111 - HYDRATION EFFECTS ON THERMOREGULATION MECHANISMS DURING JUDO TRAINING

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INTRODUCTION

Thermoregulation, the mechanisms and actions to maintain a constant body temperature, play a central role on body homeostasis. In humans, body temperature range from 36 to 39° C, at conditions from sleeping to a high intensity exercise sustained by an athlete (GARCIA; DIAS; RODRIGUES, 2001). A decrease of body central temperature of 10° C can be tolerated by humans; otherwise an elevation of more than 5° C can compromise body homeostasis. However, humans can maintain a constant body temperature, even when exposed to huge environmental conditions (SAWKA and WENGER, 1988). To maintain body temperature heat production and lost should be kept in equilibrium.

Thermal balance during exercise is affected by ambient temperature, humidity, and exercise intensity and duration (KRANNING et al., 1991, DRUST, REILY and CABLE, 2000, MONTAIN et al., 1994). According to Webb (1993) apud Garcia, Dias and Rodrigues (2001) there is a direct relation between exercise intensity and body temperature. Additionally hydration status also affects thermoregulation (SAWKA et al., 1992).

Silame-Garcia et al. (2002) reported that the thermal stress in response to exercises performed at hot/wet environment can alter cognitive process responsible for motor actions and perception, which can lead to a reduction on performance. A prolonged intense sweating can also lead to disturbance of core body temperature by fatigued sweat glands.

Thermal disturbance can also occur when the athlete clothes impairs or limits the body capacity of dissipate the heat generated by active muscles (BENNET et al. 1995). The judo is a sport modality practiced at enclosed environment with heavy and thick clothes, the jodgui, (MONTEIRO, 1998) the heat loss can be reduced, compromising the athlete performance, mainly on training programs.

This study aimed to analyze whether hydration during training sections could interfere with thermoregulatory mechanisms. Heart rate, tympanic temperature and sweating rate were measured during training sections where athletes ingest water and compared to sections where water consumption was not allowed.

METHODS

Ten healthy male subjects, according to PAR-Q criteria, non-smokers, and mean age of 17.5 (± 2.6) years were selected to participate in the study. All subjects practiced judo for at least five years. Due to lesions and healthy conditions only seven subjects concluded the study. The study was approved by the Ethics Committee of Centro Universitário de Belo Horizonte UNI-BH.

At the first phase of the study subjects were submitted to PAR-Q application (ACSM, 2003) and anthropometric characterization. Total body mass and height were measured using an anthropometric balance (Welmy®). Body mass composition was accessed according to the method of skinfold measurement (GUEDES and GUEDES, 2003) using a high precision skinfold caliper (Cescorf®).

The second phase consisted on two experimental training sections that were carried out in two non-consecutive days. The subjects were randomly divided in two groups: hydrated (HJ) and non-hydrated (NHJ). All subjects were submitted to the both condition on different training days. Both training days consisted of a habitual judo training, duration of 1 hour and 40 minutes, following four days of regular training and a 48 hours rest. Data collection was balanced and crossed. Volunteers have been strongly recommended to maintain the habitual feeding and exercise patterns on the experimental days.

Both experimental training sections consisted of running in different intensity (5 minutes), running intercalated with judo rolling: Zempo Kaeten Ukemi (5 min), Uchi Komi (Ashi-Waza - 5 min), Uchi Komi (Te Waza - 5 min); Nague Komi (5 min); Kumikata (5 min) and Handori (four 5 min sections and one 10 min section). Partners were pre-established in way to be the same in both training sections.

All subjects ingested 500 mL of water two hours before the two experimental sections to promote an equal pre-exercise hydration status. During data collection HJ ingested 200 mL of cold water every 15 minutes of training (11.3º C ± 0.6 at the first experimental section; and 9.6° C ± 3.2 at the second experimental section).

At both experimental sections the following parameters were accessed. *Sweating rate* all volunteers had body mass measured before and after the experimental section. All were wearing only swimming short and had body sweat dried by a towel. Volunteers were instructed to urinate before each measure. Sweating rate was estimated by the difference of body mass before and after experimental section, discounting water volume ingested. The body mass difference was then divided by the duration time of the exercise. *Heart rate and tympanic temperature* both were measured every five minutes, during the experimental section, through a heart hate monitor, Polar® S610, and an auricular thermometer Incoterm®, respectively. *Environmental conditions* temperature and relative air humidity were monitored by a wet and dry bulb termometer (Incoterm®). The variables were measured at the beginning and at the end of the experimental section.

