DOI: 10.4025/jphyseduc.v28i1.2817

Original Article

EFFECT OF RAPID WEIGHT LOSS ON DECISION-MAKING PERFORMANCE IN JUDO ATHLETES

EFEITO DA RÁPIDA PERDA DE MASSA CORPORAL NO DESEMPENHO DA TOMADA DE DECISÃO EM JUDOCAS

Leonardo de Sousa Fortes[1], **Hugo Augusto Alvares da Silva Lira**[1] and **Maria Elisa Caputo Ferreira**[2]

[1]Universidade Federal de Pernambuco, Recife-PE, Brasil.
[2]Universidade Federal de Juiz de Fora, Juiz de Fora-MG, Brasil.

RESUMO

Até o presente momento nenhum estudo investigou o efeito de alguma intervenção sobre a tomada de decisão em atletas de esporte de combate. O objetivo da investigação foi analisar o efeito da rápida redução de massa corporal sobre o desempenho da tomada de decisão em judocas. Trinta e nove atletas de judo do sexo masculino foram selecionados de forma não probabilística e separados aleatoriamente em dois grupos: experimental (GE) e controle (GC). Quarenta e oito horas antes do início do experimento, bem como 48 h após o seu encerramento, os atletas foram submetidos a medidas antropométricas e executaram uma luta simulada de judô, a qual foi filmada. Adotou-se o *Game Performance Assessment Instrument* (GPAI) como critério para avaliar o desempenho na tomada de decisão. As estratégias adotadas para a redução rápida de massa corporal no GE foram estruturadas na perspectiva de se atingir uma perda semanal na ordem de aproximadamente 5%. Foi identificado efeito de interação grupo vs. tempo (p<0,01) para a massa corporal, com redução apenas no GE (p=0,01). Uma interação significante grupo vs. tempo (p<0,01) foi revelada para o índice do GPAI, com melhoria da tomada de decisão sendo verificada somente no GC (p=0,01). Concluiu-se que a rápida redução de massa corporal não foi uma boa estratégia para a otimização do desempenho na tomada de decisão de judocas.
Palavras-chave: Cognição. Psicologia do Esporte. Judô.

ABSTRACT

To date no studies investigated the effect of an intervention on the decision-making in combat sports athletes. The aim of this study was to analyze the effect of rapid weight loss methods on the performance of decision-making in judokas. Thirty-nine male judo athletes were selected on a non-probabilistic way and randomly divided in experimental (EG) and control (CG) groups. Forty-eight hours before the beginning of data collection, athletes were submitted to anthropometrical measurements and performed a simulated fight of judo, which was filmed. The weight lossin the EG was conducted to generate a mean loss of 5% per week during 2 weeks. There was a group and moment interaction (p<0.01) for body mass, with decrease only for the EG (p=0.01). There was also a group and moment for the GPAI index (p<0.01), with an improvement only in the CG (p=0.01). It was concluded that the rapid weight loss methods were not a good strategy for performance optimization in decision-making judokas.
Keywords: Cognition. Sport Psychology. Judo.

Introduction

Judo is a sport characterized by a great demand for muscle power, especially in throwing techniques, which result in decisive scores for the athlete's performance[1]. In addition, it is a sport of unpredictability, that is, it is not known for sure what will happen in the fight[2]. The combat has a maximum duration of 5 minutes for males, and the winner is the judoka that scores an ippon or more points by projecting the opponent on his back, immobilization for 20 seconds or submission by choking or armlock[3]. It is an individual sport modality with division by body mass class[4]. In this sense, the adoption of methods for rapid weight loss is common among judokas[5] with the consent of coaches and athletes, who believe

that fast body mass reduction is advantageous for competitive performance[6], although scientific studies have revealed otherwise[2,7].

According to Franchini et al.[3], judo performance is determined by physical elements (strength/muscle power, speed, agility, aerobic capacity and anaerobic capacity), technical elements (throws, chokes, body shifting, etc.), tactical elements (strategy adopted in the fight), morphological elements (body composition) and psychological elements (anxiety, motivation and decision-making). Among the psychological components, decision-making stands out, considering that judo is a combat sport of unpredictability[2].

Decision-making is a phenomenon involving metacognitive components (anticipation, attention, working memory and perception) and motor components (motor execution)[8]. It is worth noting that sport technique performance in competitive situation – in the case of judo, in combat situation – emerges as the result of one's experience and acquired tactical knowledge[9]. In summary, decision-making refers to the result of the action of the adopted sport technique, which is influenced by information processing (perception, anticipation, attention and work memory) and the motor execution of the task[10].

