The Effects of Tournament Preparation on Anthropometric and Sport-Specific Performance Measures in Youth Judo Athletes

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[1]*Metabolic and Body Composition Laboratory, Department of Health and Exercise Science, University of Oklahoma, Norman, Oklahoma;* [2]*Sport and Exercise Science Program, University of Central Florida, Orlando, Florida; and* [3]*Department of Exercise and Sport Science, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina*

Abstract

Fukuda, DH, Stout, JR, Kendall, KL, Smith, AE, Wray, ME, and Hetrick, RP. The effects of tournament preparation on anthropometric and sport-specific performance measures in youth judo athletes. *J Strength Cond Res* 27(2): 331–339, 2013—The purpose of this study was to characterize the adaptations imposed by 4 weeks of precompetition judo training in youth athletes. It was hypothesized that anthropometric and sport-specific performance would improve during the preparation for a junior national championship event. Twenty youth athletes (mean ± *SD*; chronological age: 13.1 ± 3.2 years; training age: 5.3 ± 3.5 years; judo experience: 7.8 ± 2.5 hours per week) completed pretesting and posttesting procedures. Child (12 years old; $n = 8$) and adolescent (13 years old; $n = 12$) groups were evaluated to determine the anthropometric and sport-specific performance changes caused by 4 weeks of judo training conducted in preparation for the junior national championships. The child group showed an increase in flexibility (11.5%), and the adolescent group showed a decrease in skinfold thickness (−12.2%); increased jumping power (26.7%), force (7.7%), and velocity (19.0%); and improved judo-specific ability (−5.9%), as measured by the Special Judo Fitness Test (SJFT) index. Additionally, the SJFT index for all the study participants was shown to be inversely correlated to handgrip strength ($r = -0.681$), rope pull performance ($r = -0.545$), and jump height ($r = -0.503$). These results support the use of preparatory judo training in the improvement of anthropometric and sport-specific measures in adolescent athletes. Furthermore, the outcomes from this study provide direction for coaches and trainers in their efforts to impact physical performance and judo skills in children and adolescents through precompetition training.

Key Words children, adolescents, martial arts, exercise, body composition, jump ability

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27(2)/331–339

Journal of Strength and Conditioning Research

Introduction

The early specialization of youth athletes and the growing availability of high-level sporting events to younger competitors have led to increased focus on adaptations to physical training (3,11). As the stakes of competition have escalated and the relative skill levels of the youth athletes have improved, training intensity and time commitments have concomitantly increased (2,31). Particular focus has been given to athletes during periods of development in which growth and maturation may present both threats and opportunities to exercise. As a result, the long-term athlete development model has been established that suggests training philosophies that may be adopted for these developmental stages in the activities of children and adolescents (11). Two of the early stages of this model are the “learning-to-train” and “training-to-train” periods that begin around 8–9 years of age and end at 15–16 years of age, with the demarcation point between the two occurring near puberty (3).

The long-term athlete development model suggests that physical literacy or development of motor capabilities may occur at the learning-to-train level in youth athletes. Although measurable physiological results may not be present, underlying technical and sport-specific developmental skills may be acquired to improve future performance (11). Furthermore, research has shown that children that are exposed to a continued training stimulus at an early age may develop complex skills when compared with a free play environment (9). The learning-to-train stage is characterized by the development of fundamental motor skills, whereas the training-to-train stage is characterized by an increase in physiological adaptations hastened by the presence of increased androgen concentrations (11). Learning-to-train builds a solid base for a training-to-train stage, which encompasses physical, cognitive, and emotional development in competitive sports. Most of the current research involving youth athletes centers on later stages of the long-term athlete development model, specifically "training to compete" or "training to win," which generally occur after the age of 16 years, and further investigation involving sport-specific training is needed in the earlier domains of this model.

The martial art and combat sport of judo has been included in the Olympic Games since 1964 (29) and was recently a part of the first Youth Olympics held in 2010. The physical demands of judo are complex, and the physiological characteristics of judo athletes have been thoroughly reviewed by Franchini et al. (12). These characteristics are the result of judo training that requires participants to engage in intermittent bouts of activity during which strength, power, balance, and coordination are needed to throw an opponent to the ground or impose submission via pin, choke, or arm lock. Strategy is involved to execute technique while engaging the opponent through the use of gripping the uniform (judogi) and avoiding subsequent reactions and attacks. Although physical activity in children and adolescents is recommended for general health (37), judo training in youth athletes has also shown to improve aerobic and anaerobic capacity, flexibility, strength, power, and body composition, while enhancing motor learning and cognitive performance (18).