For comparison of HR, tympanic temperature and sweating ratio between the hydrated and non-hydrated condition the pared t-Student test was used ($p<0.05$).

RESULTS

Table 1 shows the environmental conditions in both experimental day. Data was collected at the beginning and at the end of the training sections.

TABLE 1: enviromental conditions at training sections days

	first training day	second training day
DBT (° C)	19	20.5
WBT (° C)	17	18.5
RAH (%)	81	81

Table 2 shows the anthropometric and age data for subjetcs involved on the study.
TABLE 2 Anthropometric and age data for subjetcs involved on

	Age (years)	Height (centimeters)	% BF
mean	17.57	174.36	18.46
s. d.	2.64	1.84	3.84

Age values are expressed in years, height in centimeters and body fat percentual (%bf) in percentage. s.d. standard deviation

Table 3 shows heart rate (HR), body mass variation (BM) and sweating rate (SR) during training sections where subjects were allowed (HJ) or not (NHJ) to ingest water. Heart rate and body mass variation were significant different between the training sections (p= 0.007 and 0.00058, respectively, comparing HJ and NHJ). Sweating rate was not different (p=0.34) comparing both training sections.

TABLE 3: Mean heart rate, body mass variation and sweating rate during HJ and NHJ.

	HR (bpm)		BM (kg)		SR ($ml.min^{-1}$)	
	HJ	NHJ	HJ	NHJ	HJ	NHJ
mean	147	155*	1.06	1.54*	14.23	15.79
sd	3.46	7.23	0.33	0.35	2.72	4.25

Mean tympanic temperature pre, post and during both training sections are shown at table 4. Tympanic temperature during training sections was significantly different between HJ and NHJ (p=0.008). However pre and post tympanic temperature were not different whether or not subjects have ingested water during training section (p=0.83 and p=0.23, HJ and NHJ respectively).

TABLE 4: Mean tympanic temperature pre, post and during HJ and NHJ.

	pre tympanic temperature (°C)		mean tympanic temperature during training section (°C)		post tympanic temperature (°C)	
	HJ	NHJ	HJ	NHJ	HJ	NHJ
mean	36.13	35.99	35.99	36.26*	36.07	36.74
sd	0.53	0.85	0.53	0.65	1.01	0.91

sd = standard deviation. *p < 0.05. HJ = hydrated training section, NHJ = non - hydrated training section.

DISCUSSION

This study compared the physiological parameters heart rate, sweating rate and tympanic temperature of young judo athletes during two experimental conditions: hydration an no-hydration during the training section. It was observed that the mean heart rate and the total body mass variation was higher during the training sections subjects were not allowed to water ingestion (NHJ).

According to McArdle; Katch; Katch, (1998) and Sawka and Wenger, (1988) the systolic ejection volume is proportionally reduced to the liquid deficit established during exercise, leading to a higher heart rate during sub maximal exercises, in agreement to data presented by this study.

According to Gisolfi, Lamb and Nadel (1993), who have evaluated the effects of liquid ingestion during a two hours exercise at 70-76% of VO2 max performed by endurance trained cyclists, the ejection volume was reduced by 15%, the cardiac debit reduced by 7% and the heart frequency augmented by 10% when the subjetcs did not ingest liquid.

Heart rate can be used as an indicator of exercise intensity (GUIMARÃES and SILAME-GARCIA, 1993). The higher heart rate observed during the training sections that subjects were not allowed to ingest water indicates that the exercise in this condition have an augmented intensity. This is corroborated by the results showing also a higher tympanic temperature during the training sections that subjects were not allowed to ingest water, compared to the training sections where subjects ingested water every 15 minutes.

