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Effect of Cervical Spine Manipulative Therapy on Judo Athletes' Grip Strength

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Abstract

Objective: The objective of this study was to perform an investigation evaluating if cervical spinal manipulative therapy (SMT) can increase grip strength on judo athletes in a top 10 national-ranked team.
Methods: A single-blinded, prospective, comparative, pilot, randomized, clinical trial was performed with 18 athletes of both sexes from a judo team currently competing on a national level. The athletes were randomly assigned to 2 groups: chiropractic SMT and sham. Three interventions were performed on each of the athletes at different time points. Force measurements were obtained by a hydraulic dynamometer immediately before and after each intervention at the same period before training up to 3 weeks with at least 36 hours between interventions.
Results: Analysis of grip strength data revealed a statistically significant increase in strength within the treatment group after the first intervention (6.95% right, 12.61% left) as compared with the second (11.53% right, 17.02% left) and the third interventions (10.53% right, 16.81% left). No statistically significant differences were found in grip strength comparison within the sham group. Overall differences in strength were consistently significant between the study groups ($P = .0025$).
Conclusion: The present study suggests that the grip strength of national level judo athletes receiving chiropractic SMT improved compared to those receiving sham. (J Manipulative Physiol Ther 2012;35:38-44)
Key Indexing Terms: *Martial Arts; Manipulation, Spinal; Chiropractic; Athletic Performance*

The competitive and dynamic atmosphere of professional sports generates a wide field in which new therapeutic techniques have a great potential for growth and development once their efficacy is showed to optimize sports performance.[1] Complementary/alternative and traditional medicine (CAM/TM) usage among athletes has been poorly studied, and recent investigations have been focused on the prevalence of their use and other descriptive approaches.[1-3] In a Hawaiian university, 56% of athletes had reported the use of 1 or more types of CAM/TM. The 2 major types of CAM/TM used in this setting seem to be massage (prevalence of 38%) and chiropractic (prevalence of 29%).[2]

When wide-ranging populations are considered, the usage of CAM/TM has increased in the last decade in various countries.[4] The chiropractic profession is considered as one of the most important CAM/TM professions, with use rates in the general population ranging from 6% to 12%, with spinal manipulative therapy (SMT) as its most commonly used therapeutic approach.[5,6] Spinal manipulative therapy is considered an effective and safe therapy for musculoskeletal disorders[7] with significant results in both short and long term.[8-14] It is consisted of a specific high-velocity, low-amplitude application of force beyond the end of passive range of motion and inside the zone known as paraphysiological space.[5] Several studies have evaluated adverse effects and potential severe outcomes from SMT, and the results indicate that SMT is comparatively a safe procedure when performed with patients without contraindications.[4,15-19]

Spinal manipulative therapy generates neuromuscular reflex responses in a surface electromyography in patients with low back pain,[22] increases quadriceps' strength after manipulation of the ipsilateral sacroiliac joint,[23] and causes temporary excitatory inhibition of lumbar and cervical motoneurons.[26] Spinal manipulative therapy has influenced a significant reduction of tumor necrosis factor α and

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interleukin 1β (proinflammatory cytokines) production when compared with placebo and other control groups[24] and has also induced a significant reduction of pain and hyperalgesia in an experimental study with SMT instrument-assisted (Activator Methods International, Ltd, Phoenix, Arizona) performed in rats.[25] In the current study, the hypothesis that cervical SMT would increase grip strength when performed in national level judo athletes was tested.

The United States has officially used chiropractic care in the Olympic Games since 1980.[1] The Brazilian Olympic Committee has been using sports chiropractic care since 2000 in their major competitions such as the Olympics and Pan American Games. During the 2007 Pan American Games in Rio de Janeiro, 209 chiropractic-based treatments were performed for 95 athletes within a total of 660 Brazilian competitors (14.40%). At the 1995 All African Games, 1135 athletes were treated by doctors of chiropractic within 6000 athletes, with a total of 1957 chiropractic treatments being performed. Most of the treatments were performed on track and field athletes (38%) followed by fighting sports (14.7%).[20] Another study revealed that 77% of the coaches from the American National Football League refer athletes to chiropractic care, and 31% of the teams officially have a chiropractor as part of their medical team.[1] Thus, there is a precedence for inclusion of chiropractic care for high-performance athletes.

