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THE EFFECT OF RAPID WEIGHT LOSS ON THE HANDGRIP STRENGTH OF NATIONAL-LEVEL WRESTLERS

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ABSTRACT

The effects of rapid weight loss (RWL) in combat sports athletes is an area that is not yet fully discovered. Therefore, the goal of this study was to determine the impact of weight loss on HGS (handgrip strength) in Greco-Roman wrestlers.

This cross-over study included ten athletes examined for HGS during three time points for each hand. The first measurement – baseline (BL), was performed before weight reduction. The second measurement – phase 1 (P1), was taken after high-intensity sports specific training (HISST) combined with RWL. In this phase, participants had to lose 5% of their body mass within three days, after which HISST was carried out (on day 3). The third measurement – phase 2 (P2), was performed seven days after P1, which included HISST with no RWL.

When comparing the HGS values, significantly higher values were observed only when P1 was compared with P2 for the left hand (p=0.039). This means that the grip was significantly stronger after RWL was conducted together with HISST.

This research could be of great importance to combat sports coaches and athletes as it evaluates the effect of RWL on performance parameters. Therefore, the results of our study could serve to improve the wrestlers' weight-reduction plan.

Keywords: *Greco-Roman, performance, weight reduction, wrestling*

UČINKI NAGLEGA ZMANJŠEVANJA TELESNE MASE NA MOČ OPRIJEMA PRI REPREZENTANČNIH ROKOBORCIH

IZVLEČEK

Učinki naglega zmanjševanja telesne mase pri športnikih v borilnih disciplinah so področje, ki še ni povsem raziskano. Zato je bil cilj te študije ugotoviti, kako nagla izguba telesne mase vpliva na moč oprijema pri rokoborcih v grško-rimskem slogu.

V pričujočo navzkrižno študijo smo vključili deset športnikov, pri katerih smo preverjali moč oprijema za vsako roko v treh različnih časovnih obdobjih. Prvo meritev – ki je predstavljala izhodišče – smo opravili pred začetkom zmanjševanja telesne mase. Drugo meritev – 1. faza – smo opravili po visokointenzivni športnospecifični vadbi v kombinaciji z naglo izgubo telesne mase. V tej fazi so sodelujoči morali v treh dneh za 5 odstotkov zmanjšati svojo telesno maso, nato pa opraviti visokointenzivno športnospecifično vadbo (tretji dan). Tretja meritev – 2. faza – je bila izvedena sedem dni po 1. fazi in je vključevala visokointenzivno športnospecifično vadbo brez zmanjševanja telesne mase.

Pri primerjavi podatkov o moči oprijema smo občutno višje vrednosti zaznali med rezultati meritev v 1. in 2. fazi za levo roko, saj so slednji pokazali, da se je moč oprijema občutno povečala po zmanjšanju telesne mase v kombinaciji z visokointenzivno športnospecifično vadbo.

Študija, ki meri učinke naglega zmanjšanja telesne mase na parametre zmogljivosti, prinaša pomembne uvide za trenerje in športnike v borilnih disciplinah in bi lahko pripomogla k izboljšanju programov za zmanjševanje telesne mase pri rokoborcih.

Ključne besede: *grško-rimski slog, zmogljivost, zmanjševanje telesne mase, rokoborba*

INTRODUCTION

To be successful in wrestling, an athlete must possess high levels of physical and psychological readiness. Indeed, wrestling is a very demanding and vigorous sport that consists of two 3-minute rounds, with a break of 30 seconds in between (Yoon, 2002). Thus, both aerobic and anaerobic energy systems are taxed during a wrestling match (Nikooie, Cheraghi, & Mohamadipour, 2017). Specifically, the anaerobic system provides explosive and short bursts of maximal power and strength, while the aerobic system is responsible for sustained effort during the match (Demirkan, Koz, Kutlu, & Favre, 2015). Furthermore, wrestling requires highly developed upper-body strength and power, particularly handgrip strength (Gerodimos et al., 2013; Demirkan et al., 2015).