Romeas, Guldner and Falbert[11] highlight the importance of identifying intervention strategies that may change an athlete's decision-making performance. On the one hand, scientific research has shown that training methods that seek to simulate situations that happen in competitions can, in the medium term, boost decision-making performance[11,12]. On the other hand, scientific findings have revealed that the exposure of an athlete to a situation of high pressure – competition, for instance – can decrease decision-making performance[13]. However, it is worth mentioning that these researches have been conducted with athletes from collective invasion sports (football, volleyball, handball and/or basketball). As far as we know, no study has investigated the effect of any intervention on decision-making in combat sport athletes to date.

It seems that rapid weight loss, pointed as a usual strategy among judo fighters[5], can decrease the athletes' cognitive performance[14,15]. In this sense, it is possible that fast body mass reduction inhibits positive metacognitive adjustments in judokas, which, in turn, may lead to poorer decision-making performance. However, it is necessary to conduct a study intended to answer this hypothesis. From a practical point of view, this type of investigation may reveal the effect of rapid weight loss on decision-making performance in judo athletes. Thus, the findings could be extremely important for coaches in this sport.

Based on this information, the purpose of this study was to analyze the effect of rapid weight loss on the decision-making performance of judokas. Considering the adverse effects of rapid body mass reduction in combat sport athletes[2,7], the following hypothesis was formulated: two weeks for reducing 10% of body mass will be enough to compromise the decision-making performance of male judo athletes.

Methods

Participants

Forty-two male judo athletes (18 to 25 years old) participating in the national judo championship were selected non-probabilistically to join this study. They were randomly divided into two groups, namely: experimental (EG, n=21; age=22.4±1.8 years old; training routine=10.1±0.6 hours/week; body fat=17.5 ± 5.0%) and control (CG, n=21; age=22.0 ±1.7 years old, training routine=10.2±0.7 hours/week; body fat=18.2±5.8%). The EG was subjected to methods for rapid weight loss (wearing plastic clothes during training, restricted food intake for prolonged period, use of laxatives, and sauna), while the CG did not suffer changes in behavior. All athletes trained on average two hours a day, five times a week.

As inclusion criteria, the participants should: (1) be a judo athlete for at least three years; (2) be systematically training the modality at least eight hours a week; (3) be enrolled in the national championship, organized by the Brazilian Judo Confederation; and (4) be available to answer a questionnaire, be subjected to anthropometric measurements and execute a decision-making performance test (Game Performance Assessment Instrument). Three of the participants were excluded from the analyses because they did not return the questionnaire fully answered or missed more than 10% of the training sessions during the experimental period (two weeks). Therefore, the analyzed sample was made up of 39 judokas (EG = 20 and CG = 19).

After being clarified on the procedures to which they would be subjected, all participants signed a free and informed consent form. The procedures adopted in this study complied with all ethical norms of the National Health Council for research involving human beings. The project was approved by the Ethics and Research Committee on Human Beings of the Federal University of Pernambuco (CAAE - 59783316.4.0000.5208).

Experimental design

All athletes from both groups (EG and CG) underwent standardized physical, technical, tactical and psychological training over the course of two weeks of investigation. The description of the training is displayed in Table 1. Forty-eight hours prior to the start of the experiment, as well as 48 h after it ended, the athletes filled in the Disordered Eating in Sports Scale[16], were subjected to anthropometric measurements (body mass and relative body fat) and performed a simulated judo fight (Figure 1). During the experimental period, the athletes were followed up by nutritionists, physicians and physiotherapists, in an attempt to ensure them satisfactory health conditions. No health problem was identified in the course of the investigation with the analyzed athletes. The strategies adopted for rapid body mass reduction in the EG were structured so as to reach a weekly loss of approximately 5%.