Judo is an intense martial art sport that can potentially cause injuries that may result in loss of strength, which is detrimental to sports performance. A recent study analyzing 3 consecutive judo championships revealed an increase of 13.5% in the incidence of injuries, with no differences between sex or weight categories of the athletes. The most common location in men were at the fingers, whereas the shoulders were more commonly associated with injury among women.[21] These findings suggest that judo may be a sport in which the impact of chiropractic therapies on the athletic performance can be tested.

Spinal manipulative therapy is growing in sports treatment, and when performed by a highly trained professional,[4] it can serve as a useful therapeutic option for the treatment of joint biomechanical dysfunctions, especially of the spine.[22-25] However, this technique has primarily been used with therapeutic aims, and little is known if it can be used as a potential sports performance enhancer.

Therefore, this study evaluated the effects of chiropractic cervical SMT[4,5] on grip force among Brazilian judo athletes who were competing on a national level.

Methods

Trial Design

A pilot clinical trial, with balanced randomization (1:1), single blind, and placebo controlled, was performed to test the influence of SMT on grip strength of judo athletes of a top 10 national-ranked judo team.

Subjects

Brazilian athletes from a national competing level judo team volunteered to the study. This group includes athletes from both sexes with a 5-day training program per week. The group was approached, and the athletes were interviewed to verify inclusion and exclusion criteria. Eighteen individuals were recruited (72% of the total invited). The participants were randomly assigned into 2 groups of 9 subjects each, with group 1 receiving SMT and with group 2 getting sham procedures. The study was registered under the International Standard Randomised Controlled Trials Number (ISRCTN) 38228413. The study was approved by the ethics committee of the Faculdade de Tecnologia e Ciências, Salvador, Brazil (register no. 904). All participants or their legal guardians signed informed consent before enrollment in the study.

Inclusion and Exclusion Criteria

The inclusion criteria were age ranging from 15 to 30 years, regular attendance to training and competing sessions for at least 4 days a week, never receiving chiropractic care, possessing no prior knowledge of chiropractic procedures, and no change of medical or physical routine because of the addition of the new procedures.

The exclusion criteria were spine anomalies, such as hypoplasia or instability of the odontoid process; acute fracture or infections; cancer; local hematoma; signs of progressive neurologic deficit; Arnold-Chiari malformation; vertebral dislocation; signs of meningeal irritation; and signs of joint instability.[4,15,16]

Study Design and Setting

The study took place at the team training facilities in Salvador, BA/Brazil in June 2009. All athletes answered a survey before the randomization and then were randomly assigned following simple randomization procedures (flip of a coin) to 2 groups. The subjects allocated in the group 1 (n = 9) were treated with standard chiropractic cervical diversified technique SMT, and group 2 (n = 9) had received a standardized sham intervention.

Spinal manipulative therapy intervention consisted of static and motion cervical joints analysis, with the patient lying supine, and areas of motion restriction received specific contact high-velocity, low-amplitude manipulation consisting of standard chiropractic diversified techniques to the cervical spine.

Sham intervention was performed using the head piece drop mechanism of a Thuli Table (Thuli Tables Inc, Dodgeville, WI). This procedure consisted of having the patient lying prone, and the drop mechanism was performed 3 to 5 consecutive times, having the contact force of the chiropractor applied directed to the head piece and not contacting the subject neck.

The study evaluated grip strength variations after 3 SMT interventions or sham procedures. Data were analyzed for SMT effect when comparing strength baseline values and after interventions within the same group (treatment or sham intervention) and also between groups.

Three interventions were performed in each group in a maximum time frame of 3 weeks with a minimum interval of 36 hours between sessions. Both groups had also received in a similar way the same amount of time expended in each intervention including patient education regarding the treatment and its potential side effects. The same chiropractor performed all interventions on all athletes for both the treatment and sham groups. The chiropractic practitioner was experienced, having a bachelor's degree in chiropractic with at least 3 years of clinical practice.[4] A trained technician performed the strength measurements without knowing which group each subject was assigned.

