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Maximal isometric handgrip strength in international and national level Turkish judo athletes

Bayram CEYLAN[1A], Furkan ÖZTÜRK[2B]

[1] *Department of Coaching Education, Faculty of Sport Sciences, Kastamonu University, Türkiye*
[2] *Department of Coaching Education, Faculty of Sport Sciences, Düzce University, Türkiye.*

Address Correspondence to Bayram CEYLAN: e-mail: b.ceylan42@gmail.com

A: Orcid ID: 0000-0002-6753-1848- B: Orcid ID: 0000-0001-8621-9063

Abstract

The aim of this study was to determine and compare maximal handgrip strength (HGS) of international and national level judo athletes. Eighteen international and 16 national level judo athletes voluntarily participated in this study. After anthropometric measurements, athletes performed the maximal isometric HGS test three times on each side with a 1-min interval between attempts. Independent sample T test was used to compare groups and Pearson correlation coefficient was calculated to determine the relationship between variables. Significance was set at $p<0,05$. There was significant difference in body mass, height, body mass index, right, left and sum relative maximal HGS between groups ($p<0,05$). No other significant difference was observed. As for correlations among variables, there were significant correlations between body mass and maximal HGS ($p=0.00$). Also, there were significant correlations between body mass index and maximal HGS ($p=0,00$). According to classificatory table, most of the athletes were classified as regular for right hand absolute and relative, left hand absolute and relative and sum absolute and relative maximal HGS. International-level judo athletes presented better maximal isometric HGS than national judo athletes given absolute power they produced while national judo athletes presented better results in relative HGS.

Keywords: Strength, combat sports, men athletes, performance

Uluslararası ve ulusal seviyedeki Türk judocuların maksimal izometrik el kavrama kuvvetleri

Özet

Bu çalışmanın amacı uluslararası ve ulusal seviyedeki judocuların maksimal el pençe kuvvetini belirlemek ve karşılaştırmaktır. Çalışmaya 18 uluslararası ve 16 ulusal seviyede erkek sporcu gönüllü olarak katıldı. Antropometrik ölçümler sonrasında sporcular 1 dakika ara ile her el için rastgele 3 kez maksimal el pençe kuvvet testini gerçekleştirdi. Grupların performanslarını karşılaştırmak için bağımsız örneklemlerde T test kullanılırken, değişkenler arasındaki ilişkiyi belirlemek için Pearson korelasyon testi kullanıldı. Analamlılık düzeyi $p<0,05$ olarak kabul edildi. Gruplar arasında vücut ağırlığı, boy, vücut kütle indeksi, sağ, sol ve toplam rölatif el pençe kuvvetinde anlamlı farklılık tespit edildi ($p<0,05$). değişkenler arasındaki ilişki incelendiğinde, vücut ağırlığı ve vücut kütle indeksi ile maksimal el pençe kuvveti arasında anlamlı ilişki tespit edildi ($p=0,00$). Sınıflandırma tablosu ile değerlendirildiğinde, sporcuların çoğu sağ mutlak ve rölatif, sol mutlak ve rölatif ve toplam mutlak ve rölatif el pençe kuvvetinde sıradan olarak sınıflandırıldı. Mutlak el pençe kuvveti düşünüldüğünde, uluslararası seviyedeki sporcular ulusal seviyedeki sporculardan daha iyi performans ortaya koydu, ancak ulusal seviyedeki sporcular rölatif performansta daha iyi sonuçlar ortaya koymuştur.

Anahtar kelimeler: Kuvvet, mücadele sporları, erkek sporcular, performans

INTRODUCTION

Handgrip strength (HGS) is defined as muscular strength and force generated by the hands (Koley & Singh, 2009) and is commonly used for clinical purposes to determine general health status and upper limb strength (Nicolay & Walker, 2005). It is also accepted very important to evaluate sport performance (Clerke, Clerke, & Adams, 2005).

Judo is a grappling combat sport from Japan which has been a part of Olympic Games since 1964. An athlete should have high level of such physical capacities as aerobic power and capacity, anaerobic power, muscle power and strength-endurance to be successful in judo (Franchini, Del Vecchio, Matsushigue, & Artioli, 2011). During a judo combat, athletes initially contact with their opponent by kumi-kata that is different gripping techniques applied to opponent's uniform (judogi). Grip is an important factor during a judo combat because it is a key factor for the judo athletes to apply a scoring action to the opponent (Calmet, Miarka, & Franchini, 2010; Farmosi, 1980). Therefore, it is of great importance for judo athletes to present high level of maximal isometric HGS.