Handgrip strength (HGS) in hand-to-hand combat sports, including wrestling, is essential for movements such as pulling, pushing, throwing and controlling the opponent, which are important determinants of the match outcome (Cronin, Lawton, Harris, Kilding, & McMaster, 2017). Moreover, possessing high HGS and endurance is very important in the later rounds of the match and can influence the continuation or end of the dominance of the opponent (Franchini, Schwartz, & Takito, 2018). Also, HGS is essential in several wrestling holds because various take-down and defensive maneuvers are based on a strong grip (Gerodimos et al., 2013). Indeed, a very strong relationship was recorded between HGS and success in wrestling (i.e., competition ranking) (García-Pallarés, López-Gullón, Muriel, Díaz, & Izquierdo, 2011; Nikooie et al., 2017). Also, elite male wrestlers had stronger handgrip compared to sub-elite wrestlers (Nikooie et al., 2017). It is important to note that both absolute and relative strength was higher in elite than in sub-elite wrestlers, which supports the hypothesis that handgrip can be observed as a determinant of overall strength in athletes (García-Pallarés et al., 2011).

In combat sports, athletes are categorized into weight classes according to their body mass in order to reduce the difference in strength and size of the competitors. The aim of dividing athletes into weight classes is to create equal competition conditions for each athlete (Castor-Praga, Lopez-Walle, & Sanchez-Lopez, 2021). However, in order to drop the weight into a class where an athlete would have an advantage over the lighter and weaker opponent, rapid weight loss is commonly practiced among combat sports athletes (Khodaee, Olewinski, Shadgan, & Kiningham, 2015; Ranisavljev et al., 2022; Todorović et al., 2021). Rapid weight loss (RWL) stands for a method characterized by losing at least 5% of body weight in fewer than seven days prior to competition (Khodaee et al., 2015). However, such large alterations in body weight, although without conclusive scientific evidence, most likely impact athletes' performance. Namely, RWL leads to detriments on anaerobic performance, which is related to reduced glycogen depletion and buffering capacity (Lakicevic et al., 2020). Reduced muscle glycogen can impair excitation-contraction coupling in the muscle and accelerate the onset of muscle fatigue, which can reduce exercise performance (Ørtenblad, Westerblad, & Nielsen, 2013). Recent studies revealed that RWL leads to significant muscle damage in combat sports athletes and impairs heart rate recovery in national-level wrestlers (Roklicer et al., 2020; Roklicer et al., 2022).

To the best of the authors' knowledge, no study has examined the influence of RWL combined with HISST on HGS in wrestlers. Thus, the aim of this study was to determine the impact of RWL on HGS in wrestlers.

METHODS

Participants

This cross-over study was carried out on a total of 10 male national level Greco-Roman wrestlers (22.44 ± 4.53 years; mean body weight: 73.36 ± 4.42 kg; mean body height: 174.43 ± 3.78 cm). To be included in the experiment, wrestlers had to have at least five years of competitive experience. Additionally, participants were eligible only if they had used RWL methods within the previous two years. Participants were free of injury at the time of the testing. The procedures were fully explained to the participants before conducting the study. Each respondent participated voluntarily by signing the informed consent. Body composition parameters were measured using a body composition analyzer (Omron BF511, Omron Healthcare Ltd., Matsusaka, Japan).

All procedures were carried out in accordance with the Declaration of Helsinki. The study was approved by the ethical board of the University of Novi Sad, Serbia (Ref. No. 46-06-02/2020-1).

Experimental Approach to the Problem

Handgrip strength was measured at three time points. The first measurement – (BL) was conducted before the weight reduction. The second measurement – Phase 1 (P1), was done after the high-intensity sport-specific training (HISST) combined with RWL. For this phase, participants had to lose 5% of their body mass within three days, after which the HISST was carried out (on day 3). The third measurement – Phase 2 (P2), was carried out seven days following P1 and included HISST (after which the measurements were done) with no RWL.

Isometric Handgrip Strength

The maximum grip strength was measured for both hands with a Takei portable dynamometer (Takei Scientific Instruments Co., Tokyo, Japan). Participants stood with the abducted shoulder. The dynamometer was previously adapted to the size of the participant's hands and held with the arms parallel to the body without squeezing/attaching the arm against the body. The position of the hand remained constantly downwards, and the palm did not bend at the wrist joint. Subjects were asked to do a maxi-

mum voluntary contraction on the dynamometer for 5 seconds. All subjects performed three trials for each hand, and the best performance was used for further analysis.

Statistical Analysis

The results are presented as mean and standard deviation. The normality of the distribution was determined by the Shapiro-Wilks test. To compare the means between the handgrip strength measurements, One Way ANOVA for repeated measures with LSD post hoc analysis was conducted. All statistical procedures were done using IBM SPSS Statistics for Windows, 20.0 (IBM Corp 20, Armonk, NY, USA). The significance level was set at $p \leq 0.05$.