Strength measurement was done in both groups before and at least 20 seconds after each intervention using a JAMAR 5030J1 hydraulic dynamometer (Sammons Preston Inc, Bolingbrook, IL).[26] Data were taken in a more natural position for judo demands, with the subject standing, arms close to the trunk, 90° of elbow flexion, and internal rotation of 45° of the wrist and hand. Athletes were then asked to have a maximum isometric grip contraction, 1 side each time, for 3 consecutive times, with a 20-second interval between measurements.[26] For analysis purpose, the arithmetic mean of all 3 measurements was taken.

Data were recorded in differently colored files for before- or after-intervention measurements in kilograms/force. Discrepancy between measurements higher than 3 dynamometer measurement units (that represents 2 kg each or 6 kg on total) was considered invalid, and all 3 strength data were collected again. Measurements that had been higher than 1 dynamometer measurement unit (2 kg) without reaching the next unit were considered as the value of the exceeded one. The very same procedure was also performed in the superior limb of the opposite side.

All interventions and measurements were performed before training sessions between 14:30 and 16:00 hours, with the purpose of minimizing training lesions interference and the hormone effects of the circadian cycle and its potential effects on athletes muscle strength.[27] Subjects were asked to not comment among them what were the characteristics of the procedure they were submitted to.

Statistical Analysis

Data analysis was performed with GraphPad Prism software 5.0 (GraphPad Inc, La Jolla, CA). For baseline questionnaires' analysis, Fisher exact test was used, and no significant differences were founded between groups, showing adequation of the randomization process allowing both groups to have similar characteristics.

Table 1. *Baseline characteristics of the study subjects*

Variable	Sham (n = 9) f	(%)	SMT (n = 9) f	(%)	*P* value, Fisher exact test
Male sex	5	55.5	4	44.4	1.00
Age, y					.33
15-20	4	44.5	7	77.8	
>20	5	55.5	2	22.2	
Judo experience, y					1.00
0-10	5	55.5	5	55.5	
>10	4	44.5	4	44.5	
Previous chiropractic knowledge					1.00
Yes	2	22.2	1	11.1	
No	7	77.8	8	88.9	
Currently disputed tournament level					1.00
National	9	100	8	88.9	
International	0	0	1	11.1	
Actual pain episode					1.00
Yes	9	100	9	100	
No	0	0	0	0	
No. of previous pain episodes					.33
0-3	7	77.8	4	44.5	
>3	2	22.2	5	55.5	

Despite the small sample size, the data distribution regarding the strength measurements among groups displayed Gaussian distribution (Lilliefors test), and paired *t* test was chosen for strength variations statistical analysis. We also compared percentile measurements variations between groups, as displayed in Tables 4 and 5, which had also displayed Gaussian distribution, and paired *t* test was used with Welch test correction (Table 6).

Results

Survey data analysis revealed that randomization process was successful, and both groups ended up having subjects with the same characteristics. Male sex was observed in 55.5% (n = 5) of the sham group (group 2) and in 44.4% (n = 4) of the SMT group (group 1). Other important variables were age, judo experience, chiropractic previous knowledge, current level of tournament dispute, and actual and previous pain episodes (summarized in Table 1), with no statistical significant differences between groups (Fisher exact test). None of the athletes in both groups had been previously submitted to chiropractic care.

A total of 55 cervical biomechanical adjustments were performed using SMT of the 27 interventions in the 9 athletes from group 1. More commonly affected joints were C1 and C2 (n = 27), representing 49.09% of total adjustments, with 7.27% of C3 and C4 (n = 4), 25.45% of C5 and C6 (n = 14), 12.72% of C6 and C7 (n = 7), and 5.45% of C7 to T1. No adjustments were performed at the C2 and C3 and C4 and C5 joints. Two side-effect episodes at SMT group (group 1) was recorded: a mild neck pain and a mild headache were reported after 3 to 6 hours after adjustments lasting less than 12 hours each. There was no