Table 1. Characterization of 10 training sessions

Session	Warm-up	Technical/Tactical	Main part	Regenerative	Psychological
1	15 minutes: Jog	20 minutes: Ippon-seoi-nage, Tai-otoshi and Kata-guruma.	40 minutes: Muscle strength (Resistance training)	10 minutes: Flexibility	20 minutes: General-Cognitive Method
2	10 minutes: Jumps and lateral displacement	15 minutes: Sukui-nague and Uki-otoshi	80 minutes: Aerobic Resistance	10 minutes: Active recovery	-
3	5 minutes: Rolls and jumps	30 minutes: Sumi-otoshi, Seoi-otoshi and Yama-arashi	25 minutes: Aerobic power	5 minutes: Flexibility	30 minutes: Specific-Cognitive Method
4	20 minutes: Jog, lateral displacements and rolls	10 minutes: Ko-uchi-gaeshi and Uki-goshi	50 minutes: Active recovery	20 minutes: Decision-making videos	-
5	10 minutes: Jumps and forward rolls	30 minutes: O-goshi, Koshi-guruma and Harai-goshi	40 minutes: Anaerobic Resistance	15 minutes: Active recovery	10 minutes: Specific-Cognitive Method
6	25 minutes: Jog and mixed jumps	20 minutes: Ushiro-goshi, Deashi-harai and Sasae-tsurikomi-ashi	25 minutes: Aerobic Power	20 minutes: Decision-making videos	-
7	15 minutes: Jumps and rolls	15 minutes: Kosoto-gari and Kouchi-gari	30 minutes: Muscle Power (Resistance Training)	15 minutes: Flexibility	20 minutes: Specific-Cognitive Method
8	5 minutes: Jog	40 minutes: Kosoto-gake, Ashi-guruma, Harai-tsurikomi-ashi and Osoto-guruma	50 minutes: Aerobic Resistance	10 minutes: Active recovery	-
9	15 minutes: Jumps and rolls	25 minutes: Sumi-gaeshi, Ura-nage and Tawara-gaeshi	40 minutes: Recovery	20 minutes: Flexibility	20 minutes: General-Cognitive Method
10	10 minutes: Jog	20 minutes: Hane-makikomi, Yoko-wakare and Kouchi-makikomi	15 minutes: Anaerobic Power	30 minutes: Decision-making videos	-

Source: The authors

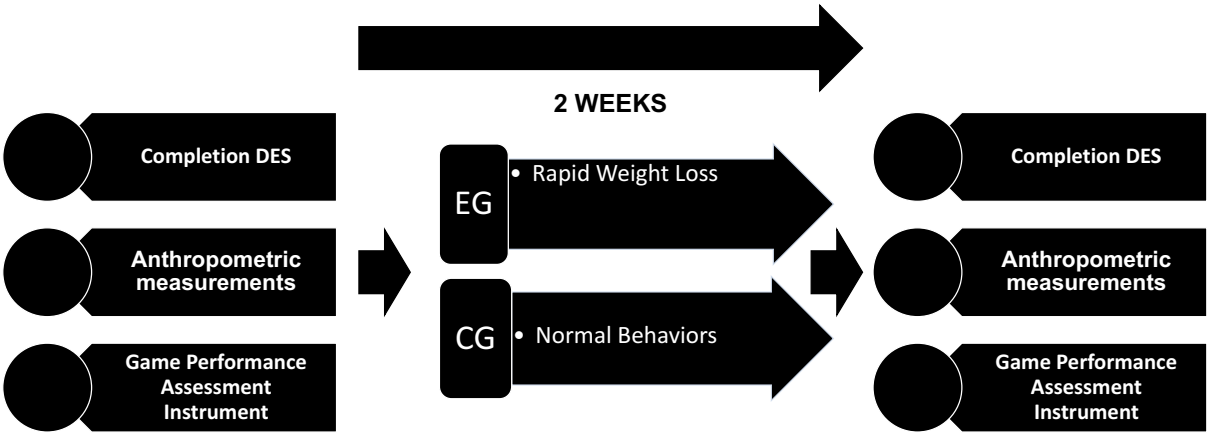

Figure 1. Research **e**xperimental design
Note: DES = Disordered Eating in Sports Scale; EG = experimental group; CG =control group.
Source: The authors

Measurements

Frequency of methods for rapid weight loss.

To assess the frequency of methods for rapid weight loss, the Disordered Eating in Sports Scale (DES) was employed, a questionnaire constructed and validated for the Portuguese language[16]. The questionnaire consists of 21 questions on a likert five-point scale (0 = Never, 1 = Almost Never, 2 = Sometimes, 3 = Often, 4 = Always). For the present study, only the "Food restriction and weight reduction" subscale was used, which is made up of six items ("I exercise more than necessary to burn calories", "During training, I wear plastic clothes to lose weight"). The higher the score, the higher the frequency of attitudes aimed at rapid weight loss. In the original validation study, the internal consistency achieved was 0.66 for the "Food restriction and weight reduction" subscale[16]. For the present sample, the internal consistency stood at 0.71, as assessed by Cronbach's alpha.

