HYDRATION STATUS, SPRINT PERFORMANCE AND PHYSIOLOGICAL RESPONSES DURING REPEATED SPRINT ABILITY (RSA) TRAINING SESSION

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ABSTRACT

The aim of this study was to investigate the relationship among hydration status level, sprint time performance capabilities and selected physiological responses which are blood pressure, heart rate and rate of perceived exertion (RPE) during a 30m Repeated Sprint Ability (RSA) training session. Fifteen male participants with mean age 21 ± 1 years old, total mean body weight of 63.21 ± 8.25kg, and mean body height of 1.68 ± 0.05m, voluntarily participated in this study. The participants underwent a RSA session with all measurements of interest (hydration status, sprint time performance, blood pressure, heart rate and RPE) were done pre, during and post sessions. Paired sample t-test was used to analyse the urine specific gravity, whilst repeated measure ANOVA was used to compare the sprint time, heart rate, blood pressure and RPE. Pearson correlation was utilised to determine the relationship between hydration status, sprint time, heart rate response, blood pressure and RPE during the training session.The results indicated no significant changes in the hydration status. Sprint time performance indicated no significant difference between all sets involved, indicating steady state sprint performance. Blood pressure, heart rate response and RPE, showed a significant increase during the 30m sprint training. Correlation value for sprint time and RPE versus hydration status demonstrated a significant correlation, a strong and linear relationship with a high significant value. As a conclusion, 30m RSA for 3 sets of 5 repetitions had no significant effect on hydration status, with sprint time performance cannot be said is influenced by hydration during RSA session. However, as the participants were trying to maintain sprint time performance, physical stress did increase and thus making it difficult to improve sprint time performance. The practical implications of this study suggested that apart from RSA actual purpose of developing speed and agility, it also offers an effective training practice for improving the heart rate responses and as anti-hypertensive exercise. Further studies on muscle metabolic factors are suggested for future research works.

STATUS HIDRASI, PRESTASI MASA PECUTAN DAN TINDAK BALAS FISIOLOGI SEMASA SESI LATIHAN KEBOLEHAN PECUTAN BERULANGAN (RSA)

ABSTRAK

Objektif kajian ini adalah untuk mengkaji hubungan antara tahap status hidrasi, prestasi masa pecutan dan respon fisiologi iaitu respon kadar degupan jantung, kadar tekanan darah dan kadar tahap keletihan (*rate of perceived exertion-RPE*) semasa menjalani latihan keupayaan pecutan ulang alik 30m (RSA). Seramai lima belas subjek dengan min usia adalah 21±1 tahun, min keseluruhan berat badan 63.21± 8.25kg, min ketinggian badan 1.68 ± 0.05m, telah terlibat secara sukarela dalam kajian ini. Subjek melakukan sesi latihan RSA dengan semua pengukuran telah dilakukan sebelum, semasa dan selepas sesi latihan merangkumi ujian status hidrasi, prestasi masa pecutan, tekanan darah, kadar degupan jantung dan RPE. Ujian t-berpasangan digunakan untuk analisis status *urine specific gravity*, manakala masa pecutan, kadar degupan jantung, tekanan darah dan RPE dianalisis dengan menggunakan analisis *repeated measure* ANOVA. Korelasi Pearson digunakan untuk menentukan hubungan antara status hidrasi, masa pecutan, kadar degupan jantung, tekanan darah dan RPE sepanjang sesi latihan. Hasil dapatan tidak menunjukkan sebarang perbezaan signifikan ke atas status hidrasi. Prestasi masa pecutan tidak menunjukkan perbezaan yang signifikan antara semua set yang terlibat, yang menunjukkan prestasi pecutan yang stabil. Tekanan darah, tindak balas kadar degupan jantung dan RPE, menunjukkan peningkatan yang signifikan semasa sesi latihan. Nilai korelasi untuk masa pecutan dan RPE, dengan status hidrasi menunjukkan korelasi dengan nilai signifikan yang tinggi, menunjukkan hubungan yang kuat dan linear. Sebagai kesimpulan, latihan 30m RSA untuk 3 set, 5 ulangan ini tidak memberikan impak yang besar ke atas status hidrasi. Oleh itu, prestasi masa pecutan tidak dipengaruhi oleh dehidrasi semasa sesi RSA. Walau bagaimanapun, ketika subjek cuba untuk mengekalkan prestasi masa pecutan, stres fizikal turut meningkat menyebabkan kesukaran untuk meningkatkan prestasi masa pecutan. Implikasi kajian ini mencadangkan bahawa selain daripada memfokuskan kelajuan dan ketangkasan, RSA juga menawarkan satu kaedah latihan yang berkesan untuk meningkatkan tindak balas kadar denyutan jantung dan praktikal sebagai latihan anti-hipertensi. Kajian lanjut mengenai faktor-faktor metabolik otot adalah disarankan untuk kajian di masa hadapan.