Table 2. *Strength measurements for SMT group in kilograms/force*

	PRE 1R	PRE 1L	PRE 2R	PRE 2L	PRE 3R	PRE 3L	POST 1R	POST 1L	POST 2R	POST 2L	POST 3R	POST 3L
1	32.0	32.7	31.3	33.3	39.3	36.7	32.7	35.3	41.3	40.7	42.7	39.3
2	26.7	28.7	28.0	30.7	293	26.7	29.3	29.3	30.7	30.0	28.7	26.0
3	24.7	22.7	23.3	21.3	25.3	25.3	28.0	26.0	25.3	24.7	28.0	27.3
4	40.0	40.7	48.0	50.7	36.0	43.3	44.7	51.3	49.3	53.3	42.7	46.0
5	46.0	43.3	55.3	50.0	52.7	52.7	47.3	45.3	52.7	47.3	58.7	54.7
6	30.7	29.3	29.3	31.3	35.3	34.7	34.7	32.0	32.0	34.0	32.7	34.0
7	34.0	30.7	32.0	31.3	34.0	32.0	33.3	31.3	33.3	34.0	32.7	33.3
8	52.0	43.3	55.3	50.0	60.7	57.3	55.3	48.7	56.7	55.3	57.3	56.0
9	49.3	46.0	50.7	53.3	49.3	50.7	53.3	58.0	52.7	52.0	47.3	54.0
Mean	37.3	35.3	39.3	39.1	40.2	39.9	39.8	39.7	41.6	41.3	41.2	41.2
SD	10.0	8.2	12.8	11.8	11.6	11.6	10.4	11.3	11.6	11.2	11.6	11.9

There was no significant discrepancy between strength measurements from different arms before and after each intervention (paired *t* test).
L, left; *R*, right; *PRE*, pre intervention; *POST*, post intervention.

Table 3. *Strength measurements for the sham intervention group in kilograms/force*

	PRE 1R	PRE 1L	PRE 2R	PRE 2L	PRE 3R	PRE 3L	POST 1R	POST 1L	POST 2R	POST 2L	POST 3R	POST 3L
1	28.7	29.3	27.3	31.3	27.3	32.7	29.3	34.0	30.7	32.0	31.3	32.7
2	30.0	26.0	23.3	26.0	26.7	28.7	31.3	28.7	22.0	24.0	28.7	29.3
3	50.0	48.7	45.3	47.3	51.3	49.3	51.3	52.0	48.7	46.0	50.7	48.7
4	43.3	43.3	56.7	48.7	47.3	44.0	44.7	40.0	54.7	44.7	52.7	44.0
5	45.3	49.3	48.0	48.0	46.7	50.7	48.7	48.7	48.0	50.0	49.3	50.0
6	56.7	54.7	54.0	52.0	62.7	58.0	58.0	54.7	58.0	56.7	61.3	55.3
7	26.7	21.3	28.7	27.3	28.0	28.7	26.0	24.0	28.0	28.0	28.0	27.3
8	22.0	23.3	23.3	24.7	22.0	22.7	23.3	24.7	23.3	24.0	22.7	21.3
9	48.0	42.0	59.3	50.7	50.0	48.0	46.0	35.3	54.7	47.3	46.0	44.0
Mean	39.0	37.6	40.7	39.6	40.2	40.3	39.8	38.0	40.9	39.2	41.2	39.2
SD	12.3	12.6	14.9	11.8	14.3	12.3	12.5	11.6	14.7	12.3	13.6	11.8

There was no significant discrepancy between strength measurements from different arms before and after each intervention (paired *t* test).
L, left; *R*, right; *PRE*, pre intervention; *POST*, post intervention.

Table 4. *Strength comparisons immediately before and after interventions in the SMT group*

Intervention	Mean: Prior mean kg/force	Mean: Post mean kg/force	Before and after mean difference (%)	*P*
First intervention R	37.256	39.847	6.954	.002
First intervention L	35.254	39.701	12.614	.013
Second intervention R	39.256	41.551	5.846	.070
Second intervention L	39.107	41.256	5.495	.079
Third intervention R	40.218	41.180	2.391	.468
Third intervention L	39.921	41.183	3.161	.058
First × second intervention R	37.256	41.551	11.528	.007
First × second intervention L	35.254	41.256	17.025	.002
First × third intervention R	37.256	41.180	10.532	.047
First × third intervention L	35.254	41.183	16.817	.005

Data were compared using paired *t* test.
L, left; *R*, right.

report of side effects on group 2 (sham intervention). Strength measurement data from both groups were recorded on Tables 2 and 3.

Analysis of the SMT group revealed a statistically significant increase of grip strength in both hands after the first intervention (mean increase of 6.95% at the right hand and 12.61% on the left one). Significant differences were also found when baseline (before first intervention) was compared with strength data registered after the second and third interventions, revealing a final increase 10.53% on the right side and 16.82% on the left hand after the third intervention. No significant statistical differences were founded when comparing strength measurements immediately before and after the second and third interventions (Table 4).