Anthropometry

For body mass and height determination, a portable digital scale (Tanita® BC-601, São Paulo, Brazil) and a portable stadiometer (Welmy®, Santa Bárbara do Oeste, Brazil) were used. Body mass index (BMI) was determined by the ratio between body mass (kg) and height squared (m). The thickness of the tricipital, pectoral and subscapular skin folds was measured using a Lange adipometer (Lange ©, Washington, USA) to estimate body density through the predictive equation proposed by Jackson and Pollock[17]. Relative body fat was estimated by the Siri equation[18].

Game Performance Assessment Instrument (GPAI)

Decision-making performance was assessed in a simulated fight, adopting the official rules of judo[19]. It should be noted that all athletes simulatively fought against an opponent of the same body mass class. The entire combat was filmed with a CANON® camera (model SX60). The analysis and categorization of the actions were based on the GPAI[10]. All throwing techniques (nague-waza)[6] were adopted as a decision-making component in the simulated

judo fight. Situations that resulted in scoring (Yuko, Wazari or Ippon) were considered as appropriate action.

The decision-making index was calculated as per the formula below, considering the changes suggested by Memmert and Harvey[10]. Each action was analyzed by two judo experts and classified as appropriate or inappropriate.

$$DMI = \frac{Aa + 10}{(Aa + 10) + (Ia + 10)}$$

Where:
DMI = Decision-making index
Aa = appropriate actions
Ia = inappropriate actions

Statistical analysis

The Levene test was used to test the homecedasticity, while data sphericity was verified by the Mauchly test. When that last assumption was violated, the Greenhouse-Geisser correction was adopted. Considering that the DES is composed of likert scale, a non-parametric test was chosen to compare the score between the pre- and the post-experiment moment. On the other hand, due to the non-parametric violation of the rest of the data, measures of central tendency (mean) and dispersion (standard deviation and standard error) were used to describe the research variables. The two-way ANOVA with repeated measures was applied to compare decision-making performance between groups, both before and after the experiment. The size of the Cohen effect was calculated for the analysis of the magnitude of the differences. To analyze the effect size, the classification proposed by Rhea[20] was employed: $d<0.2$ = trivial, $0.2 \leq d < 0.4$ = low effect size, $0.4 \leq d > 0.8$ = moderate effect size and, $d \geq 0.8$ = large effect size. All data were processed on the SPSS 21.0 software, adopting a significance level of 5%.

Results

No statistically significant difference was found in the comparisons between the groups (EG and CG), before the experiment, for the following variables: age (p=0.20), relative body fat (p=0.29), frequency of methods for rapid weight loss (p=0.23) and GPAI performance (p=0.26).

Table 2 presents the results of comparisons between EG and CG. Group vs. time interaction effect was identified (p<0.01) for body mass, with reduction only in the EG (p=0.01; d=0.9). A significant group vs. time interaction (p<0.01) was revealed for the decision-making index, with performance improvement being verified only in the CG (p=0.01; d=0.7).

Concerning the Food restriction and weight reduction subscale, the results indicated group vs. time interaction effect (p<0.01), with increased score verified only for the CG (p=0.01; d = 0.9).

Table 2. Mean and standard deviation of the Game Performance Assessment Instrument index, body mass and score in the "Food restriction and weight reduction" subscale by research stage (before and after the experiment).

Variables	EG (n = 20)	CG (n = 19)	Effects	F	*p*
Body mass (kg)					
Before	72.5 ±3.6	73.1 ± 3.9	Group	39.25	0.01
After	64.8 ± 4.0*	72.6 ± 4.2	Time	33.34	0.21
Δ%	-10.6	-0.7	Interaction	62.43	0.01
d	0.9	0.1			
GPAI (index)					
Before	0.48 ± 0.1	0.47 ± 0.1	Group	36.04	0.01
After	0.49 ± 0.1	0.52 ± 0.1*	Time	31.73	0.23
Δ%	1.2	5.1	Interaction	40.59	0.01
d	0.1	0.7			
FRWR Subscale					
Before	12.7 ±0.9	12.6 ±0.8	Group	53.11	0.01
After	19.5 ±1.0*	12.5 ±0.9	Time	48.75	0.19
Δ%	34.87	-0.8	Interaction	56.92	0.01
d	0.9	0.1			

Note: FRWR = *food restriction and weight reduction*; GPAI = *Game Performance Assessment Instrument*; *d* = effect size. $^{*}p < 0,05$ vs. before.
Source: The authors

Discussion

The present investigation had as premise to compare decision-making performance among judokas with and without the adoption of methods for rapid weight loss. The results showed that those fighters that employed methods for fast body mass reduction (EG) had no changes in the GPAI, while the CG showed a boost as to the latter, corroborating the hypothesis of the present investigation.