A judo combat consists of constant dynamic changes, requiring athletes to use combination of maximal strength and endurance during grappling phase. It helps athletes control the distance between them and their opponents (Franchini et al., 2011). As the duration of a given judo combat is 4 min or more (golden score), muscle strength and endurance become more important to maintain strength for a long periods of time. Furthermore, judo also includes non-standing combat (ne-waza) where an athlete applies a chokehold, an arm lock or immobilization to defend his/her opponent during which maximal strength and muscular endurance are very important (Bonitch-Góngora, Bonitch-Domínguez, Padial, & Feriche, 2012).

Given that HGS is an important part of judo performance, many authors have studied it. Franchini, Schwartz, and Takito (2018) highlighted the need of classificatory table to evaluate judo athletes according to weight categories and applied maximal isometric HGS test to 406 male judokas and stated that absolute maximal isometric HGS increases from light to heavy weight categories while relative maximal isometric strength decreases vice versa. Moreover, they suggested that a single hand is enough to classify the athletes due to the high correlation between right and left hands. In contrast, Bonitch-Góngora et al. (2012) suggested difference between dominant and non-dominant hands stating that dominant hands of the judo athletes presented higher maximal HGS compared to non-dominant hands. In another study, Zaggelidis (2016) compared hand grip strengths of judo and karate athletes and found that judo athletes presented larger hand grip strength, which can be explained with the nature of the judo where athletes grip the opponents judogi in order to attack, defend and maintain balance and distance between themselves and their opponents (Margnes & Paillard, 2011). Kons, Detanico, Ache-Dias, and Dal Pupo (2019) investigated relationship between judo specific tests and match performance, stating that hand grip strength is significantly associated with time motion performance of the judo athletes during official competition in both lightweight and heavyweight athletes.

However, given that HGS is one of the most important elements in judo performance, the number of previous relevant studies are less (Franchini et al., 2018; Iermakov, Podrigalo, & Jaglello, 2016; Zaggelidis, 2016). Thus, the aim of this study was to determine maximal HGS of international and national level Turkish judo athletes and compare both groups according to maximal HGS classificatory table. The main hypothesis of this study was that international level athletes would present better performance and classification than national level judo athletes.

METHODS

Design

This study was descriptive and comparative that was conducted with adult male judo athletes. Athletes performed the maximal isometric HGS test using right and left hands. They executed this test 3 times with each hand, with 1-min intervals between attempts. The measurements of the international level judo athletes were carried out during a training camp while national level athletes participated in the study during their competitive period.

Subjects

Eighteen international (at least 3 years of experience as an international athletes and having medals at international tournaments including World/European Championships, Grand Slam/Prix and continental cups) and 16 national level (at least 3 years of experience in judo and participation in national tournaments and championships) judo athletes with black belts (Age=20.8±3.4, body mass=77.7±17.9, height=1.73±0.09, BMI=25.4±3.5) voluntarily participated in this study. Physical

characteristics of the athletes are given in Table 1. After informed about the nature of the study, all athletes signed an informed consent form. All measurements were held according to latest version of the Declaration of Helsinki.

Measurements

Body mass and body fat percentage were measured with bioimpendance device (BC-545, Tanita, Japan with 50 kHz frequency) and height was measured with a portable stadiometer (Seca 213, Germany), with 1 mm accuracy. The maximal isometric HGS was measured three times on each side with 1-min intervals with a digital dynamometer (Takei, Japan), with a 1 kilogram-force (kgf) accuracy. Athletes were told to generate the highest possible force for a period of 3-5 sec while in standing position and with self –selected wrist position and fully extended elbow. The highest value for each side was used for analysis. Also, relative values for each side, total and relative total values were also calculated by dividing the force generated with body mass of the athletes. The athletes' HGS performance were classified according to(Franchini et al., 2018). The dynamometer was set according to the recommendations by American Society of Hand Therapy (Mathiowetz, Weber, Volland, & Kashman, 1984). A researcher with extensive testing experience conducted measurements.

Statistics

Statistical analysis was carried out using SPSS 23 software. The data normality was checked with Shapiro-Wilk test and descriptive methods using skewness and kurtosis coefficients (Mishra et al., 2019). Data were described as mean and standard deviation after the confirmation of assumptions for the parametric statistics. Athletes were compared using Independent Sample T test. The effect size for independent sample T test was calculated and classified according to Cohen (1988) (0,20 small, 0,50 medium and 0,80 large ES). Relationships between variables were determined using Pearson correlation coefficient and classified according to (Hopkins, 2016) as 0,0 trivial; 0,1 small; 0,3 moderate; 0,5 large; 0,7 very large; 0,9 nearly perfect and 1 perfect. Significance was set at $p<0,05$.