According to Bompa (6), in order to reach a high performance standard, the specific age to begin judo training is between 8 and 10 years and the age to specialize is 15–16 years. These recommendations encompass the learning-totrain, training-to-train, and training-to-compete periods as outlined by the long-term athlete development model (3). There is limited research involving judo-specific training adaptations during these physiological and technical developmental stages. The purpose of this study was to characterize the adaptations imposed by 4 weeks of intensive preparatory judo training in youth athletes, with the hypothesis that anthropometric and sport-specific performance would improve during the preparation for a junior national championship event. A secondary purpose of this investigation was to evaluate differences in adaptations to the tournament preparation between child and adolescent judo athletes.

Methods

Experimental Approach to the Problem

The testing measurements for this study were completed before and after preparation for the USA Judo Junior National Championships. Body composition, flexibility, handgrip strength, jump performance, rope pull performance, and judo-specific ability were assessed in a single day during baseline testing and posttesting. The junior national championships was the second major tournament of the year for the youth athletes. The 4-week training period examined during this study began 6 weeks before (early June) and concluded 2 weeks before (early July) the date of the competition (mid-July). This design was selected to limit the potential effects on performance testing that may have been introduced by any attempts to lose weight before the tournament.

All testing occurred in the morning and participants were asked to be in a fasted and euhydrated state. Participants were allowed to ingest food and water ad libitum before completing the Special Judo Fitness Test (SJFT). Testing procedures were conducted in the same order for both baseline and posttesting measurements (Figure 1), and efforts were made to maintain the same groups for the SJFT. Participants wore athletic clothes for all testing measurements, with the exception of the SJFT, during which they sported their judo uniform(judogis). To minimize possible physical risks associated with testing, all testing was completed by strength and conditioning specialists certified in first aid and cardiopulmonary resuscitation. The Institutional Review Board of the University of Oklahoma Health Sciences Center approved all procedures conducted during this study, and informed consent was obtained from both the participants and their parents or guardians.

Subjects

Participants were 7 to 19 year old volunteers (mean 6 SD; chronological age: 13.1 ± 3.2 years; training age: 5.3 ± 3.5

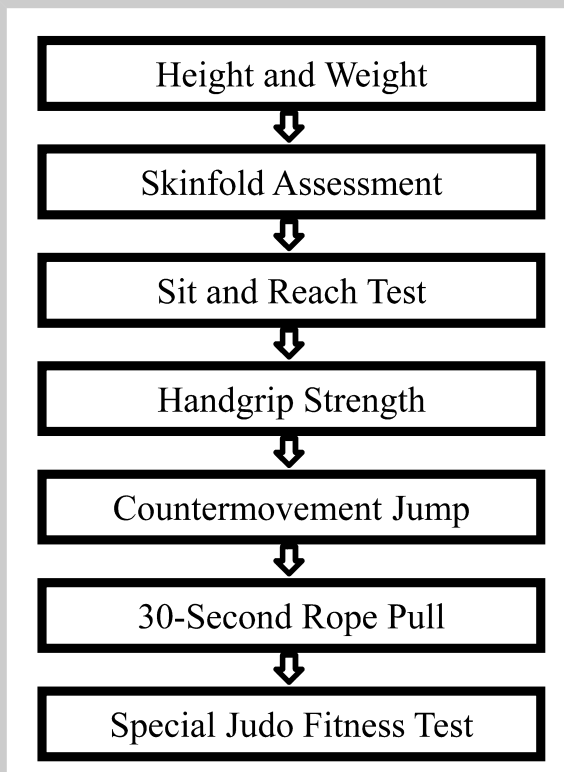

Figure 1. Order of testing procedures.

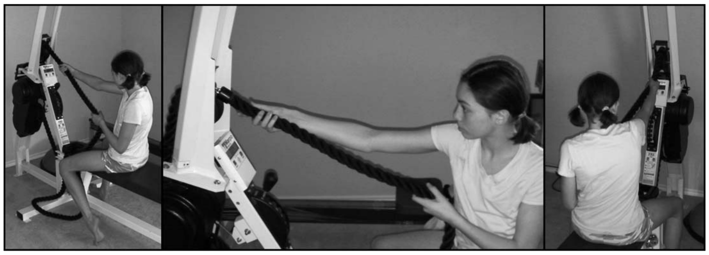

Figure 2. Rope trainer used to track distance pulled during 30 seconds.

years; judo experience: 7.8 ± 2.5 hours per week), who planned to compete at the USA Judo Junior National Championships.