Group 2 (sham intervention) data analysis revealed no statistically significant differences among grip strength measurements in all interventions and when they were combined (Table 5).

Table 5. *Strength comparisons immediately before and after in athletes receiving sham therapy*

Intervention	Mean		Before and after mean difference (%)	*P*
	Prior mean kg/force	Post mean kg/force		
First intervention R	38.960	39.848	2.279	.111
First intervention L	37.552	37.996	1.182	.720
Second intervention R	40.663	40.885	0.545	.822
Second intervention L	39.552	39.183	−0.932	.694
Third intervention R	40.218	41.181	2.394	.344
Third intervention L	40.292	39.182	−2.754	.051
First × second intervention R	38.960	40.885	4.940	.304
First × second intervention L	37.552	39.183	4.343	.146
First × third intervention R	38.960	41.181	5.700	.091
First × third intervention L	37.552	39.182	4.340	.070

Data were compared using paired *t* test.
L, left; *R*, right.

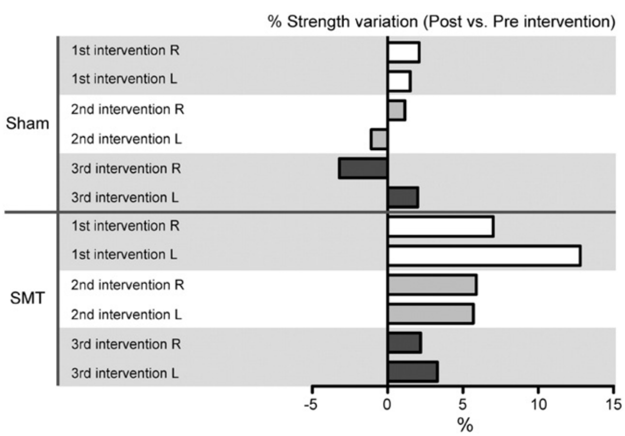

Fig 1. *Percentage of strength variation after each intervention. Data represent the percentage of strength variation after each intervention for both arms of the athletes.*

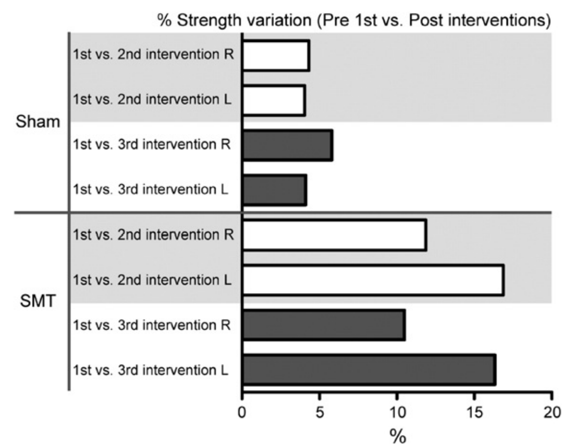

Fig 2. *Spinal manipulative therapy optimizes grip strength in judo athletes. Data represent the percentage of strength variation after each intervention compared with baseline (prefirst intervention) for both arms of the athletes.*

Furthermore, a graphic analysis was performed, on Figures 1 and 2, to compare grip strength variation between SMT group (group 1) and sham (group 2). A consistent increase in these values can be observed in group 1 when compared with group 2, and 2 strength reductions can be registered at the left hand after the second and third interventions in group 2. These nonstatistically significant results found were not observed in any strength data recorded in group 1.

A greater increase on the grip strength at the left hand was observed when compared with the right one among subjects who received SMT (group 1) in all measurements, except for the second one, which had similar end points. This difference was compared and revealed to be nonsignificant ($P = .6777$). When discrepancies were analyzed between the left and right hand on group 2 (sham), a greater strength increase at the right hand in all interventions measurements was found. All variations observed between hand sides in both groups were not statistically significant, which means that they occurred by chance.

Percentile measurements variations between groups, as described in Tables 4 and 5, were also analyzed according to Table 6, revealing a *P* value of .0025.