RESULTS

Table 1 presents descriptive characteristics of international and national level judo athletes.

Table 1. Descriptive characteristics of the participants

Variables	International level (n=18)	National level (n=16)	t	P	d
Body mass	85,1 ± 17,9	69,3 ± 13,2	-2,94	0,006	0,50
Age	21,0±4	20,6 ± 2,7	-0,36	0,716	0,06
Height	1,76±0,09	1,70 ± 0,06	-2,16	0,038	0,40
Lean body mass (kg)	72,1±12,4	61,2±9,7	-2,38	0,025	0,51
Body fat (%)	12,2 ± 4,5	11,4 ± 4,2	-0,49	0,623	0,09
BMI	27,04 ± 3,22	23,74 ± 3,0	-3,09	0,004	0,53

There was significant difference in weight (p=0,006), right relative (p=0,022), left relative (p=0,022) and total relative (p=0,018) values of international and national level judo athletes. As for classification, the percentages of athletes for maximal isometric HGS are as follows: right hand= 38% Poor, 50% Regular, 5,56% Good, 5,56% Excellent (International level), 12,5% Very Poor, 18,75% Poor, 62,5 Regular, 6,25% Good (National level); right hand relative= 11,11% Poor, 72,22% Regular, 11,11% Good, 5,56% Excellent (International level), 12,5% Very Poor, 6,25% Poor, 50% Regular, 25% Good, 6,25% Excellent (National level); left hand= 5,56% Very Poor, 11,11% Poor, 72,22% Regular, 5,56% Good, 5,56% Excellent (International level), 12,5% Very Poor, 25% Poor, 56,25% Regular, 6,25 Good (National level); right relative= 11,11% Poor, 72,22% Regular, 11,11% Good, 5,56% Excellent (International level), 12,5% Very Poor, 6,25% Poor, 50% Regular, 25% Good, 6,25% Excellent; left relative= 5,56% Very Poor, 16,67% Poor, 77,78% Regular (International level), 18,75% Poor, 68,75% Regular, 12,5% Good (National level); total= 22,22% Poor, 61,11% Regular, 11,11% Good, 5,56% Excellent (International level), 12,5% Very Poor, 18,75% Poor, 62,5% Regular, 6,25% Good (National level); total relative= 5,56% Very Poor, 22,22% Poor, 72,22% Regular (International level), 18,75% Poor, 62,5 Regular, 18,75 Good (National level).

Table 2. Handgrip strength performances of the participants

HGS	International level (n=18)	National level (n=16)	t	P	d
Right (kgf)	48,7±8,4	46,3±10,9	-0,70	0,487	0,12
Left (kgf)	48,6±8,3	44,4±9,4	-1,39	0,174	0,23
Right relative (kgf/kg)	0,58±0,07	0,66±0,12	2,44	0,022	-0,42
Left relative (kgf/kg)	0,57±0,06	0,64±0,08	2,41	0,022	-0,5
Total (kgf)	97,4±15,7	90,7±20,1	-1,06	0,296	0,18
Total relative (kgf/kg)	1,15±0,12	1,30±0,20	2,53	0,018	-0,46

The correlations between body mass, BMI, LBM and absolute and relative HGS performances of the athletes can be found in Table 3. There were significant large and very large correlations between body mass and absolute right, left and sum HGS performances while there were significant moderate correlations between body mass and relative HGS performances (p<0,01). There were also large and very large correlations between BMI and absolute right, left and sum HGS performances while there were significant moderate correlations between BMI and relative right, left and sum HGS performances. As for correlations between LBM and HGS performances, there was significant moderate correlations between BMI and relative right, left and sum HGS (p<0,05) while there was no significant correlation between LBM and absolute right, left and sum HGS performances (p>0,05).

Table 3. Correlation between body mass, body mass index and maximal handgrip strength

	Right	Right relative	Left	Left relative	Sum	Sum relative
Body mass	0,69**	-0,41**	0,80**	-0,45**	0,77**	-0,44**
BMI	0,68**	-0,43**	0,77**	-0,42**	0,72**	-0,44**
LBM	-0,17	-0,44*	-0,66	-0,41*	-0,13	-0,45*

BMI: Body mass index; LBM: Lean body mass. *p<0,05; **p<0,01

DISCUSSION

This study aimed to determine HGS performance of international and national level judo athletes and show differences between them. The main findings of the study are as follows: international level judo athletes presented better absolute right and left HGS performance but national level athletes presented better relative HGS results and body mass and BMI and LBM positively correlated with absolute HGS performance while they correlated negatively with relative HGS performances.