Boy ($n = 10$) and girl ($n = 10$) participants were classified as "child" (7–12 years; $n = 8$; chronological age: 9.9 ± 1.6 years; training age: 3.7 ± 1.6 years; current judo training load: 6.1 ± 2.0 hours per week) or "adolescent" (13 years; $n = 12$; chronological age: 15.3 ± 2.0 years; training age: 6.4 ± 4.0 years; current judo training load: 8.9 ± 2.2 hours per week) by age and placed into 2 separate groups for analysis. Participants reported having competed in an average of 5.95 tournaments in the past year. Half of the group reported regular aerobic training and 35% reported regular resistance training. Only 4 participants reported practicing sports other than judo. Maturation assessment (Tanner staging) was not conducted because of considerations of personal intrusion. The delineation between the child and adolescent groups were based on age categories determined by the Pan American Judo Union and International Judo Federation for juvenile/intermediate competitors (12 years and younger) and junior/cadet competitors (13–19 years) (1).

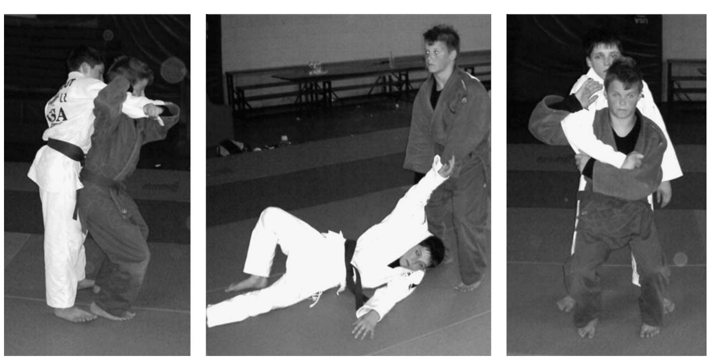

Figure 3. Standard judo shoulder throwing technique (seoi nage) used during the Special Judo Fitness Test.

Skinfolds, Height, and Weight (Body Composition)

Skinfold testing was conducted using separate protocols for boys and girls. Each skinfold measurement was taken on the right side of the participant's body, and involved grasping the skin and subcutaneous fat with the thumb and forefinger. Calibrated skinfold calipers (Lange skinfold calipers; Cambridge Scientific Industries, Cambridge, MA, USA) were used to determine the thickness (mm) of skin and subcutaneous fat at each respective site. Triceps, subscapular, and abdominal skinfolds (26), and triceps, anterior suprailiac, abdominal, and thigh skinfolds were measured for the boys and girls, respectively (20). The sum of the skinfolds (SKFsum) was determined for further statistical analysis. Test-retest reliability data for SKFsum from the authors' laboratory for youth athletes ($n = 10$) resulted in an intraclass correlation (ICC) of 0.99 with an *SEM* of 3.6 mm. Height and body mass (BM) were measured with a calibrated standard medical scale (439 Physician Scale; Detecto, Webb City, MO, USA).

Sit and Reach Test (Flexibility)

The sit and reach test was conducted with the participant seated on the floor, with legs extended and soles of feet in contact with the base of a standard sit and reach box (Flex-Tester; Novel Products, Inc., Rockton, IL, USA). The participant was asked to place one hand on top of the other and slowly lean forward in an active stretch as far as possible. Once the participant could no longer lean forward, this position was held for a minimum of 2 seconds. The distance (cm) from the scale listed on the sit and reach box was measured and recorded (sit and reach). Test-retest reliability data for sit and reach from the authors' laboratory for youth athletes ($n = 10$) resulted in an ICC of 0.79 with an *SEM* of 4.1 cm.

Handgrip Strength Assessment

The participant's handgrip (kg) was measured with a digital handgrip dynamometer (DHS-176; Detecto) in the standing position. The subject was asked to stand with arm adducted at the side with a 90° bend at the elbow. Participants were asked to squeeze the handle as forcefully as possible for 3–5 seconds

Table 1. Comparison of values for body mass, skinfolds, flexibility, handgrip strength, and rope pull performance.