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%	percent
ANOVA	analysis of variance
ATP	adenosine triphosphate
BMI	body mass index
bpm	beats per minute
d	day
EPOC	excess post-exercise oxygen consumption
H	hour
kg	kilogram
kg/m^2	kilogram per square metre
KLSF	Kaedah latihan suaian fizikal (physical conditioning training methods
L	litre
m	metre
min	minute
mmhg	milimeter of mercury
Na+	sodium
NATA	National Athletic Trainers` Association
^oC	degrees Celsius
PCr	phosphocreatine
RH	relative humidity
RPE	rate of perceived exertion
RSA	repeated sprint ability

s	second
SD	standard deviation
Ta	ambient temperature
Tg	globe temperature
UPSI	Universiti Pendidikan Sultan Idris
USG	urine specific gravity
VO_{2max}	maximum rate of oxygen uptake
WBGT	wet bulb globe temperature
WHO	world health organization
y	years

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Maintaining hydration status is considered important for sports performance as well as physical well-being. Neural, hormonal, metabolic and mechanical aspects involves in any physical training including sprint training are greatly influenced by the level of fluid available in the body (Kraft, et al., 2010). Fluid or water plays a fundamental role in the body as it functions as the solvents for nutrients, transport of nutrients to muscle cells, help body eliminate waste products, maintenance of constant body temperature and protection of the fetus during pregnancy (Armstrong, 2007; Sawka et al., 2007).

There are several ways to assess hydration status and its variations. According to Lentner (1981), body water loss or gain was assumed as the results from acute changes in body weight over a small time phase. As 1ml water equal to the weight of 1g, hence the changes in body weight can be utilized to measure water gain or loss. (Lentner, 1981). Other methods in assessing hydration status are by measuring blood and urine indices while determination of perception of thirst is categorized as a subjective method in hydration assessment (Armstrong, 2007, Gonzalez-Alonso, Calbet & Nielsen 1999; Shirreffs, 2000).

Maintaining an appropriate level of hydration status during training may positively influence blood volume, cardiac output (Gonzalez-Alonso, Mora-Rodriguez, & Coyle, 2000) muscle blood flow (Gonzalez-Alonso, Calbet, & Nielsen, 1998, 1999), core temperature, and muscle temperature (Murray, 2007). Dehydration of approximately 3% body mass loss has deleterious effects in physiological and performance-influencing variables such as reduced motor performance, reduced muscular endurance, cardiovascular drift, reduced sweat rate, blood volume and heat dissipation in addition to heat illness (Heaps, Gonzalez-Alonso, & Coyle, 1994; Oppliger & Bartok, 2002; Sawka, 1992). The changes suggest that hypohydration is an important factor to consider when athletes involved in exercise training, considering the effects on the acclimatization in muscle, body metabolism, hormonal and neutral control and cardio-respiratory function with both aerobic and anaerobic training.

1.2 Problem Statements

There are some problem statements that lead to significance of this study. The Scientific Consensus Statement by American College of Sports Medicine (2005) stated that dehydration of more than 2% of body mass can compromise physiological function and impair performance capacity. Nevertheless, lower levels of dehydration can also impair performance. Studies by Armstrong et al. (1985), Edward et al. (2007), Walsh et al. (1994) and Maxwell et al. (1999), showed that hypohydration 2% and lower, can compromise performance. Thus, more studies are needed to verify whether low hydration level may have any effect on the repeated ability training session.

Many studies conducted on the effects of hypohydration on anaerobic performance had yield mixed results. Previous study has indicated that there was no impairment on anaerobic exercise performance in a temperate environment either in moderate hypohydration or hyperthermia condition (Cheuvront, Carter, Haymes, & Sawka, 2006). Another study suggested that 2 to 3% of body mass loss did not have significant effect on sprint performance (Watson, et al., 2005). Likewise, no significant results on performance also reported by Jacobs (1980) and Smith et al. (2001). Contradictory, studies by Horswill et al. (1990), Hickner et al.(199), Maxwell, Gardner and Nimmo,(1999) and Drust et al.(2005) somehow showed a significant effect on the anaerobic performance. Thus, it is a question whether was there any relationship between hydration status, and sprint performance during the repeated sprint ability training session.

Repeated sprint ability (RSA) has been introduced as one of the training method suitable for team sports such as soccer or rugby to the KLSF's trainees. During the period of learning and training, some of the trainees reported feeling thirst during the RSA session. Question arises whether hydration status will be affected or not due to cumulative effect of several short sprints performed. However, referring to the thirst response is not a reliable indicator of dehydration, as this is a kind of subjective measure. Therefore, it is an urge to examine the hydration status by using more reliable and accurate hydration assessment.