As mentioned above, the most important finding of the study was that international level judo athletes presented higher absolute HGS performance, but when relative HGS is taken into account national level athletes' performance seem better. This stemmed from the difference in body mass of the athletes. Bonitch-Góngora, Almeida, Padial Puche, Bonitch-Domínguez, and Feriche (2013) indicated better performance in HGS of elite judo athletes in both sexes and concluded that HGS can differ athletes from different levels. However, the results can differ according to the method by which HGS is measured. (Franchini et al., 2011; Franchini, Takito, Kiss, & Strerkowicz, 2005). In s study where elite and non-elite athletes' HGS was compared, Franchini et al. (2005) stated right and left HGS performance of elite judo athletes as 51±10 - 49±10 kgf and non-elite athletes as 42±11 - 42±10 kgf. The authors reported that there was no significant difference in HGS between elite and non-elite athletes. In another study, the authors used two different techniques to measure HGS of judo athletes and they concluded dynamic judogi HGS test is better to discriminate between different levels compared to isometric HGS test (Franchini et al 2011). This may stem from the fact that dynamic HGS test requires sport specific ability.

HGS is affected by many factors such as age, sex, intracellular fluid rate, physical and physiological capacity and body mass as well as differences in levels of the athletes (Dias et al., 2012; Fallahi & Jadidian, 2011; Franchini et al., 2018; Franchini, Schwartz, & Takito, 2020; Leyk et al., 2007; Silva, Fields, Heymsfield, & Sardinha, 2011; Zaggelidis, 2016). In line with this explanation, our findings

indicate that body mass and BMI affected relative HGS performance. Franchini et al. (2018) stated that heavier judo athletes presented better absolute HGS performance compared to lighter judo athletes but when relative HGS was taken into account, lighter athletes' performance was better. The same findings were reported by another study where HGS performance of judo athletes from different age categories were investigated (Franchini et al., 2020). The authors stated a relationship between body mass and HGS. Moreover, absolute HGS performance of senior judo athletes were found higher than young judo athletes, which indicate age difference affects HGS performance. The increase in body mass can lead to an increase in HGS performance. This is explained with the increased muscle mass in high level athletes. Also, lean body mass is stated to be significantly associated with HGS performance (Leyk et al., 2007).

There may be differences in HGS performance according to training methods and the characteristics of a given sport. A study which investigated maximal isometric HGS performance of karate and judo athletes reported dominant HGS performance of judo athletes as 73.72±7.85kg and non-dominant hand as 71.34±8.10kg while karate athletes presented a HGS performance 68.28±7.3 with dominant and 63.28±7.50kg with non-dominant hand. In the light of these findings, judo athletes presented better HGS performance compared to karate athletes (Zaggelidis, 2016). The difference between karate and judo athletes may have stemmed from the characteristics such as controlling the opponent by holding the judo uniform and pulling/pushing the opponent during the judo trainings and matches (Dias et al., 2012).

HGS can also be affected by cellular and physiological differences as well as physical and individual differences among judo athletes. Silva et al. (2011) reported decreased HGS performance with decreased intracellular fluid. In judo, anaerobic energy contribution is stated to be higher due to fast and explosive technique attempts during the matches (E. Franchini et al., 2011). Following a judo match, judo athletes presented worse HGS performance compared to baseline due to the increased lactate concentration (Bonitch-Góngora, Bonitch-Domínguez, Padial, & Feriche, 2012).

This study had some limitations. The number of the participants for both group would be increased for more accurate results. Also, different ages and sexes can be included and athletes can be compared to according to their weight categories.

In conclusion, international level judo athletes presented better HGS performance in terms of right, left and total absolute HGS while national level judo athletes presented better values in relative HGS. Also, body mass, BMI and LBM significantly correlated with HGS performance.