Therefore, it seems that the adoption of methods for rapid weight loss (wearing plastic clothes, using sauna and/or laxatives/appetite suppressants) may lead to a decrease in metacognitive performance, corroborating the hypotheses pointed out by Romeas, Guldner and Falbert[11] and Davids et al.[12].

Authors emphasize that athletes that have used methods for fast body mass reduction may present reduced blood flow in the telencephalon and reduced conduction speed of the nerve impulse[7], which can decrease metacognitive performance[13]. Thus, considering that blood flow reduction in the telencephalon decreases oxygenation in upper cerebral areas[21], it is possible to assume that rapid weight loss attenuates attention and anticipation skills, deemed as critical to decision-making performance[9], which, cautiously, can explain the findings for the EG, which indicated maintenance in decision-making performance. It should also be noted that fast body mass reduction leads to dehydration[22], which may be directly related to reduced conduction velocity of the nerve impulse. In this sense, rapid weight loss, even if indirectly, can attenuate the response time between information processing and motor execution, which, in a way, can also explain the results found for the EG after two weeks of intervention.

In addition, it is worth emphasizing that in sports with division by body mass class, more specifically judo, for countless times throughout the season the athlete is instructed by his coach to compete in classes below the body mass considered normal for his stature[23]. In this sense, many competitors adopt methods for rapid weight loss on days prior to the main competition, believing that these attitudes give them advantage over their opponents. Thus,

body mass "cycling" is common in these athletes' sports careers[4]. However, many coaches do not show technical knowledge related to rapid weight loss and water dysfunctions, hormonal imbalance, increased risk of injury, decreased bone mineral content, and development of eating disorders[24].

Regarding the "Food restriction and weight reduction" subscale, the findings of the present study revealed an increase in the scores of the EG and maintenance in those of the CG after the two weeks of intervention. This result indicates that the EG judokas increased, while the CG maintained the frequency of use of methods related to rapid weight loss. In addition, it is worth noting that the body mass of the EG was attenuated in relation to that of the CG after the two weeks adopting methods for rapid weight loss, revealing a large effect size. Research has shown that the adoption of methods for fast body mass reduction can generate health problems, such as cardiac arrhythmia, reduced bone mineral density and decreased muscle mass[5,24]. It is worth mentioning that at least 60% of combat sports athletes use methods for rapid weight loss on the eve of competitions[5,22], which is worrisome.

Although the experimental design of the present research has never been used with judo athletes, the results should be analyzed with caution, since the investigation has limitations, especially regarding the use of a double indirect method to assess fat percentage.

Conclusions

The results of the present study allowed concluding that rapid weight loss was not a good strategy to improve the decision-making performance of judokas, since the EG did not change and the CG boosted the GPAI index. From a practical point of view, this research indicates that rapid weight loss, commonly adopted by judo athletes, may prevent positive metacognitive adjustments resulting from the typical training of the modality.

Finally, further researches are suggested to analyze how the adoption of methods for rapid weight loss affect in the long run the physical and cognitive performance of judokas. Moreover, investigations with females should be carried out as well.

References

1. Agostinho MF, Philippe AG, Marcolino GS, Pereira ER, Busso T, Candau RB, et al. Perceived training intensity and performance changes quantification in judo. J Strength Cond Res 2015;29:1570-1577.
2. Franchini E, Brito CJ, Artioli G. Weight loss in combat sports: physiological, psychological and performance effects. J Int Society Sports Nutr 2012;9:52-60.
3. Franchini E, Branco BHM, Agostinho M, Calmett M, Candau R. Influence of linear and undulating strength periodization on physical fitness, physiological and performance responses to simulated judo matches. J Strength Cond Res 2015;29:358-367.
4. Artioli GG, Franchini E, Nicastro H, Sterkwicz S, Solis MY, Lancha-Junior AH. The need of a weight management control program in judo: a proposal based on the successful case of wrestling. J Int Society Sport Nutr 2010;15(7):1-5.
5. Brito CS, Roas AFM, Brito ISS, Marins JCB, Cordova C, Franchini E. Methods of body-mass reduction by combat sport athletes. Int J Sport Nutr Exercise Metabolism 2012;22(1): 89-97.
6. Franchini E, Brito CJ, Fukuda DH, Artioli GG. The physiology of judo-specific training modalities. J Strength Cond Res 2014;28:1474-1481.
7. Abedelmalek S, Chtourou H, Souissi N, Tabka Z. Caloric Restriction Effect on Proinflammatory Cytokines, Growth Hormone, and Steroid Hormone Concentrations during Exercise in Judokas. Oxidative Med Cellular Longevity 2015;3:492-500.
8. Memmert D, Harvey S. The Game Performance Assessment Instrument (GPAI): Some concerns and solutions for further development. J Teaching Physic Educ 2008;27:220-240.

