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Original

# Effect of *uchi-komi* prescribed as high-intensity interval training on Judo athletes

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ABSTRACT

*Objective:* The aim of this study was to analyse the effects of a period of training performing *uchi-komi* prescribed as high-intensity interval training on the performance of judo athletes.
*Method:* Twenty judo athletes performed *uchi-komi* prescribed as high-intensity interval training (HIT; n = 10) or auto-oriented *uchi-komi* (control; n = 10). The judo athletes participated in 3 sessions (60 min for day) of Judo training per week, totalizing 18 sessions in 6 weeks. High-intensity interval training was performed with 30 s of entry to judo technique (all-out) and 15 s of rest, two times per week for 6 weeks. Athletes performed 8 repetitions of high-intensity interval training in the first week, 10 repetitions in the second and third weeks, and 12 repetitions in the fourth, fifth, and sixth weeks. Pre and post training, athletes performed the Countermovement jump, Isometric judogi chin-up (isometric test), and Special judo fitness test.
*Results:* Special judo fitness test and isometric test showed interaction ($P$<0.01). Both the Control ($P$<0.01) and HIT groups ($P$<0.01) demonstrated improvement in the Special judo fitness test and isometric test. The Special judo fitness test presented a difference between groups at post ($P$<0.01) but not pre ($P$= 0.06). The isometric test presented a difference between groups at pre ($P$ = 0.03) and post ($P$<0.01). Countermovement jump did not demonstrate interaction ($P$<0.77).
*Conclusions:* Training using *uchi-komi* prescribed as HIT improved performance in the Special judo fitness test and isometric test, without changing power in the lower limbs of judo athletes.
*Key words:* Combat sport; Martial arts; Special judo fitness test; Isometric judogi chin-up; Countermovement jump.

## Efecto del uchi-komi prescrito como entrenamiento intervalado de alta intensidad en atletas de judo

RESUMEN

*Objetivo:* El objetivo del presente estudio fue analizar los efectos de un período de entrenamiento realizando *uchi-komi* prescrito como entrenamiento intervalado de alta intensidad en el desempeño de atletas de judo
*Método:* Veinte atletas de judo realizaron *uchi-komi* prescrito como entrenamiento intervalado de alta intensidad (HIT; n = 10) o *uchi-komi* auto-orientado (control; n = 10). Los atletas de judo participaron de 3 sesiones (60 minutos por día) de entrenamiento de judo por semana, totalizando 18 sesiones en 6 semanas. El entrenamiento intervalado de alta intensidad fue realizado con 30 segundos de entradas de técnicas de judo (*all-out*) y 15 segundo de intervalo, dos veces por semana durante 6 semanas. Los atletas realizaron 8 repeticiones de entrenamiento intervalado de alta intensidad en la primera semana, 10 repeticiones en la segunda y tercera semana y 12 repeticiones en la cuarta, quinta y sexta semana. Antes y después del entrenamiento, los atletas realizaron la prueba de salto vertical con contramovimiento, el *Isometric Judogi Chin-up* (prueba isométrica) y el *Special judo fitness test.*
*Resultados:* El *Special judo fitness test* y la prueba isométrica mostraron interacción (P<0,01). Ambos grupos, control (P<0,01) y HIT (P<0,01), demostraron mejoría en el *Special judo fitness test* y en la prueba isométrica. El *Special judo fitness test* presento diferencia entre los grupos en el momento post (P <0,01), mas no en el momento pre (P = 0,06). La prueba isométrica presento diferencia entre los grupos en el momento pre (P = 0,03), y en el post (P <0,01). El salto con contramovimiento no demostró interacción (P <0,77).
Conclusiones: El *Uchi-Komi* prescrito como HIT mejoró el desempeño en el *Special judo fitness test* y en la prueba isométrica, sin alterar la potencia de miembros inferiores de los atletas de judo.
*Palabras Clave:* Deporte de combate; Artes marciales; Special judo fitness test; Prueba isométrica; Salto vertical con contramovimiento.