The higher tympanic temperature during the training sections that subjects were not allowed to ingest water is in accordance with many studies that also reported an increased internal temperature during exercises with no liquid ingestion (GREENLEAF; CASTLE, 1971; HORSTMAN; HORVATH, 1972; LADELL, 1955; SAWKA et al., 1983; STRYDOM; HOLDSWORTH, 1968 apud CANDAS et al., 1986).

Guimarães and Silame-Garcia (1993) have studied the effects of water intake (1320ml at 12 °C) on thermoregulation during long term exercises, at 50% of VO_{2max}, on unfavorable conditions to sweat evaporation. The heart rate, retal and body temperature were all higher on the non-water intake situation.

Gisolfi and Copping (1974) have also studied the effects of water ingestion on body temperature during prolonged exercise, at 75% of VO_{2max} at 35° C. They compared the ingestion of cold water (10°C), warm water (the same of internal temperature), external cooling through a wet towel and non water ingestion. The ingestion of water at 10° C was the most effective procedure to prevent hyperthermia. Retal temperature reduction observed during cold water ingestion was attributed in part to the hypotermic quality of water and also to the hydration, once no retal temperature reduction during external cooling.

The present study, as many others, corroborates the important role of water ingestion on the thermoregulatory mechanisms during exercises on hot and humid environments.

According to Scott, William and Sawka (1995) hypohydration or body water reduction leads to increased internal body temperature during exercise. Tests performed on three hydration status confirmed that temperature threshold increases gradually with hypohydration status.

Within a broad environmental temperature variation, 5° C to 30° C, the internal body temperature would be affected only by exercise intensity (Nilsen (1938) apud Pandolf et al. 1988). In the present study the sweating ratio was not different between the conditions studied (p=0.34). Although internal temperature was higher on the NHJ situation it must be stressed that final and initial body training temperature was not different at both conditions. It could be suggested that sweating ratio and environmental conditions observed would not represent a thermal stress situation, considering the environmental temperature of 19 to 20.5°C, below the thermoneutral condition proposed by Clark and Edholom (1985). Both could have prevented body temperature elevation. As the exercise intensity was higher at the NHJ this could explain the higher body temperature in this situation. However, as the environment had not imposed a thermic stress condition, thermoregulatory mechanisms were efficient on maintaining the body temperature at the end of the exercise similar to the initial one.

It must be also emphasized that the subjects involved on this studies were all athletes with more than five years of practice. This training condition probably contributed to the thermoregulatory response of the subjects (OLSCHEWSKI;

BRÜCK, 1988; SCHMIDT; BRÜCK, 1981; SAWKA, 1993; OLSCHEWSKI; BRUCK, 1988).

CONCLUSION

During judo training sections the heart rate and internal temperature were higher on non-hydration situation, what could be attributed to increased exercise intensity. The present study did not found difference on sweating ratio comparing hydration and non-hydration situation. it must be emphasized that body temperature at the end of the training was not different from the temperature at exercise beginning, at both conditions It could be proposed that sweating rate, due to environmental condition, would avoided body temperature increasing.

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HYDRATION EFFECTS ON THERMOREGULATION MECHANISMS DURING JUDO TRAINING

ABSTRACT

Introduction: Thermoregulation has an important role in body homeostasis. Thermal stress can modify the level of activation of cognitive processes responsible for the motor perception and actions, leading to performance reduction. Moreover, dehydration can significantly increase rectum temperature and cardiac heart rate, reducing sweat production, V02max. and the exercise performance, in comparison with conditions of normal hydration. As judo is a sport modality practiced at enclosed environment with heavy and thick clothes, the jodgui, the heat loss can be reduced, compromising the athlete performance, mainly on training programs. **Aims:** study the effects of hydration in the thermoregulatory mechanisms during the training of judo athletes. **Method:** the sample consisted of 10 judo athletes with more than five years of practice (average age of 17 years and 18.46% of corporal fat). The athletes appeared for two training days consisted of a habitual judo training, duration of 1 hour and 40 minutes, following four days of regular training and a 48 hours rest. Subjects were divided in two experimental balanced groups, a) hydrated (HJ - the athlete ingested 200 ml of water every 15 minutes during the training) and b) not hydrated (NHJ - the athlete did not ingest water during the training). This study it was approved by the Committee of Ethics in Research of the UNIBH. During both training sections heart rate, tympanic temperature and sweating rate were accessed. The data were analyzed by pared Student "t" test ($p<0.05$). **Results:** The following differences between HJ and NHJ were observed: heart rate (155 bpm in NHJ and 147 bpm in HJ) and mean tympanic temperature during training section (36.26ºC in NHJ and 35.99ºC in HJ). Sweating rate was not different between the training section where the athletes ingested water compared in the one water ingestion was not allowed. **Conclusion:** Hydration during training section affected heart rate and mean tympanic temperature.