	Children ($n = 8$)		Adolescents ($n = 12$)	
	Baseline	Posttest	Baseline	Posttest
Body mass (kg)*	37.6 ± 3.0	37.7 ± 3.0	63.0 ± 6.4	62.7 ± 6.6
Sum of skinfolds (mm)	41.8 ± 33.3	38.4 ± 31.8	50.5 ± 26.6†	44.3 ± 22.3
Sit and reach (cm)*	26.4 ± 4.3†	29.4 ± 3.5	34.1 ± 6.9	35.3 ± 7.7
Dominant handgrip (kg)*	16.4 ± 3.9	15.5 ± 4.8	32.9 ± 11.7	32.3 ± 11.5
Nondominant handgrip (kg)*	14.7 ± 3.6	14.8 ± 4.4	29.3 ± 11.2	28.2 ± 11.0
Rope pull (m)*	24.7 ± 1.2	25.7 ± 1.7	30.0 ± 0.7	30.6 ± 0.5

*Significant difference between children and adolescents at baseline ($p = 0.05$).
†Significant difference between baseline and posttesting measures ($p = 0.05$).

with a single hand and advised against holding their breath during the test. The participant completed 3 standing trials for each hand (dominant and nondominant hand). Test-retest reliability data for dominant handgrip from the authors' laboratory for youth athletes ($n = 10$) resulted in an ICC of 0.99 with an *SEM* of 1.7 kg; ICC and *SEM* for nondominant handgrip were 0.99 and 1.9 kg, respectively.

Jump Protocol (Height, Power, Force, and Velocity)

The jump protocol was performed on judo mats (tatami) with the participants barefoot (no shoes or socks). An accelerometer (Myotest Sport; Myotest S.A., Sion, Switzerland) was placed on the participant's waist, to record height, power, force, and velocity in a series of 3 countermovement jumps (CMJs). Each participant's BM was entered into the accelerometer's graphical display, and the device's standardized protocol was completed. The participant began standing, hands on waist, and encountered a series of audible signals that alerted the participant to bend the knees and maximally jump in the vertical plane. Upon landing, a second and third audible signal alerted the participant to complete the series of 3 jumps for the CMJ test. The average value for jump height (cm), power ($W \cdot kg^{-1}$), velocity ($N \cdot kg^{-1}$), and force ($cm \cdot s^{-1}$) was then recorded from the device's digital display. Test-retest reliability data for CMJ height from the authors' laboratory for youth athletes ($n = 10$) resulted in an ICC of 0.95 with an *SEM* of 2.7 cm; ICC and *SEM* for CMJ power were 0.82 and 5.2 $W \cdot kg^{-1}$; for CMJ velocity, 0.79 and 24.8 $N \cdot kg^{-1}$; and for CMJ force, 0.77 and 2.4 $cm \cdot s^{-1}$, respectively.

Thirty-Second Rope Pull

A rope trainer (VMX Rope Trainer; Marpo Kinetics, Inc., Livermore, CA, USA) was used to track the distance (m) pulled during 30 seconds of rope pull exercise (Figure 2). The rope trainer was set at the lowest resistance setting for all participants. From a seated position, participants performed hand-to-hand horizontal pulls with an underhand (supinated) grip for a duration of 30 seconds. Distance was recorded from the rope trainer's digital display (rope pull). Test-retest reliability data for rope pull from the authors' laboratory for youth athletes ($n = 10$) resulted in an ICC of 0.94 with an *SEM* of 1.7 m.

Special Judo Fitness Test

Following a standardized warm-up protocol, including low-intensity judo movements and stretching, the SJFT, as

Table 2. Comparison of values for the countermovement (CMJ) test.

	Children ($n = 8$)		Adolescents ($n = 12$)	
	Baseline	Posttest	Baseline	Posttest
CMJ height (cm)	28.4 ± 2.5	26.9 ± 2.8	33.1 ± 1.5	32.8 ± 1.6
CMJ power ($W \cdot kg^{-1}$)	24.6 ± 10.0	28.3 ± 8.2	25.0 ± 7.9*	31.7 ± 5.4
CMJ force ($N \cdot kg^{-1}$)	22.0 ± 4.8	21.9 ± 3.1	19.4 ± 1.4*	20.9 ± 1.7
CMJ velocity ($cm \cdot s^{-1}$)	155.5 ± 43.7	172.8 ± 36.1	160.3 ± 37.4*	190.8 ± 25.4

*Significant difference between baseline and posttesting measures ($p = 0.05$).

Table 3. Comparison of values for the Special Judo Fitness Test (SJFT).

	Children ($n = 8$)		Adolescents ($n = 12$)	
	Baseline	Posttest	Baseline	Posttest
SJFT sum of throws*	19.0 ± 0.7	18.6 ± 0.9	21.8 ± 0.4	22.5 ± 0.5
SJFT heart rate A ($b \cdot min^{-1}$)	196 ± 7	190 ± 11	193 ± 11	190 ± 7
SJFT heart rate B ($b \cdot min^{-1}$)	157 ± 17	162 ± 13	170 ± 12	164 ± 16
SJFT index*	18.78 ± 1.93	19.12 ± 2.15	16.75 ± 1.22†	15.76 ± 0.86

*Significant difference between children and adolescents at baseline ($p = 0.05$).
†Significant difference between baseline and posttesting measures ($p = 0.05$).