RESULTS

The wrestlers' characteristics are presented in Table 1. According to the results obtained, statistically significant differences were observed across the three time points. The values obtained in P1 were significantly lower for body weight, BMI, FM, and VBF, while muscle mass increased significantly compared to the baseline measurement. The results in P2 were significantly higher for body weight, BMI, FM, and VBF, while muscle mass was significantly lower in this phase compared to P1. Basal metabolic rate was not significantly different across the three time points.

Table 1. Descriptive characteristics of body composition of wrestlers (n=10)

	BL	P1	P2
Body weight (kg)	73.36±4.42	69.27±4.12*	72.38±4.17#
BMI (kg/m2)	24.11±0.96	22.62±0.98*	23.64±1.07#
FM (%)	16.37±2.22	12.74±3.15*	14.98±2.47#
MM (%)	42.51±1.41	44.64±2.14*	43.36±1.71#
VBF (%)	6.11±1.05	4.88±1.16*	5.66±1.32#
Basal metabolic rate (kcal)	1717.33±64.98	1677.11±61.49	1704.11±56.43

Values are presented as mean and standard deviation (M±SD); BL – baseline values; P1 – phase one: HISST combined with RWL; P2 – phase two: HISST with no RWL procedures included; BMI – Body mass index (kg/m2); FM – Fat mass (%); MM –muscle mass (%); VBF – Visceral body fat (%); statistically significant difference compared to baseline values, p≤0.001; # statistically significant difference compared to P1, p≤0.01.*

The handgrip strength values for both hands are presented in Table 2. Although the higher values for the right hand are visible in P1 and P2 in comparison to the baseline, the difference remained statistically insignificant. As for the left hand, similar values were obtained during BL and P2. However, according to LSD pairwise comparisons, significantly higher handgrip strength was observed in P1 only when compared to P2, p=0.039 (Figure 1).

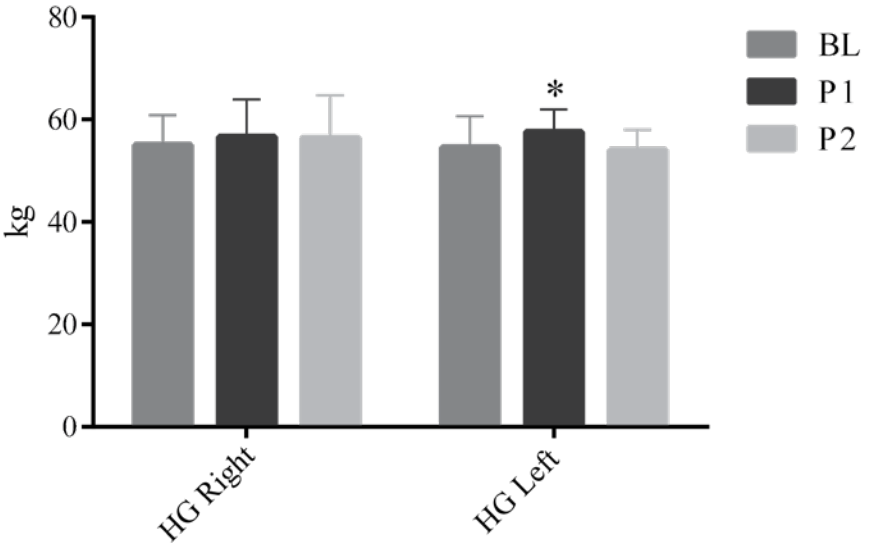

Figure 1. Handgrip strength differences in Greco-Roman wrestlers.

*Legend: * - significantly different compared to P2 (left handgrip) p<0.05; BL – baseline measurement; P1 – phase one: HISST combined with RWL; P2 – phase two: HISST with no RWL procedures included; HG – right and left handgrip strength; kg – kilograms.*

Table 2. Handgrip strength of wrestlers.