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# Efeito do uchi-komi prescrito como treinamento intervalado de alta intensidade em atletas de judô

RESUMO

*Objetivo:* O objetivo do presente estudo foi analisar os efeitos de um período de treinamento realizando *uchi-komi* prescrito como treinamento intervalado de alta intensidade no desempenho de atletas de judô.
*Método:* Vinte atletas de judô realizaram o *uchi-komi* prescrito como treinamento intervalado de alta intensidade (HIT; n = 10) ou o *uchi-komi* auto-orientado (controle; n = 10). Os atletas de judô participaram de 3 sessões (60 min por dia) de treinamento de judô por semana, totalizando 18 sessões em 6 semanas. O treinamento intervalado de alta intensidade foi realizado com 30 segundos de entradas de técnicas do judô (*all-out*) e 15 segundos de intervalo, duas vezes por semana durante 6 semanas. Os atletas realizaram 8 repetições de treinamento intervalado de alta intensidade na primeira semana, 10 repetições na segunda e terceira semanas e 12 repetições na quarta, quinta e sexta semanas. Antes e depois do treinamento, os atletas realizaram o teste de salto vertical com contramovimento, o teste *Isometric judogi chin-up* (teste isométrico) e o *Special judo fitness test.*
*Resultados:* O *Special judo fitness test* e o teste isométrico mostraram interação (P <0,01). Ambos os grupos, Controle (P <0,01) e HIT (P <0,01), demonstraram melhora no *Special judo fitness test* e no teste isométrico. O *Special judo fitness test* apresentou diferença entre os grupos no momento pós (P <0,01), mas não no momento pré (P = 0,06). O teste isométrico apresentou diferença entre os grupos no momento pré (P = 0,03) e no pós (P <0,01). O salto com contramovimento não demonstrou interação (P <0,77).
*Conclusões:* O *uchi-komi* prescrito como HIT melhorou o desempenho no *Special judo fitness test* e no teste isométrico, sem alterar a potência de membros inferiores dos atletas de judô.
Palavras-chave: Esporte de combate; Artes marciais; Special judo fitness test; Teste isométrico; Salto vertical com contramovimento.

## Introduction

Judo is a high-intensity interval combat sport.[1,2] Official matches present sequences of ~20–30 seconds of a combat situation with ~5–10 seconds of pause.[1,2] The contests may have duration times of a few seconds to some minutes, with the match ending when one of the opponents scores with a decisive technique (*ippon*), scores more points (waza-ari) in four minutes of regular time, or through a golden score in supplementary time. The energy expended in Judo combats is predominantly provided by oxidative system, with important demand from the glycolytic system in gripping disputes and groundwork moments, and from the ATP-PCr system in actions that generate scores.[3] Consequently, high level competitive judo athletes present highly developed strength and endurance capacity.[4] Therefore, strategies to improve the specific physical demands of judo athletes are desirable to support good performance in contests.

High-intensity interval training (HIT) is one of the most effective methodologies for improving the aerobic and anaerobic performance of athletes.[5-7] HIT involves repeated short (<45s) or long (>1min) bouts of high-intensity activity with recovery periods.[5,7] Few studies have tested the use of the HIT method in judo training.[8,9] The studies that reported improvement in physical performance added HIT using a cycle-ergometer or *uchi-komi*[8,9] to traditional judo training. *Uchi-komi* is the repeated entry for different techniques, without throwing, which is part of a judo training session.[10] The purpose of *uchi-komi* is to improve the techniques and specific physical demands of Judo.[10] It may be performed in bouts of different lengths and using different techniques,[10] and usually, in the practice of the sport, the sequences are guided by tradition and expertise of the sensei. Although improvement in physical performance was reported when an additional HIT training session using *uchi-komi* was applied,[8,9] it is not known if only adjusting the habitual *uchi-komi* practice using the HIT method would improve the performance of judo athletes in specific physical tests. The advantage of performing the habitual *uchi-komi* prescribed as HIT is that it can be performed without spending additional time on training. This optimization of training may contribute to reducing accumulated fatigue and improving performance of athletes.[11]

