Original Article

Acute effect of official kickboxing game on handgrip muscle strength: winners vs. losers

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Abstract

Although an increased number of those practising martial arts, there is little information about the physiological responses induced by such physical activities. Therefore, the aim of this study was to examine the effect of an official kickboxing game (three 2-min rounds with a 1-min break between rounds) on handgrip muscle strength (HGS) considering the outcome of the game (winners vs. losers). Thirty-one kickboxers (age 24.5 (6.0) years, weight 74.1 (11.6) kg, height 1.77 (0.08) m and body mass index 23.5 (2.2) kg.m⁻², mean (standard deviation)) were examined for anthropometric characteristics and performed the HGS test using an isometric digital dynamometer (Takei, Tokyo, Japan) before and after a game. Dominant and non-dominant hand HGS was measured and their sum was calculated. Post-game HGS decreased in total (-3.5 kg (-5.6;-1.4), 0.15 (mean (95% CI), effect size), in the dominant hand (-1.9 kg (-2.9;-0.9), 0.16) and in the non-dominant hand (-1.6 kg (-3.3;-0.6), 0.14). The largest decreases were noticed in winners (-4.6 kg (-6.5;-2.7), 0.22; -2.4 kg (-3.5;-1.3), 0.23; -2.2 kg (-3.4;-1.0), 0.21, respectively), while the corresponding findings in losers were not statistically significant (-1.8 kg (-6.4;2.9), 0.07; -1.1 kg (-3.3;1.1), 0.08; -0.7 kg (-3.3;2.0), 0.05, respectively). We also observed different patterns in variability changes; variability increased in losers, while it decreased in winners. In conclusion, a kickboxing game has a negative effect of small size on HGS and this effect is related with the outcome of the game. The findings of this study can be used by coaches and fitness trainers in order to evaluate training load and achieve neuromuscular loads similar to game demands.

Keywords: neuromuscular fatigue, physical fitness, exercise, martial arts.

Introduction

Kickboxing is a martial art, which involves “two competitors directing full-force strikes with the hands, elbows, knees, shins and feet at each other” (Buse, 2009). Physiological, biomechanical and psychological characteristics of athletes influence performance (Buse, 2009; Devonport, 2006; Zabukovec & Tiidus, 1995). The research on physiological profile of kickboxers has revealed high levels of aerobic power, moderate-to-high anaerobic power and low body fat (Zabukovec & Tiidus, 1995). Since it is a sport in which both arms and legs play an active role, a recent study was conducted with regard to the upper-to-lower limbs ratio in strength, velocity and power, and revealed significant correlation between arms and legs’ anaerobic power (Nikolaïdis, Fragkiadakis, Papadopoulos, & Karydis, 2011).

While the aforementioned studies focused on profiling the physical and physiological characteristics of athletes, there is little information about the acute physiological responses induced by such physical activities. This lack of information might limit the development of optimal training programs, because kickboxing’s physiological responses remain unknown. Therefore, the aim of this study was to examine the effect of an official kickboxing game (three 2-min rounds with a 1-min break between rounds) on handgrip muscle strength (HGS) considering the outcome of the game (winners vs. losers).

Material and methods

To study the effect of an official kickboxing game on HGS, we conducted our research during the South Greece Cup (Athens, May, 2012). Thirty-one kickboxers (age 24.5 (6.0) years, weight 74.1 (11.6) kg, height 1.77 (0.08) m and body mass index 23.5 (2.2) kg.m⁻², mean (standard deviation)) volunteered for this study and provided written informed consent and were injury-free.

The participants were examined for anthropometric characteristics, were questioned about training experience (4.8 (3.1) years), training units weekly (4.2 (0.8)), duration of each unit (96.5 (23.7) min; weekly 411.0 (143.0) min) and number of previous games (14.4 (20.9)), and performed the HGS test using an isometric

digital dynamometer (Takei, Tokyo, Japan) before and after a game. A game consisted by three 2-min rounds with a 1-min break between rounds. HGS was measured in both dominant and non-dominant hand, and their sum was calculated. The participants were asked to stand with their elbow bent at approximately 90° and instructed to squeeze the handle of the handgrip dynamometer (Takei, Tokyo, Japan) as hard as possible for 5 seconds (Adam, Klissouras, Ravazzolo, Renson, & Tuxworth, 1988). HGS values were presented separately for dominant, non-dominant hand and their sum in kg, and relative value was calculated as the sum of each hand divided by body mass and expressed as $\text{kg}\cdot\text{kg}^{-1}$ of body mass.