	BL	P1	P2	F	p	Partial Eta squared
HG right (kg)	55.55 ±5.81	56.66 ±7.28	56.44 ±8.35	0.104	0.857	0.013
HG left (kg)	54.55 ±6.06	57.55 ±4.44*	54 ±4	1.845	0.199	0.187

*Values are presented as mean and standard deviation (M±SD); BL – baseline values; P1 – phase one: HISST combined with RWL; P2 – phase two: HISST with no RWL procedures included; F – F ratio; HG right – right-hand handgrip strength; HG left – left-hand handgrip strength; *statistically significantly different compared to P2 according to post hoc pairwise comparisons, p≤0.05.*

DISCUSSION

To the author‘s knowledge, this is the first cross-over design study that analyzes the impact of combining RWL with HISST and HISST alone on HGS performance in national-level Greco-Roman wrestlers. The obtained results demonstrated changes in HGS values in the phase when body weight reduction was implemented. Maximum grip strength production significantly increased only for the left hand of the athletes. There are not many previous studies examining the influence of RWL on HGS in wrestlers. Research conducted on elite wrestlers showed a decrease in HGS performance after applying RWL (Jlid, Maffulli, Elloumi, Moalla, & Paillard, 2013). On the other hand, weight loss failed to alter the HGS values in college wrestlers (Serfass, Stull, Alexander, & Ewing Jr., 1984; Marttinen, Judelson, Wiersma, & Coburn, 2011). In contrast to the results of these studies, this research reported a positive effect of RWL on HGS values. Isometric strength production was higher for the left hand during the combined phase of RWL with HISST compared to values observed in P2. The average HGS performance of the right hand was also increased, albeit without statistical significance. Several possible mechanisms may explain these findings. Athletes have probably experienced psychological arousal due to reaching the target weight for the category in which they intend to compete, which potentially leads to improved strength performance. Additionally, changes in body composition may be related to the results shown. The increase in muscle mass, as well as the decrease in FM and VBF during the application of RWL, are probably responsible for the positive alterations in HGS values. Due to the already mentioned importance of HGS in separating more successful wrestlers from less successful ones, coaches and athletes could probably implement RWL before the competition. Of course, the weight loss process must be conducted with some caution due to the negative impact on other health aspects of athletes. Future studies on larger

samples are needed to clearly understand the results obtained in this study. In combat sports, the link between weight loss and HGS has been most investigated in judo. As in wrestling, the previous findings are inconsistent. Some studies have reported that RWL reduces HGS values in judo athletes (Degoutte et al., 2006; Clarys, Ramon, Hagman, Deriemaeker, & Zinzen, 2010; Isacco et al., 2020). However, the weight loss did not change the HGS performance of the left hand in national level judokas (Filaire et al., 2001). Additionally, weight reduction did not affect the maximal isometric strength in Czech judokas, although marginally higher average HGS values were observed for both the left and right hand after the RWL period (Coufalová, Cochrane, Maly, & Heller, 2014). The results are also in conflict in Mixed Martial Arts (MMA). Camarço et al. (2016) failed to find alterations in HGS values after RWL was applied. Contrary, RWL significantly decreased HGS performance in amateur MMA fighters (Alves et al., 2018). All studies demonstrated a negative or no effect of RWL on HGS values in combat athletes. Only the results of our research showed a positive impact of RWL on HGS performance. The cross-over design of the presented study may be a factor that contributed to the final outcome. Some of the future research could focus on the influence of RWL on HGS in combat sports like sambo, taekwondo, or boxing. Finally, this study has several relevant limitations that should be mentioned. First, the study was conducted on a relatively small sample . Second, the respondents were national-level wrestlers. Participants' hand dominance was not reported prior to testing. Future studies should monitor glycogen and various inflammation and muscle damage levels along with subjective levels of physical and/or mental arousal. Additionally, future studies should investigate the impact of RWL on HGS values in elite wrestlers. Finally, athletes were free to choose weight loss methods. Hence, wrestlers most likely used different techniques of RWL.

CONCLUSION

The aim of this study was to determine HGS in national-level wrestlers. Particularly, the impact of RWL on the handgrip strength was measured during baseline and two different phases – P1 and P2. Comparing the HGS values, a significant difference was observed only when P1 was compared to P2 for the left hand. Specifically, the handgrip was stronger after RWL was included along with HISST. This phenomenon may be interpreted as psychological arousal of athletes who have attained the target weight for a certain category they tend to compete in. This research could be of great importance for combat sports coaches and athletes as it evaluates the effect of RWL on performance parameters. Although further studies on this matter would be of great importance, the findings of our study might serve to improve the wrestlers' weight reduction plan.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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