KEY WORDS: Thermoregulation, hydration, Judo-Gui.

EFFET DU HYDRATATION DANS LES MÉCANISMES DU TERMORREGULATÓRIOS PENDANT LES ENTRAINEMENTS DES ATHLÈTES DU JUDO

RESUMO

Introduction: Le commande de température coporele a un rôle important dans l'équilibre de l'homéostasie du corps. L'effort thermique peut modifier le niveau de l'activation des procédés cognitifs responsables pour la perception et les actions de moteur, pouvant aboutir à la réduction de La performance. D'ailleurs, la déshydratation peut prendre l'élévation significative de la température de rectum et de la fréquence cardiaque, réduisant le rythme de la production de sueur, le V02max. et la capacité d'obtenir des exercices, en comparaison des conditions de l'hydration normale. Pour être judo une pratiqué avec lourd et les vêtements épais bons, ceci peuvent intervenir par conséquent avec la perte de la chaleur et avec l'homéostasie du corps. **Objectif:** pour analyser les effets de l'hydration dans les mécanismes de commande de température coporele pendant la formation des athlètes du judo. **Méthode:** l'échantillon s'est composé de 10 athlètes de judo avec plus de cinq ans de pratique (âge moyen de 17 ans et de 18.46% de graisse corporelle). Les athlètes étaient évident pendant deux fois pour une formation habituelle de 1 heure de judo, avec une semaine d'intervalle entre elles et ont été divisés dans deux groupes expérimentaux de la forme équilibrée étant que chaque volontaire était commande de se : a) hydraté (JH - l'athlète a ingéré 200 ml de l'eau toutes les 15 minutes pendant la formation) et b) non hydraté (JNH - l'athlète n'a pas ingéré l'eau pendant la formation). Cette étude elle a été approuvée par le Comité de l'éthique dans la recherche de l'UNIBH. Pendant la formation les mesures de la fréquence cardiaque, la température de interne et l'impôt de la transpiration ont été pris. Les données ont été analysées par l'essai "t" de l'étudiant appareillé ($p<0,05$) **Résultats:** Des différences dans les variantes étudiées ont été trouvées : moyenne de la fréquence cardiaque (bpm 155 bpm dans situation JNH et 147 dans situation JH) et moyenne de la température de interne (36,26º C dans situation JNH et 35,99ºC dans situation JH). L'impôt moyen de la transpiration n'était pas différent en sessions de formation où les athlètes ont ingéré l'eau comparée dans la formation ceux où l'ingestion de l'eau ne s'est pas produite. **Conclusion:** L'hydration influencée dans la température cardiaque de fréquence et de interne, étant alors de grande importance une bonne orientation pour l'hydration dans à niveaux proportionnés aux athlètes

UNITERMOS: commande de température coporele, hydratation, Judo-Gui.

EFECTO DE LA HIDRATACIóN EN LOS MECANISMOS TERMORREGULADORES DURANTE LOS ENTRENAMIENTOS DE LOS ATLETAS DE JUDO

RESUMEN

Introducción: la termorregulación tiene un importante papel en el equilibrio de la homeostasis del cuerpo. El estrés térmico puede alterar el nivel de activación de los procesos cognitivos responsables por la percepción y acciones motoras, pudiendo culminar en reducción del desempeño. Además, la deshidratación puede llevar a la elevación significativa en la temperatura rectal y en la frecuencia cardíaca reduciendo el ritmo de producción del sudor, el VO2max y la capacidad de realizar ejercicios, en comparación con las condiciones de hidratación normal. Por ser el judo practicado con una vestimenta pesada y bien gruesa, ésta puede interferir en la disipación del calor y consecuentemente en la homeostasis del cuerpo.