In terms of the repeated sprint ability (RSA), it is the capabilities to perform the best sprint performance over repetitions of sprints which are normally less than 10 seconds, split by recovery time (less than 60 seconds) (Bishop, Girard, & Mendez-Villanueva, 2011). Thus, RSA is an essential fitness requirement for team-sport athletes. Short burst sprint is best described as a single short sprint (5 to 6 second), which takes time 6 second or less of maximal sprint. In this short burst sprint, the major contributor of energy is from anaerobic sources which include phosphocreatine [PCr] degradation and glycolysis cycle, where adenosine triphosphate (ATP) is mainly resynthesized. While a small (<10%) source of energy is supplied from aerobic metabolism (Aerenhouts, Zinzen, & Clarys, 2011; Boutcher, 2010).

A typical sprint training session usually takes approximately between 40 minutes to 60 minutes; whereby the athletes will repeat the sprint for several repetitions. While the short sprint in a single manner does not affect hydration status, but repeated over several times for about one hour may have a significant effect on hydration status. The most important rule in generating the most benefits in long term

training is to maximize acute stimulus and adaptation in each training session. Thus, if the single training session is lacking in terms of its` quality of performance (acute stimulus) due to hydration status, the cumulative adaptation longitudinally might also be impaired. However, this assumption is in need of further investigation, in which why this study was done.

To conclude, the main aim of this research were to investigate the relationship of hydration status level, with their sprint time performance, heart rate response, blood pressure and rate of perceived exertion (RPE) among KLSF`s trainees, during the RSA training session.

1.3 Significance of Study

Current approach in designing physical performance training program is by dividing the training program into anaerobic and aerobic based training types. Aerobic types of physical activities with its low-intensity and longer duration of performance has always been regarded as having a significant influence on hydration status level among involved individuals. At the same time, anaerobic type of physical activities characterized by its higher level of intensity and short burst duration in each repetition and set performed, has been seen having less or no effect on hydration status (Smith, et al., 2001; Watson, et al., 2005; Cheuvront, Carter, Haymes and Sawka, 2006 and Jacobs, 1980). Due to this, coaches and athletes tend to neglect an appropriate hydration status maintenance during an anaerobic type of training session, as they assume that hydration status will remain the same and will not impair anaerobic

performance during training session. However, anaerobic training session typically consist of several repetitions of any exercises or activities, combine together into sets of activities, and perform repeatedly for over a period of time. Thus the question arise, whether repeated activities in interval mode for a total training session duration between 40-60 minutes of time, will affect hydration status. If the hydration status is affected due to activities performed, to what extent it may influence anaerobic performance depicted by increases or decreases of sprint time, heart rate response and participant rate of perceived exertion (RPE). Therefore, this study is significant because it provides an insight into the cumulative effect of anaerobic type of training such as short sprints on hydration status. It is also significant in a way that it will show the relationship of hydration status with other variables such as heart rate response, blood pressure and RPE that are normally part of importance physiological indicators in an assessment of exercise performance.

1.4 Purpose of Study

1.4.1 To determine the changes of hydration status before and after 30m RSA sprint training session among KLSF trainees.

1.4.2 To investigate the changes in sprint time before and after 30m RSA sprint training session.

1.4.3 To determine the changes in physiological responses during a 30m RSA sprint training session.

1.4.4 To investigate the relationship between hydration status, sprint time and physiological responses across 30m sprint training session.

1.5 Research Questions

The study focus on the following questions:

1.5.1 Will there be significant differences in hydration status among KLSF's trainees before and after 30m RSA sprint training session?

1.5.2 Will there be significant changes in sprint time across 30m RSA sprint training session?

1.5.3 Will there be significant changes in heart rate responses during a 30m RSA sprint training session?

1.5.4 Will there be significant changes in blood pressure during a 30m RSA sprint training session?

1.5.5 Will there be significant differences in participants` RPE during a 30m RSA sprint training session?

1.5.6 Will there be a significant correlation between hydration status, sprint time, heart rate response, blood pressure and RPE among KLSF trainees?

1.6 Limitation and Delimitation

In performing this study, there were be some limitations and delimitations involved. The constraint might relate to the availability of the participants and phases of training during the time of recruitment. Apart from that, this study is delimited in several ways. Results obtained might only applicable to similar type of people, with similar design of training and environment. Above all, the researcher had minimized the limitations and delimitations effect on research outcome by considering all factors when designing the research method.