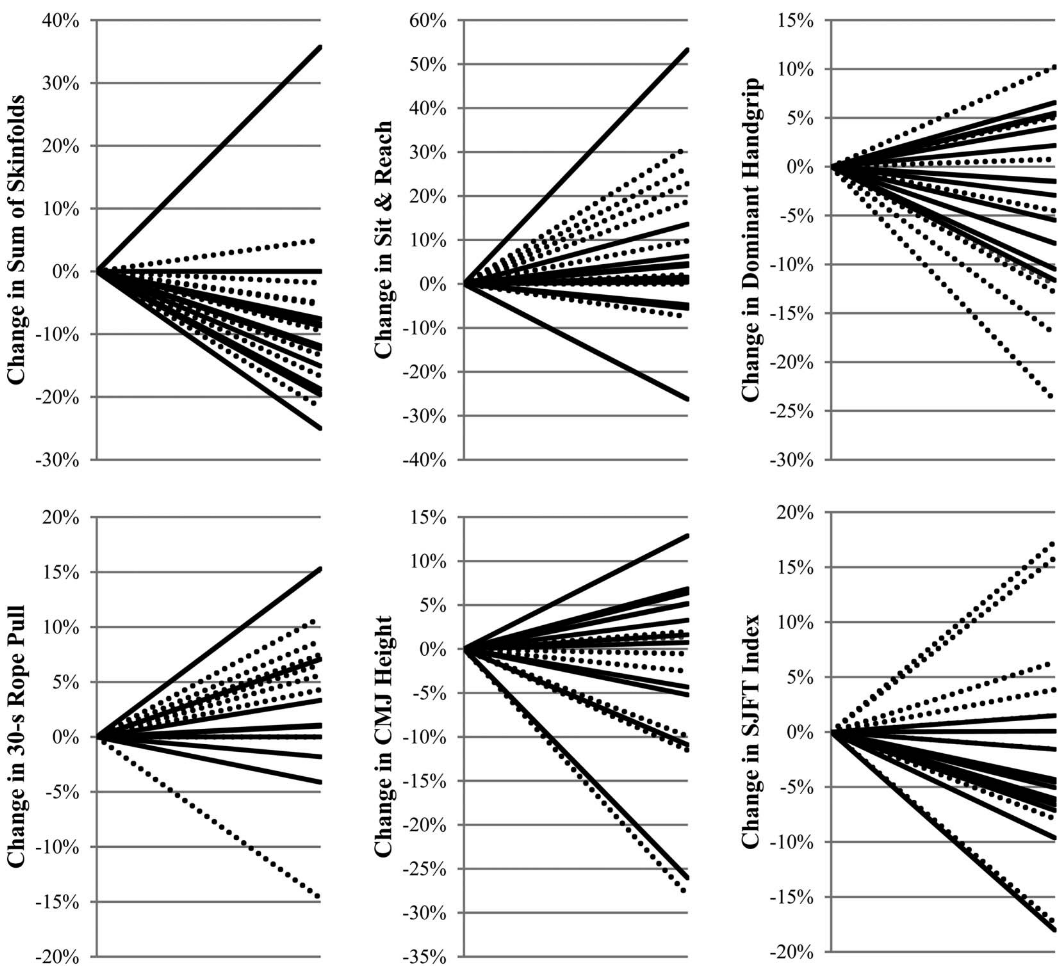

Figure 4. Individual percent change values for selected variables in child (dotted lines) and adolescent (solid lines) judo athletes. CMJ = countermovement jump; SJFT = Special Judo Fitness Test.

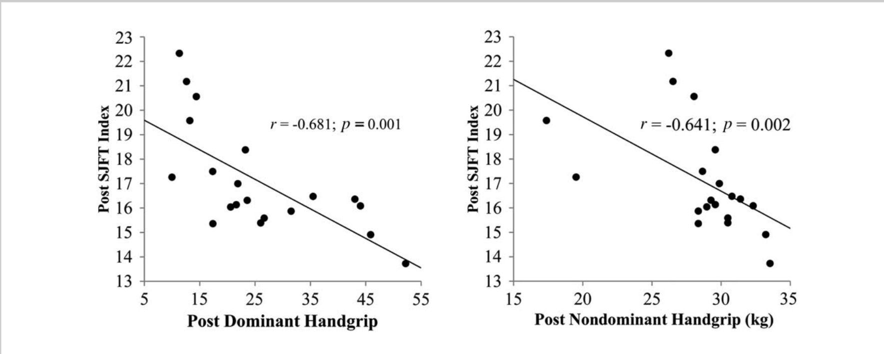

Figure 5. Association between Special Judo Fitness Test (SJFT) index at posttesting and handgrip strength.