Objetivo: analizar los efectos de la hidratación en los mecanismos termorreguladores durante los entrenamientos de atletas de judo. **Método**: la muestra consistió en 10 atletas de judo con más de cinco años de práctica (edad media 17 años y 18,46% de grasa corporal). Los atletas comparecieron dos veces para un entrenamiento habitual de 1 hora de judo, con una semana de intervalo entre ellos y fueron divididos en dos grupos experimentales de forma balanceada, siendo que cada voluntario se controló a sí mismo: a) hidratado (JH - el atleta ingirió 200 ml de agua a cada 15 minutos durante el entrenamiento) y b) no hidratado (JNH - el atleta no ingirió agua durante el entrenamiento). Este estudio fue aprobado por el Comité de Ética en Pesquisa de UNIBH. Durante el entrenamiento fueron realizadas las medidas de frecuencia cardíaca, temperatura timpánica y tasa de sudoración. Los datos fueron analizados por el test "t" de estudiante pareado ($p< 0,05$). **Resultados**: fueron encontradas diferencias en las variables estudiadas: media de frecuencia cardíaca (155 latidos por minuto en la situación JNH y 147 latidos por minuto en la situación JH) y media de la temperatura timpánica (36,26% en la situación JNH y 35,99% en la situación JH). La tasa de sudoración media no fue tan diferente en los entrenamientos en que los atletas ingirieron agua comparada con los entrenamientos en que no hubo ingestión de agua. **Conclusión**: la hidratación influyó en la frecuencia cardíaca y en la temperatura timpánica, siendo entonces de gran importancia una buena orientación a los atletas para la hidratación en niveles adecuados.

Unitérminos: termorregulación, hidratación, Judo-Gui.

EFEITO DA HIDRATAÇÃO NOS MECANISMOS TERMORREGULATÓRIOS DURANTE OS TREINAMENTOS DE ATLETAS DE JUDÔ

RESUMO

Introdução: A termorregulação tem um importante papel no equilíbrio da homeostase do corpo O estresse térmico pode alterar o nível de ativação dos processos cognitivos responsáveis pela percepção e ações motoras, podendo culminar em redução do desempenho. Além disso, a desidratação pode levar a elevação significativa na temperatura retal e na freqüência cardíaca, reduzindo o ritmo de produção de suor, o VO2máx. e a capacidade de realizar exercícios, em comparação com as condições de hidratação normal. Por ser o judô praticado com uma vestimenta pesada e bem grossa, essa pode interferir na dissipação do calor e conseqüentemente na homeostase do corpo. **Objetivo:** analisar os efeitos da hidratação nos mecanismos termorregulatórios durante os treinamentos de atletas de judô. **Método:** a amostra consistiu de 10 atletas de judô com mais de cinco anos de prática (idade média de 17 anos e 18,46% de gordura corporal). Os atletas compareceram por duas vezes para um treinamento habitual de 1 hora de judô, com uma semana de intervalo entre eles e foram divididos em dois grupos experimentais de forma balanceada, sendo que cada voluntário foi controle dele mesmo: a) hidratado (JH o atleta ingeriu 200 ml de água a cada 15 minutos durante o treinamento) e b) não hidratado (JNH o atleta não ingeriu água durante o treinamento). Este estudo foi aprovado pelo Comitê de Ética em Pesquisa do UNIBH. Durante o treinamento foram realizadas as medidas da freqüência cardíaca, temperatura timpânica e taxa de sudorese. Os dados foram analisados pelo teste "t" de student pareado ($p < 0,05$). **Resultados:** Foram encontradas diferenças nas variáveis estudadas: média da freqüência cardíaca (155 bpm na situação JNH e 147 bpm na situação JH) e média da temperatura timpânica (36,26°C na situação JNH e 35,99°C na situação JH). A taxa de sudorese média não foi diferente nos treinos em que os atletas ingeriram água comparada aos treinos em que não houve ingestão de água. **Conclusão:** A hidratação influenciou na freqüência cardíaca e temperatura timpânica, sendo então de grande importância uma boa orientação para a hidratação em níveis adequados aos atletas.

UNITERMOS: termorregulação, hidratação, Judogui.