REFERENCES

1. Bonitch-Góngora, J. G., Almeida, F., Padial Puche, P., Bonitch-Domínguez, J. G., & Feriche, B. (2013). Maximal isometric handgrip strength and endurance differences between elite and non-elite young judo athletes.
2. Bonitch-Góngora, J. G., Bonitch-Domínguez, J. G., Padial, P., & Feriche, B. (2012). The Effect of Lactate Concentration on the Handgrip Strength During Judo Bouts. The Journal of Strength & Conditioning Research, 26(7), 1863-1871. doi:10.1519/JSC.0b013e318238ebac
3. Bonitch-Góngora, J. G., Bonitch-Domínguez, J. G., Padial, P., & Feriche, B. (2012). The effect of lactate concentration on the handgrip strength during judo bouts. J Strength Cond Res, 26(7), 1863-1871. doi:10.1519/JSC.0b013e318238ebac
4. Calmet, M., Miarka, B., & Franchini, E. (2010). Modeling of grasps in judo contests. International Journal of Performance Analysis in Sport, 10(3), 229-240. doi:10.1080/24748668.2010.11868518
5. Clerke, A. M., Clerke, J. P., & Adams, R. D. (2005). Effects of hand shape on maximal isometric grip strength and its reliability in teenagers. Journal of Hand Therapy, 18(1), 19-29. doi:https://doi.org/10.1197/j.jht.2004.10.007
6. Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd Edition). New York: Routledge.
7. Dias, J. A., Wentz, M., Külkamp, W., Mattos, D., Goethel, M., & Júnior, N. B. (2012). Is the handgrip strength performance better in judokas than in non-judokas? Science & Sports, 27(3), e9-e14.
8. Fallahi, A. A., & Jadidian, A. A. (2011). The effect of hand dimensions, hand shape and some anthropometric characteristics on handgrip strength in male grip athletes and non-athletes. J Hum Kinet, 29, 151-159. doi:10.2478/v10078-011-0049-2
9. Farmosi, I. (1980). Body-composition, somatotype and some motor performance of judoists. J Sports Med Phys Fitness, 20(4), 431-434.
10. Franchini, E., Del Vecchio, F. B., Matsushigue, K. A., & Artioli, G. G. (2011). Physiological Profiles of Elite Judo Athletes. Sports Medicine, 41(2), 147-166. doi:10.2165/11538580-000000000-00000
11. Franchini, E., Schwartz, J., & Takito, M. Y. (2018). Maximal isometric handgrip strength: comparison between weight categories and classificatory table for adult judo athletes. J Exerc Rehabil, 14(6), 968-973. doi:10.12965/jer.1836396.198
12. Franchini, E., Schwartz, J., & Takito, M. Y. (2020). Maximal isometric handgrip strength in judo athletes from different age groups. Sport Sciences for Health, 16(1), 93-98.
13. Franchini, E., Takito, M. Y., Kiss, M. A. P. D. M., & Strerkowicz, S. (2005). Physical fitness and anthropometrical differences between elite and non-elite judo players. Biology of sport, 22(4), 315.
14. Hopkins, W. G. (2016). A new view of statistics. Retrieved from http://www.sportsci.org/resource/stats/index.html
15. Iermakov, S. S., Podrigalo, L. V., & Jaglello, W. (2016). Hand-grip strength as an indicator for predicting the success in martial arts athletes. Archives of Budo.
16. Koley, S., & Singh, A. P. (2009). An association of dominant hand grip strength with some anthropometric variables in

Indian collegiate population. Anthropol Anz, 67(1), 21-28. doi:10.1127/0003-5548/2009/0003
17. Kons, R. L., Detanico, D., Ache-Dias, J., & Dal Pupo, J. (2019). Relationship between physical fitness and match-derived performance in judo athletes according to weight category. Sport Sciences for Health, 15(2), 361-368. doi:10.1007/s11332-018-00524-y
18. Leyk, D., Gorges, W., Ridder, D., Wunderlich, M., Rüther, T., Sievert, A., & Essfeld, D. (2007). Hand-grip strength of young men, women and highly trained female athletes. Eur J Appl Physiol, 99(4), 415-421. doi:10.1007/s00421-006-0351-1
19. Margnes, E., & Paillard, T. (2011). Teaching balance for judo practitioners. Ido Mov Culture Journal Martial Arts Anthropometrics, 11, 42-46.
20. Mathiowetz, V., Weber, K., Volland, G., & Kashman, N. (1984). Reliability and validity of grip and pinch strength evaluations. The Journal of Hand Surgery, 9(2), 222-226. doi:https://doi.org/10.1016/S0363-5023(84)80146-X
21. Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. Annals of cardiac anaesthesia, 22(1), 67.
22. Nicolay, C. W., & Walker, A. L. (2005). Grip strength and endurance: Influences of anthropometric variation, hand dominance, and gender. International Journal of Industrial Ergonomics, 35(7), 605-618. doi:https://doi.org/10.1016/j.ergon.2005.01.007
23. Silva, A. M., Fields, D. A., Heymsfield, S. B., & Sardinha, L. B. (2011). Relationship between changes in total-body water and fluid distribution with maximal forearm strength in elite judo athletes. J Strength Cond Res, 25(9), 2488-2495. doi:10.1519/JSC.0b013e3181fb3dfb
24. Zaggelidis, G. (2016). Maximal isometric handgrip strength (HGS) in Greek elite male judo and karate athletes. Sport Science Review, 25(5-6), 320.