outlined by Sterkowicz (34), was completed. Participants wore their judo uniform (judogi) and were barefoot (no shoes or socks). All testing was performed on judo mats (tatami). Two nontesting participants stood 6 m apart on a judo mat. The testing participant began between the 2 nontesting participants and, when signaled, approached and threw one of the nontesting participants to the ground after gripping the judogi, and using a standard judo shoulder throwing technique (ippon seoi nage; Figure 3). After completion of the throw, the testing participant approached and threw the other nontesting participant to the ground using the same technique. This exercise was performed for 15 seconds (throw A). The duration of each set of throwing drills was monitored by a timing device (Platinum Professional Fight and Gym Timer; Title Boxing, Lenexa, KS, USA). After 10 seconds of rest, the testing participant performed the repeated throwing drill for an additional 30 seconds (throw B). Following another 10-second rest period, a final series of throws was completed for 30 seconds (throw C). A heart rate monitor (Polar FS1; Polar Electro, Inc., Lake Success, NY, USA) was worn by the participant throughout the test. Heart rate was recorded at the completion (heart rate A) and 1 minute after (heart rate B) the third series of throws. The number of throws during each throwing session was totaled (throw A + throw B + throw C = SJFT sum of throws). The SJFT index was calculated from the following formula: SJFT index = (final heart rate + post heart rate)/SJFT sum of Throws. Test-retest reliability data for the SJFT Index from the authors' laboratory for youth athletes ($n = 10$) resulted in an ICC of 0.76 with an *SEM* of 1.7.

Four-Week Judo Training Program

The 4-week training program consisted of 8 workouts per week, totaling ~16 hours. Each workout lasted between 1.5 and 2.5 hours, with hydration breaks taken every 5–10 minutes. Morning workouts were conducted on Tuesday, Wednesday, Thursday, and Saturday. Evening workouts were conducted on Monday, Tuesday, Wednesday, and Thursday. A standard morning workout consisted of stretching (~10 minutes); a warm-up of interval sprinting (~20 minutes); various body weight exercises consisting of tumbling, plyometrics, and falling practice (20 minutes); judo-specific technical practice (10–15 minutes); ground-based sparring (~20 minutes); and standing-based sparring (~20 minutes). Morning workouts were concluded with the participants climbing a 9-m rope suspended from the ceiling (~2 times per workout). Evening workouts consisted of a short dynamic warm-up (~15 minutes), moving judo-specific technical practice (15–20 minutes), static judo-specific technical practice (15–20 minutes), ground-based sparring (~20 minutes), static and moving throwing practice (~20 minutes), and conditioning, including interval sprinting or circuit training (10–15 minutes). The training protocols were similar to those outlined by Baudry et al. (4), Costa et al. (8), Lidor et al. (23), Richards (32), and Takahashi (38).

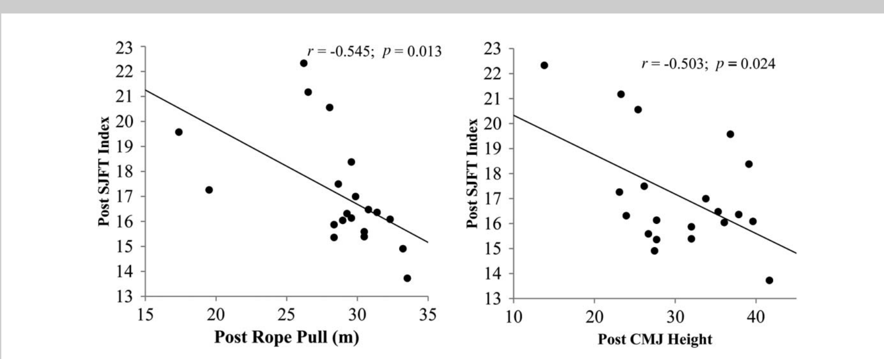

Figure 6. Association between Special Judo Fitness Test (SJFT) index at posttesting and rope pull performance and countermovement jump (CMJ) height.