Discussion

Both nonprofessional and high-performance sports involve a high demand for athletic performance enhancement. A better athletic performance can be achieved by shortening recovery time and lesion incidence and by improving specific athletic function. This peculiar characteristic impulses a high demand for quality research focusing on performance enhancement.[1,5]

There are few studies that evaluate the effects of SMT in athletes, and we could not find similar studies performed within judo athletes in the literature. The present study adds important insights to the field, pointing the SMT as a promising approach to enhance grip strength in judo athletes.

The statistically significant increase in the grip strength observed in both hands on group 1 might be due to the already-observed SMT effects in inducing vertebral motion with concomitant spine nerve root responses and increase in muscle strength.[28,23] In our study, the primary involved nerves targeted using the SMT approach are

Table 6. *Percentile variation comparisons between groups as described in Tables 4 and 5*

Before and after interventions difference, SMT group (%)	Before and after interventions difference, sham group (%)
6.95	2.28
12.61	1.18
5.85	0.55
5.50	−0.93
2.39	2.39
3.16	−2.75
11.53	4.94
17.03	4.34
10.53	5.70
16.82	4.34

Mean percentile differences were compared between the groups using paired *t* test with Welch correction, $P = .0025$.

musculocutaneous (cervical roots C5, C6, and C7), which innervates biceps muscle; median (C5, C6, and C7 roots), which innervates forearm anterior muscles and thumb short muscles; and ulnar nerve (C8 and T1), which supplies ulnar carpal flexor, the ulnar half of the deep finger flexors, thumb adductor, and the deep part of its short flexor.[29]

Other previously related SMT effects include quadriceps strength increase,[23] neuromuscular reflex response in surface electromyography,[22] lumbar and cervical motoneuron temporary inhibition,[26] and modulation of proinflammatory cytokines (tumor necrosis factor α and interleukin 1β).[24]

An important positive aspect concerns the chosen methodological rigidity to obtain strength measurements using only 1 dynamometer, always performed immediately before and after each intervention and before training sessions in the same period and in a small time frame of 3 weeks. We believe that this had a positive influence in minimizing effects of the circadian cycle hormonal influence and possible microtrauma and tissue fatigue due to training and competition.[27] Another favorable point on sample uniformity is the regular daily training basis of the team and the high level of athlete competition (national) of all the study subjects.

Limitations

Potential limitations of present study include the small sample size, great difference among interventions characteristics, athlete communication regarding applied procedures, and its potential interference on placebo effect. On the other hand, none of the subjects had been previously treated by chiropractic, and knowing that 77.8% of all individuals of the sham group (group 2) and 88.9% of the treatment group (group 1) had never heard the term *chiropractic* makes it unlikely to infer that they knew what type of procedure they were being subjected to (sham or treatment) and its potential negative influence over the placebo effect.

Another aspect when dealing with high-performance teams is the constant pressure and demand on the health care personal for a quickly return to play and urgent implementation of any potential performance enhancer to all athletes. The way we have found to be beneficial in dealing with this outward pressure and properly conduct a randomized clinical trial is to do it in a small limited time (3 weeks) and letting the team understand the importance of studies such as that for future greater sports development.

Other potential limitation appears when the athletes change their usual training and treatment routine because of the addition of new procedures. That can lead to study bias and outcome changes. We have stated to all team members to not change their routine, as the purpose was to add additional interventions and not to replace them. As far as we could observe, the athlete routine was kept similar before, after, and at the end of the study.

Future Studies

The findings of this study add important insights to the sports performance field because it shows a marked grip strength increase in elite judo athletes after being submitted to cervical SMT. It can be translated as a potential marked performance enhancer once grip strength is a vital aspect of judo combats.

In that way, it is important to do similar studies in larger judo athlete samples and in other high-performance level athletes of different sports, trying to observe if SMT can also have a positive influence on performance in other modalities.

Conclusions

The present study tested the effect of chiropractic SMT on elite judo athletes' grip strength and found a significant increase in grip strength for those submitted to the SMT compared with those getting sham interventions. In addition, subjects in the SMT group had achieved significant and progressive enhancement of the grip strength with the first, second, and third interventions. Future studies are encouraged to validate our results in larger samples of high-performance athletes.

Practical Applications

- This study showed that cervical SMT increased elite judo athletes' grip strength.
- This study suggests that chiropractic SMT may affect athletic performance.

Funding Sources and Potential Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

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