9. Araújo D, Davids K, Diniz A, Rocha L, Santos JC, Dias C, Fernandes O. Ecological dynamics of continuous and categorical decision-making: The regatta start in sailing. Eur J Sport Sci 2015;15(3):195–202.
10. Memmert D, Roth K. The effects of non-specific and specific concepts on tactical creativity in team ball sports. J Sports Sci 2007;1:1-10.
11. Romeas T, Guldner ., Faubert J. 3D-Multiple Object Tracking training task improves passing decision-making accuracy in soccer players. Psychol Sport Exercise 2016;22:1-9.
12. Davids K, Araújo D, Correia V, Vilar L. How small-sided and conditioned games enhance acquisition of movement and decision-making skills. Exercise Sport Sci Reviews 2013;41(3):154-161.
13. Kinrade NP, Jackson RC, Ashford KJ. Reinvestment, task complexity and decision making under pressure in basketball. Psychol Sport Exercise 2015;20:11-19.
14. Reale R, Cox GR, Slater G, Burke LM. Regain in body mass after weigh-in is linked to success in real life judo competition. Int J Sport Nutr Exerc Metab 2016;26(6):525-530
15. Santos JFS, Herrera T, Franchini E. Can Different conditioning activities and rest intervals affect the acute performance of taekwondo turning kick?. J Strength Cond Res 2015;29:1640-1647.
16. Fortes LS, Almeida SS, Ferreira MEC. Psychometric analysis of Disordered Eating in Sports Scale (DES). Paidéia 2016;26:171-180.
17. Jackson AS, Pollock ML. Generalized equations for predicting body density of men. Br J Nutr 1978;40:497-504.
18. Siri WE. The gross composition of the body. In: Tobias CA, Lawrence JH, editors. Advances in biological and medical physics. New York: Academic Press, 1956:239-80.
19. International Judo Federation (2016). [Internet]. International judo rules. [Acesso em 1 de junho de 2016]. Disponível em: http://www.intjudo.eu/.
20. Rhea, MR. Determining the magnitude of treatment effects in strength training research through the use of the effect size. J Strength Cond Res 18: 918-920, 2004.
21. Soares AHG, Oliveira TP, Cavalcante BR, Farah BQ, Lima AHRA, Cucato GG, et al. Effects of active recovery on autonomic and haemodynamic responses after aerobic exercise. Clin Physiol Funct Imaging 2017;37(1):62-67
22. Artioli G, Iglesias R, Franchini E, Gualano B, Kashiwagura D, Solis M, et al. Rapid weight loss followed by recovery time does not affect judo-related performance. J Sports Sci 2010; 28: 21-32.
23. Durguerian A, Bougard C, Drogou C, Sauvet F, Chennaoul M, Filaire, E. Weight loss, performance and psychological related states in high-level weighlifters. Int J Sports Med. 2016;37(3):230-238.
24. Chapman J, Woodman T. Disordered eating in male athletes: a meta-analysis. J Sports Sci 2016; 34(2):101-109.

Acknowledgements: To Santander Bank for funding the project. To Pernambuco Science and Technology Foundation [*Fundação de Amparo à Ciência e Tecnologia de Pernambuco*] (FACEPE) for granting the second author a scientific initiation scholarship. To the judokas for their willingness to participate in the investigation.

.

Received on Oct, 12, 2016.
Reviewed on Dec, 07, 2016.
Accepted on Dec, 18, 20/16.

Author address: Leonardo de Sousa Fortes. Endereço: Rua Clóvis Beviláqua, 163/1003, Bairro Madalena, Recife-PE, CEP 50710-330. E-mail: leodesousafortes@hotmail.com