The aim of this study was analysing the effect of a period of training performing habitual *uchi-komi* prescribed as a HIT method on performance in physical tests of judo athletes. The hypothesis raised was that 12 sessions performed in 6 weeks (2 times a week) of *uchi-komi* prescribed as HIT could improve the performance of judo athletes. This is in accordance with the necessary number of sessions and weeks of HIT training reported in the literature for improving performance.[7]

## Methods

### *Subjects*

Twenty judo athletes (15 male and 5 female) of the senior category (over 16 years) of a judo team participated in this study. The athletes were members of the Paranaense Judo federation, had a minimum of 2 years of experience in Judo practice, and had been competing in regional and/or national championships for a minimum of 1 year. Male and female athletes were separately randomized into two groups (HIT and control) using a simple draw. Therefore, 10 athletes (8 male and 2 female; 23.1 ±10.1 years, 75.6±18.3 kg body mass, and 1.77 ± 0.07 m height) composed the HIT group and 10 different athletes (7 male and 3 female; 19.1 ± 5.6 years, 72.8 ± 18.7 kg body mass, and 1.72 ± 0.11 m height) composed the control group. All athletes were free of injuries, and did not consume pharmacological treatments or ergogenic substances. The athletes were requested not to consume caffeine or substances containing alcohol for 24h before the evaluation days (pre and post). The ingestion of food and liquids was not controlled, but athletes were instructed not to change their habitual eating habits. This study was approved by a local ethics committee and athletes were informed of all procedures involved in the present study and signed a consent term prior to participation.

### *Procedures*

This is a clinical trial, in a randomized and controlled study, performed during the pre-competitive period for a regional championship. The judo athletes participated in 3 sessions (60 min for day; Monday, Wednesday, and Friday) of Judo training per week, totalizing 18 sessions in 6 weeks. All training sessions were conducted on the tatami. The sessions were performed in the following manner: warm-up (running, sit-ups, and jumping jacks), *ukemi* and *ukemi-waza* (rolling and falling cushioning), *uchi-komi* (entry for techniques), and *randori* (combat). The HIT group performed the *uchi-komi* (without throwing) part of the training oriented by HIT methodology in two sessions a week, totalizing 12 sessions in 6 weeks. The HIT training was performed with 30 s of entry for techniques and 15 s of rest, requiring maximal speed (all-out) and good application of the technique. In the first week, athletes performed a single set of 8 repetitions of *Osoto-gari* (total

of 5.75min). In the second and third weeks they performed a single set of 10 repetitions (total of 7.25 min) of *Osoto-gari* (5 rep.) and *Ippon-seoi-nage* (5 rep.), and in the fourth, fifth, and sixth weeks athletes performed a single set of 12 repetitions (total of 8.75 min) of *Osoto-gari* (6 rep) and *Ippon-Seoi-Nage* (6 rep). The control group performed a similar total time of *uchi-komi* (without throwing) in an auto-oriented manner, and the time and number of entries for techniques were not controlled. At pre and post 6 weeks, respecting 48 h without exercise, athletes performed the Countermovement jump test, the Isometric judogi chin-up, and the Special judo fitness test. Before these tests, athletes performed a warm-up similar to that performed in the training sessions (10 min of running, sit-ups, and jumping jacks).

The special judo fitness test (SJFT)[12] was performed in three periods (A, 15 s; B and C, 30 s) with 10 s intervals between them. During each period, athletes threw two opponents as fast as possible using the *ippon-seoi-nage* technique. The opponents presented similar height and body mass characteristics and were positioned in front of each other, separated by 6 m. Heart rate was measured at the end and 1 min post completion of the test using a heart rate monitor (Polar FT7, Polar Electro Oy, Kempele, Finland). The performance variable computed was the SJFT index, which was calculated as follows: Index= (HR post + HR 1 min post)/total number of throws. The previously reported intra-class correlation coefficient of the SJFT index is 0.89.[13]

For the isometric *judogi* chin-up test (Isometric test), the judo athletes maintained their grip on a *judogi* for as long as possible.[14] The *judogi* was rolled around a bar fixed at a height of 2.50 m. The test began with the athletes gripping the *judogi* with elbows flexed and chin above the hands. The time sustained in this position was registered using a chronometer that was started when the athletes were in the ideal position and stopped when athletes were not able to maintain the initial position (chin above the hands). The intra-class correlation coefficient (0.97) of this test has been reported previously.[15]

The countermovement jump (CMJ) test was performed on a jump contact mat (Cefise; Nova Odessa, SP, Brazil). The test began in the upright position, with arms akimbo. The athletes squatted and then jumped vertically at fast as possible to perform the jump with a stretch-shortening cycle. Three attempts were allowed, with an interval of 60 seconds between attempts. The best of the three jumps was retained for analysis.