Statistical Analyses

PASW Statistics (version 18.0; SPSS, Inc., Chicago, IL, USA) was used for all statistical calculations and comparisons. One-way analysis of variance (ANOVA) between child and adolescent groups for baseline BM, SKFsum, sit and reach, dominant handgrip, nondominant handgrip, CMJ height, CMJ power, CMJ force, CMJ velocity, rope pull, SJFT sum of throws, heart rate A, heart rate B, and SJFT index values was completed. Analysis of covariance was used to compare the values between the child and adolescent groups after the 4-week preparatory training period, while controlling for differences in the pretesting values.

Repeated measures ANOVA was used to examine the differences for the child group and the adolescent group between baseline testing and posttesting for BW, SKFsum, sit and reach, dominant handgrip, nondominant handgrip, CMJ height, CMJ power, CMJ force, CMJ velocity, rope pull, SJFT sum of throws, heart rate A, heart rate B, and SJFT index values. Pearson's correlation coefficients were calculated to examine the relationship between judo-specific ability (SJFT index) and the collected physiological variables for the overall group during posttesting. A type I error rate $\leq$5% was considered statistically significant for all analyses.

Results

Descriptive statistics for the child and adolescent groups are listed in Tables 1–3. Significant baseline differences between the child and adolescent groups were shown for BM ($p = 0.007$), sit and reach ($p = 0.011$), dominant handgrip ($p = 0.001$), nondominant handgrip ($p = 0.002$), rope pull ($p = 0.001$), SJFT sum of throws ($p = 0.001$), and SJFT index ($p = 0.009$) values. The posttesting values for SJFT index between the child (adjusted mean = 18.54) and adolescent (adjusted mean = 16.15) groups after controlling for baseline SJFT index value (adjusted mean = 17.56) were significantly different ($p = 0.005$). Analysis of covariance results revealed no significant differences between groups for any of the other examined variables.

For the child group, the only variable to significantly change during the training camp was sit and reach ($p = 0.035$). For the adolescent group, SKFsum ($p = 0.003$) and SJFT index ($p = 0.003$) significantly decreased, whereas CMJ power ($p = 0.022$), CMJ force ($p = 0.016$), and CMJ velocity ($p = 0.020$) significantly increased. Individual percent change values for selected variables are shown in Figure 4.

Pearson's correlation coefficient calculations for the overall group showed a significant inverse relationship between SJFT index and values for dominant handgrip, nondominant handgrip, rope pull, and CMJ height at posttesting (Figures 5 and 6). No significant relationships were found for SJFT index and SKFsum, sit and reach, CMJ power, CMJ force, or CMJ velocity ($p > 0.05$).

Discussion

Research involving judo training in children and adolescents is limited (4,21,33), and a few short-term (~4 weeks) training studies examining youth athletes are available in the literature (19,28). The current study is unique in examining anthropometric and sport-specific performance measures in child and adolescent judo athletes. Participants increased training time from ~4 hours per week in the child group and ~9 hours per week in the adolescent group to ~16 hours per week during the 4 weeks of preparatory training. When controlling for baseline differences, SJFT index was significantly different after precompetition training, with the adolescent group scoring better than the child group. The only variable to show any statistical improvement over the course of the 4-week training program in the child group was flexibility, whereas the Adolescent group showed a decrease in skinfold thickness; increased jumping power, force, and velocity; and improved judo-specific ability (SJFT index). Additionally, judo-specific ability for all the study participants was shown to be related to handgrip strength, rope pull performance, and jump capability.

No changes were noted in BM for any of the examined groups; however, significant decreases in skinfold thickness indicates a loss of body fat, and possibly an increase in muscle mass, in response to short-term precompetition judo training for the adolescent group. This parallels previous research in which short-term sport-specific training has shown to decrease body fat percentage in youth athletes (28). The lack of changes in the child group may be related to the group's mean age of ~10 years, which falls within a time period that is characterized by the absence of sex hormones linked to muscle hypertrophy and an accumulation of body fat (27). In support, a series of investigations in 7-year-old boys and girls showed no change in body fat percentage after 9 months of judo training (21,22,33).

Handgrip strength and sit and reach values were within those reported from previous research involving youth judo players, albeit on the lower end of these measurements (21,24,33,41). Handgrip strength may be a discriminatory variable between judo athletes of differing experience levels (24); however, the lack of improvements in the current sample is not unexpected because of the training ages of both the child and adolescent groups. Improvements in flexibility as a result of judo training in both younger (~7 years) and older (~15 years) youth judo athletes have been shown previously (21,33,41). Similarly, 4 weeks of wrestling training has shown to improve sit and reach values in cadet wrestlers (28).

