre-Test Means and Post-Test Means of Blood Plasma Content in Blood Before and After 12 Minutes, 18 Minutes and 24 Minutes of Water Workouts

	Sum of Squares	Df	Mean Square	F	P
Between Groups	12.133	2	6.067	3.323	.046*
Within Groups	76.667	42	1.825		
Total	88.800	44			

Critical value (2, 42) = 3.22

*P<.05 significant difference between plasma content lost

Table 2: Table Showing the Scheffe's Post Hoc Test of Pair wise Comparison of Blood Plasma Content Lost during 12 Minutes, 18 Minutes and 24 Minutes Water Workouts

(I) Water Wkt	(J) Water Wkt	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
12	18	.53333	.49334	.562	-.7186	1.7853
	24	1.26667*	.49334	.047	.0147	2.5186
18	12	-.53333	.49334	.562	-1.7853	.7186
	24	.73333	.49334	.341	-.5186	1.9853
24	12	-1.26667*	.49334	.047	-2.5186	-.0147
	18	-.73333	.49334	.341	-1.9853	.5186

*P< .05 significant difference between plasma content lost

Table 3 Table Showing Contrast between Means of 12 and 24 Minutes Water Workouts

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Fluid Loss	Assume equal variances	1	1.2667	.49334	2.568	42	.014

*P<.10 significant contrast between plasma content lost

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