*Statistics Analisys*

The results of the SJFT index, CMJ, and isometric judogi chin-up test at pre and post moments are presented as mean ± standard deviation (Parametric variables). A two-factor (time and group) generalized estimating equation technique (GEE) was performed for between, within, and interaction comparisons. When an interaction effect was found, the Bonferroni correction was performed. All analyzes were performed using IBM® SPSS® Statistics 21. The significance level adopted was p <0.05.

## Results

For the SJFT index and time in the isometric test, the GEE showed interaction, time, and group effects (Table 1). Both the Control ($P$<0.01) and HIT groups ($P$<0.01) presented improvement with training in the SJFT index and isometric test (Table 1; Figure 1). Furthermore, for the SJFT index, a difference was observed between groups at the post moment ($P$<0.01) but not at the pre moment ($P$ = 0.06; Table 1; Figure 1). For the isometric test, a difference was found between groups at pre ($P$ = 0.03) and post ($P$<0.01) moments (Table 1; Figure 1). For CMJ, the GEE did not demonstrate interaction, time, or group effects (Table 1).

## Discussion

The hypothesis raised in the present study was that 6 weeks of habitual *uchi-komi* prescribed as HIT could improve performance in judo specific physical tests of judo athletes. The results found confirm this hypothesis, since both the Control and HIT groups presented improvement in the SJFT index and time in the isometric test, with superior results found (and interaction effects) for HIT compared to the control.

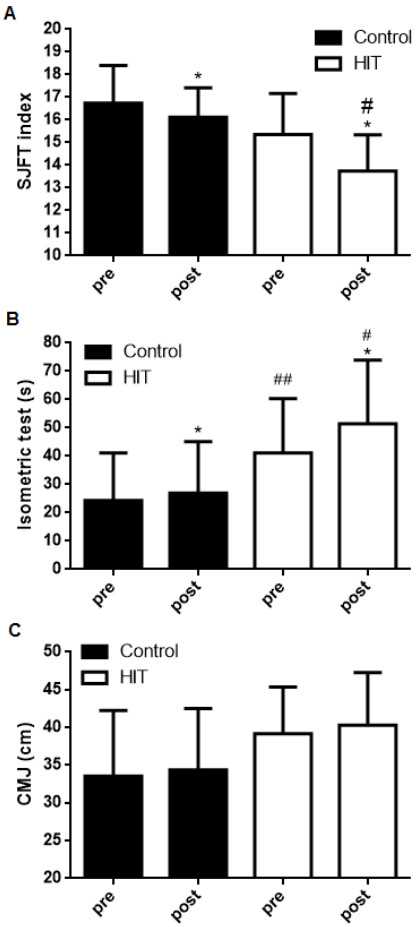


**Figure 1.** Special judo fitness test index (A), isometric judogi chin-up test (B), and countermovement jump test (C) at pre and post training in Control and HIT groups. Significantly different from pre (*P <0.01). Significantly different from control (# P < 0.01; (## P < 0.05).