Countermovement jump values for height were consistent with similar-aged judo and nonjudo subjects (39,41) and lower than older subjects in studies using the same measurement device (7,30). Countermovement power, force, and velocity values in the current sample of youth athletes were lower than previously reported during reliability studies for older subjects (7), but significantly increased over the 4-week period of intensive training in the adolescent judo players. Judo training uses the stretch-shortening cycle while attempting many throwing techniques (10), and the current training regimen included plyometric drills. Training these types of movements over 4 weeks has shown to improve speed and power during vertical jump testing in high school athletes, with the authors of the study suggesting that these changes were a result of neurological rather than muscular adaptations because of the short-term nature of the activity (19). Furthermore, Lloyd et al. (25) recently reported improvements in leg stiffness, an indicator of stretch-shortening cycle function, from 4 weeks of plyometric training in 12- and 15-year-old boys, with no changes in 9-year-olds or controls. Therefore, short-term intensive judo training conducted during the current study may have improved the young judo players' jumping ability through neurological adaptations or improved biomechanical efficiency.

To the authors' knowledge, this is the first study to examine rope pull performance using a commercial rope trainer as a method of combining strength and endurance parameters and a means of tracking adaptations to sport-specific training. Previously, Franchini et al. (15) used a dynamic endurance-based grip strength test using a judogi to discriminate between national-level and recreational-level athletes. In comparison, the adolescent group athletes in the current study displayed a greater rope pull distance over 30 seconds than the child group athletes. The lack of improvements for rope pull distance in the child or adolescent groups are in contrast to previous increases reported from judo training in seated row and flexed arm hang, and the examination of variables from upper-body Wingate tests (14,21,33,36). Previous data suggest that the use of a 30-second rope pull test, as a measure of upper-body strength and endurance, may have merit in this population as national caliber judo athletes have shown an upper-body to lower-body anaerobic capacity ratio of 81% compared with roughly 51% in nonathletes (12,40).

Another novel aspect of this study is the assessment and examination of SJFT in children and adolescents. The ability to discriminate between experience levels using the SJFT has been thoroughly explored and standards with regard to adults have been established (13,17). Future investigations, with the use of the currently presented values, should be dedicated to the development of standards in younger populations. As expected, because of differences in strength and technical ability, the SJFT index values for the current sample of children (~19) and adolescents (~16) are higher than adult standards. The nearest reported SJFT index values (~14) were for nonelite Brazilian judo participants (16). Furthermore, the current results show that the adolescent group's SJFT index improved after the precompetition training, whereas the child group's SJFT index remained similar. A number of physiological variables including CMJ height, anaerobic threshold, aerobic capacity, and peak velocity during a graded exercise test have correlated with judo-specific ability as measured by variables from the SJFT (10,35,42). The current study highlighted a relationship between SJFT index CMJ height, handgrip strength, and rope pull performance. Accordingly, gripping and pulling exercise combinations have previously been explored as a mechanism to improve judo performance (5,15). Future studies may examine the effects of rope pull exercise, either with a rope trainer or a suspended rope, on judo-specific ability.

There are a number of limitations to this study that must be considered. Because of the observational nature of the precompetition training, rather than a highly controlled intervention, the results of the study may be less generalizable. Maturity status, via Tanner staging, was not established for the current group of athletes, and could be considered a limitation. However, because of the placement of youth judo athletes into age groups for competitions, consistency with these age groups was in line with the proposed research question. The lack of comparative norms for the SJFT index in younger judo athletes makes the current findings difficult to interpret. The observed differences in SJFT index may be because of the child group's inconsistency in performance during the SJFT. Finally, no age-matched control group was used for this study, which would have provided a more clear view of the observed changes. Despite these limitations, the current study characterizes the effects of preparatory training for competition on youth athletes while providing a comparison between children and adolescents.

Practical Applications

Short-term intensive preparatory judo training, as described in this study, improved anthropometric and performance variables in youth athletes. However, body composition, jump ability, and judo tasks significantly improved in the adolescent group, whereas the child group only significantly improved flexibility. These results are consistent with the outcomes of the learning-to-train and training-to-train periods as outlined by the long-term athlete development model, stating that gains achieved by the child group may not be measurable through strictly physiological data. When the entire sample of judo athletes was examined, a moderate relationship was observed between judo-specific ability and grip strength, jump height, and rope pull performance. These results support the use of judo training in the improvement of anthropometric and sport-specific measures in youth, primarily adolescent (>12 years), athletes, while providing specific areas of focus for coaches and trainers to enhance their efforts in impacting physical performance and judo skills.

Acknowledgments

The authors thank Sensei Patrick Burris and all the judoka from USA Stars Foundation who participated in this study. Additionally, the authors acknowledge Kyle Sunderland and Carsen Hyde for their efforts in data collection.

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