1.7 Operational Definition

Repeated Sprint Ability (RSA) Training

RSA is characterized as a short sprint with duration less than 10 seconds, spread by recoveries interval which is less than 60 seconds. RSA is widespread of sprint training for most team sports as well as racket sports. Athletes who are involved in this kind of sports, are required to reproduce utmost or near utmost efforts in sprint training. The capabilities to recuperate and to repeat performance in a series of sprints perhaps is an essential fitness requirement of athletes in team and racket sports. (Girard, Mendez-Villanueva, & Bishop, 2011)

KLSF's trainees

KLSF's trainees refer to any students who are currently registered as a full time student with Universiti Pendidikan Sultan Idris (UPSI), and enrolled in Physical Conditioning Training Methods (KLSF) course at the time of data collection. As part of their course requirement, they were performing a 12 weeks physical conditioning program during the time of the data collection.

Hydration status

Hydration status refers to the amount or level of body fluid lost or balance which regards to the body weight changes and urine specific gravity measurement.

Sprint time

Sprint time is the time the participants completed each cycle of back-to-back 30m sprint, with start and end as indicated in Chapter 3 under procedure's section.

Rationale for the RSA task

30m length

Referred to Spencer, Bishop, Dawson & Goodman (2005), the vital point in a competition are usually led by short, high intensity sprints in the range of distance 10 to 30m.

3 sets of 5 repetitions

According to Spencer et al. (2005), the range number of sprint repetitions are considerable between 5 to 15 repetition.

Recovery 60s

Repeated sprint ability exercise is stated as short duration sprint (≤10s), interspersed with brief recovery periods (≤ 60s) (Girard, Mendez & Bishop, 2011).

Rest in between sets (5minutes)

For this research, 5 minutes rest in between sets had been applied in the RSA training session for participants to complete all the study procedure assessment (heart rate response, body weight, blood pressure, RPE) before proceed to another sets. Furthermore, it is a tolerable recovery time as the participants involved are not among high performance athletes.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to hydration

Generally the term hydration is widely used to describe the availability or content of water or fluid in the body, with euhydration defined as state or situation of being in water balance, in excess of water balance (positive state) as hyperhydration and deficit in water balance (negative state) as hypohydration . Dehydration happens when the water begin to lose from the body, while rehydration is the way to increase back the water loss so that the body water would be in equilibrium state or euhydration. (Murray, 2007; Shirreffs, 2000, 2003). Dehydration occurs when water loss is more than water intake, which reduces total body water below regular basal rate. Water loss can happen via urination, sweating, faeces and respiratory evaporation (Armstrong

2007). Hydration status is deemed important due to the fact that water plays important roles in human body. Some of the roles of water are medium of nutrient transportation in the body, circulatory function, metabolism, part of component for biochemical reactions, body temperature regulations and many other physiological based roles (Chang & Leung, 2014; Jéquie & Constant, 2009; Sawka, Wenger, & Pandolf, 2011; Westerterp, 2010; Armstrong 2007).

Water forms on average about 60-75 per cent of total body weight (Daniels & Popkin, 2010; Segal, et al., 1991), with 65% of total body water compromising intracellular and the balance 35% cover extracellular fluid throughout the whole body (including interstitial fluid and plasma) (Guyton & Hall, 2000). Athletes with highly trained and active, could comprise of about 70% of total body water due to the higher percentage of lean body mass than body fat mass when compared to the general population (Benardot, 2006).

2.2 Hydration status in tropical climate

Tropical climate has hot and humid environment throughout the year, which is characterized by consistently high monthly temperatures. The average temperature each month is higher than 18ºC, and annual rainfall annually at least about 59 inches. More than 33% of the world population lives in the humid tropics, including Malaysia

(Hue, 2011). The effects of the tropical environment on human exercise performance varies including on the physiological aspects as well as dehydration, due to the response of hot condition. The effect of hypohydration is likely to be greater when competing in a tropical environment, mostly when competing in a range of events for several of days (Wood, Finn & Marsden, 2001).

Galloway and Maughan (1997) in their study stated that compared to those who exercise in a cold environment, the ability to perform in the heat is obviously decreased. This performance reduction was due to the increasing rate of body core temperature was related to the range of homeostatic changes in the body. According to Nybo et al. (2010), these factors can basically be divided into two conditions, which are the central nervous system variation and impairments of cardiovascular system. The variation in central nervous system could lead to central exhaustion. While, cardiovascular function is impaired by the reduction of oxygen delivery which consequence of reduction in total aerobic energy in exercising muscles. This could lead to peripheral exhaustion. Mohr et al. (2012) also stated that the combinations of central and peripheral exhaustion cause the impairments of performance such as total number of sprint, great power and force in running and running distance after half of the competition.

Voltaire, Berthouze-Aranda and Hue (2003), examined the influence of hot and humid conditions on performance, emphasis on the effects of tropical weather on thermoregulation and cardiac responses during a prolonged effort. The study involved