**Table 1.** Special judo fitness test index, isometric judogi chin-up test, and countermovement jump test at pre and post training in Control and HIT groups.

| | Groups | Pre (mean ± SD) | Post (mean ± SD) | p Group | p Time | p Inter. |
|---|---|---|---|---|---|---|
| SJFT index | Control | 16.74 ± 1.67 | 16.11 ± 1.30 | <0.01 | <0.01 | <0.01 |
| | HIT | 15.35 ± 1.81 | 13.75 ± 1.60 | | | |
| Isometric test (s) | Control | 24.30 ± 16.79 | 26.90 ± 18.17 | =0.01 | <0.01 | <0.01 |
| | HIT | 41.10 ± 19.26 | 51.40 ± 22.57 | | | |
| CMJ (cm) | Control | 33.53 ± 8.72 | 34.36 ± 8.14 | 0.07 | 0.05 | 0.77 |
| | HIT | 39.19 ± 6.17 | 40.32 ± 6.95 | | | |

SJFT: Special judo fitness test; CMJ: countermovement jump; Pre: Pre training; Post: Post training.

The SJFT is based on the specific movements and time structure of a judo match[12] and is the most commonly used test to evaluate the match specific physical capacities of judo athletes.[9,16,17] Presenting high-intensity efforts and an intermittent nature, this test makes demands predominantly from the anaerobic alactic system, with an important contribution from the anaerobic lactic and oxidative systems, presenting similar demands to those imposed by judo combat.[18] In the present study, training with *uchi-komi,* both prescribed as HIT and auto-oriented, improved the SJFT of judo athletes. Furthermore, the results showed higher improvement in SJFT when *uchi-komi* was prescribed as HIT. This is in accordance with previous studies that reported improvement in physical performance of judo athletes submitted to additional HIT using a lower and upper body cycle-ergometer and *uchi-komi*.[8,9] The superior results shown in the SJFT after *uchi-komi* prescribed as HIT could be related to similarity between the physical demands of *uchi-komi* (performed in an intermittent all-out protocol) and judo matches.[10] This result suggests that performing *uchi-komi* two times per week for six weeks was sufficient to improve judo-match specific abilities of athletes. Therefore, it could be suggested that judo players and physical coaches could consider planning the *uchi-komi* in habitual judo training sessions using the HIT method.

Improvement in the isometric test of judo athletes as a response to uchi-komi training is reported for the first time in the present study. This is a relevant result since judo athletes spend approximately half of judo contests gripping the opponent.[2] Furthermore, a previous study suggests that athletes with higher isometric endurance grip strength present a greater number of attacks and show higher effectiveness in judo matches.[19] Improvement in isometric chin up during a periodized preparatory period has been reported previously.[20] However, in contrast to the reported study,[20] the present study did not include strength exercise during the training routine. It is possible that only the movements performed during the uchi-komi, which demands gripping the opponent during the technical execution, was sufficient to improve isometric endurance grip strength of judo players. This suggestion is reinforced by the superior results found for the HIT group, which possibly increased the number and intensity of technical entries in the uchi-komi. It is important to highlight that athletes recruited in the present study did not have experience in strength training. Since this suggestion has not been reported before, further studies should be performed to help explain the results found.

No effects were found for the CMJ test, suggesting that *uchi-komi* prescribed as HIT did not change power of the lower limbs of judo players. A previous study reported improvement in the CMJ test in young judo players following a short-term intensive judo training protocol that included a plyometric regimen.[21] This result leads us to suggest that the characteristic of training used in the present study, with only judo practices, without power and strength exercises, was not sufficient to improve power of the lower limbs of the subjects. Future studies should investigate if including power and strength exercises plus *uchi-komi* prescribed as HIT could improve power of the lower limbs of judo athletes.

Although previous studies have reported improvement in physical performance of judo athletes post a period of training with additional HIT using *uchi-komi*,[8,9] the novelty of the present study was that no additional training was included, only the habitual *uchi-komi* performed during the routine training, prescribed as HIT. The advantage of not including additional training is that it does not increase the time spent training, which may contribute to fatigue accumulation and related negative consequences.[11] It is important to highlight that the training load and other markers associated with fatigue accumulation were not reported in the current study and should be tested in the future.

From these results, judo athletes and coaches could consider manipulating the part of training intended for *uchi-komi* using the HIT method, in particular using similar protocols to those of the present study (8-12 X 30 s of all-out effort with 15 s of rest). For now, it is possible to conclude that training using habitual *uchi-komi* prescribed as HIT improves performance in the SJFT and isometric test without changing power of the lower limbs of judo athletes.

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