Data were analyzed using IBM SPSS v.20.0 (SPSS, Chicago, USA). Values are presented as means with standard deviations. Dependent student *t*-test was used to examine differences between post- and pre-game. Differences are presented as means with 95% confidence intervals (CI). Effect sizes (*ES*) for statistical differences were determined using the following criteria: $ES \leq 0.2$, trivial; $0.2 < ES \leq 0.6$, small; $0.6 < ES \leq 1.2$, moderate; $1.2 < ES \leq 2.0$, large; and $ES > 2.0$, very large (Batterham & Hopkins, 2006). Correlation coefficient *r* examined the relationship between body mass and HGS. To interpret the magnitude of these correlations we adopted the following criteria: $r \leq 0.1$, trivial; $0.1 < r \leq 0.3$, small; $0.3 < r \leq 0.5$, moderate; $0.5 < r \leq 0.7$, large; $0.7 < r \leq 0.9$, very large; and $r > 0.9$, almost perfect (Hopkins, Marshall, Batterham, & Hanin, 2009).

Results

Pre- and post-game HGS values are presented in **Table 1**. Post-game HGS decreased in total (-3.5 kg (-5.6;-1.4), 0.15 (mean (95% CI), effect size), in the dominant hand (-1.9 kg (-2.9;-0.9), 0.16) and in the non-dominant hand (-1.6 kg (-3.3;-0.6), 0.14). The largest decreases were noticed in winners (-4.6 kg (-6.5;-2.7), 0.22; -2.4 kg (-3.5;-1.3), 0.23; -2.2 kg (-3.4;-1.0), 0.21, respectively), while the corresponding findings in losers were not statistically significant (-1.8 kg (-6.4;2.9), 0.07; -1.1 kg (-3.3;1.1), 0.08; -0.7 kg (-3.3;2.0), 0.05, respectively). The effect size of these decreases was trivial in total and small in winners. We also observed different patterns in variability changes; variability increased in losers, while it decreased in winners. The correlations between weight and HGS ranged from large (losers) to very large (total and winners) and the highest values were recorded in winners (**Figure 1**). We did not observe any differences before and after the game with regard to these correlations.

Table 1. Handgrip muscle strength pre- and post-game in participants according to game outcome.

		Total (n=31)		Losers (n=19)		Winners (n=12)	
		Pre-game	Post-game	Pre-game	Post-game	Pre-game	Post-game
		(mean (SD))	(mean (SD))	(mean (SD))	(mean (SD))	(mean (SD))	(mean (SD))
Dominant hand	(kg)	53.7 (11.9)	51.8 (11.9)‡	52.5 (13.2)	51.4 (14.8)	54.5 (11.2)	52.1 (10.1)‡
Non-dominant hand	(kg)	50.0 (11.3)	48.4 (11.5)*	49.4 (12.1)	48.7 (13.9)	50.5 (11.1)	48.3 (10.1)‡
Sum	(kg)	103.8 (22.8)	100.3 (23.0)‡	101.9 (24.8)	100.1 (28.3)	105.0 (22.0)	100.4 (19.8)‡
Sum	($\text{kg}\cdot\text{kg}^{-1}$)	1.40 (0.20)	1.35 (0.22)†	1.44 (0.26)	1.41 (0.30)	1.37 (0.16)	1.31 (0.15)‡

* $p < 0.05$, † $p < 0.01$, ‡ $p < 0.001$.

Figure 1. (A, B)

Figure 1. (C, D)

Figure 1. Relationship between handgrip muscle strength and weight before and after kickboxing game in total (A, B), losers (C, D) and winners (E, F). Dash lines denote 95% confidence intervals.

Discussion

The main finding of this study was that HGS decreased after a kickboxing game and this size of this decrease was dependent on the outcome of the game, i.e., it was statistically significant in the case of the winners. To the best of our knowledge, this is the first study to be conducted on this topic and, therefore, it was not possible to compare our findings with previous research. The decrease in HGS might be attributed to the activity profile of this sport, which includes many actions involving upper limbs. On the other hand, we interpret the higher decrease in winners' HGS as a higher neuromuscular fatigue, which cannot be tolerated by losers.

Kickboxing in this study caused smaller decrease in HGS (~3.5%), compared with a similar study in taekwondo (~7%) (Chiodo et al., 2012). Since no previous study profiled the HGS in kickboxing, we examined our pre-game values with regard to athletes from other martial arts and sports. Compared with other sport disciplines and physical activities, kickboxers had similar values with physical education students (Nikolaidis & Sacklova, 2011), higher than soccer players (Nikolaidis, 2012) and lower than handball players (Nikolaidis & Ingebrigtsen, 2013). Kickboxers had similar HGS with boxers and taekwondo athletes (Chiodo et al., 2012; Guidetti, Musulin, & Baldari, 2002). In addition to the importance of the use of HGS as an assessment tool of physical fitness, we also showed that this measure has the ability to differentiate kickboxers according to their performance.

Conclusions

In conclusion, a kickboxing game has a negative effect of trivial to small size on HGS and this effect is related with the outcome of the game. The findings of this study can be used by coaches and fitness trainers in order to evaluate training load and achieve neuromuscular loads similar to game demands.

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