Research in Physical Education, Sport and Health
2024, Vol. 13, No. 1, pp.3-7
ISSN(Print):1857-8152; ISSN(Online):1857-8160

COMPARATIVE ANALYSIS OF PHYSICAL CAPABILITIES IN MALE AND FEMALE JUDOKAS THROUGH VARIETY OF TESTS

DOI: https://doi.org/10.46733/PESH2413103p
(Original scientific paper)

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Abstract

*The aim of this study was to examine the differences in physical capabilities between genders in adolescent judo athletes through different tests.Total of 16 athletes, male (n=10, aged 15.25±1.64) and female (n=6 aged 14.54±1.89) took part in the testing procedure that included test for height, weight, start reaction, countermovement jump (CMJ), standing broad jump (SBJ), shuttle run 10*5, maximum isometric handgrip test, isometric abdominal hold, and Biering-Sorenson test.The results showed that male judokas were taller (p = 0.000), jumped higher in CMJ (p = 0.018), and jumped further in SBJ (p = 0.000). No differences were found in the tests for reaction, change of direction, handgrip strength, and endurance of the core musculature. Overall, the research provides insight into the understanding of physical differences between young male and female judokas, offering information that may have implications for further training and development of adolescent athletes in this sport*

Key words: *Judo, Physical capabilities, Judokas, Strength, Grip strength, Adolescents*

Introduction

Judo, a dynamic Olympic sport rooted in Japanese tradition, stands out for its emphasis on precise techniques and strategic maneuvers. Athletes, known as judokas, navigate a world of intricate throws and disciplined grappling techniques, showcasing a fusion of strength, agility, and mental acuity. With competitions structured across various weight divisions for both men and women, judo demands a holistic approach to training, encompassing technical proficiency, strategic adaptability, and physical resilience.

Strength is vital for judokas, affecting their positioning and control. Throws like Uchi-Mata and groundwork rely heavily on strength. Handgrip tests, common in the literature, show differences between elite and non-elite judokas (Branco, Diniz, Santos, Shiroma, & Franchini, 2017) as well as between junior and cadet judokas(Agostinho, Junior, Stankovic, Escobar-Molina, & Franchini, 2018). Studies exploring gender differences have shown male judokas to have higher numbers of grip strength compared to female ones (Franchini, Del Vecchio, Matsushigue, & Artioli, 2011), with limited studies looking specifically in young judokas.

Explosive strength, or power, has also been seen as a key physical quality of performance in sprots and it has been well documented.(Cormie, McGuigan, & Newton, 2011).In judo, power or explosive strength has been linked to better and faster tactical repositioning as well as the ability of performing powerful throws (Franchini, Branco, Agostinho, Calmet, & Candau, 2015). For example, in elite judokas, the control of the opponent using grip work (kumi-kata) is very brief, from where subsequent throws appear and last 0.98 to 1.70 seconds (Marcon, Franchini, Jardim, & Neto, 2010).

There have been different types of vertical and horizontal jumps with and without preparation that has been regularly used to assess judokas' power capabilities. Among the most frequently used are the countermovement jump (CMJ) and standing broad jump (SBJ)(Witkowski, Superson, & Piepiora, 2021).

Reactivity tests evaluate different stimulus types sent to the central nervous system, including visual, auditory, tactile, proprioceptive, and kinesthetic stimuli. These tests although limited, have been conducted on judo athletes to assess their responsiveness (Cynarski, Słopecki, Dziadek, Böschen, & Piepiora, 2021). Furthermore, change of direction (COD) is crucial in judo for maneuvering and creating openings for throws. Techniques like "Seoi Nage" induce reactions from opponents, followed by rapid changes in direction. This skill is vital for both offense and defense. While COD tests are common in sports diagnostics, their application in judo is unique due to the sport's distinct requirements (Gonzalo-Skok & Bishop, 2023)

they are less prevalent in combat sports due to the sport's nature, which lacks pronounced, high-speed COD's as seen in team sports.

The robust trunk musculature in judo serves as more than just physical strength; it functions as a dynamic center influencing multiple factors crucial for athletic performance. Despite the needs of maximal strength and power, two motor components dominated by the anaerobic system, aerobic capacity also prevails in competitions that last anyway from 1 to 5 minutes (Julio et al., 2017). One such quality is the strength endurance which is characteristics for the ability of the muscles to create the minimum force needed for a prolonged period of time (Ren, Tian, McNeill, Lenetsky, & Uthoff, 2023) therefore tests such as Isometric Abdominal Hold, Biering-Sorenson Test, Plank, Side Plank, Sit-Ups, have been widely used as cost-effective methods for testing the core in Judokas.

In the literature to date, studies comparing young judokas by gender that include tests for anthropometrics, reaction, change of direction, power, strength, and strength-endurance are limited, so the objective of this study is to examine differences in male and female judokas in different physical capacities using 9 different tests.

Materials and Methods

Participants

Total of 16 participants students of First Elite Sports School in Shanghai were divided into 2 groups male (N=10) aged 15.25±1.64, and female (N=6) aged 14.54±1.89 have taken part in this study.

All athletes were in their preparatory period involved in 6 days per week judo training and 4 days of strength & power training. Written, informed parental consent as well as participant assent was collected for each study participant.

Design and Procedures

As the procedure is a part of a semi-annual testing performed in all sports schools in Shanghai, the athletes were familiar with the schedule of testing and the tests itself.

At the start of the testing procedure athletes were given a standardized type of warm-up that they performed for a week before the testing.

The schedule of testing time was to be related to the true training time of the athletes during the week and it was managed by the school's representatives and coaches.

Participants' height and weight measurements were conducted following the procedures outlined in the Anthropometric Standardization Reference Manual (Lohman, Roche, & Martorell, 1988)

Following anthropometric measurements, participants underwent several physical tests:

Grip Strength Test: Conducted using a digital tensiometric dynamometer from Rosvola(Roberts et al., 2011).

Start Reaction Test: The start reaction test utilized optical timing gates (VALD SmartSpeed Plus Electronic Timing System) placed 2 meters apart from 2 starting lines. Athletes reacted to a change in light from blue to green, with timing taken from start to gate contact. Four trials were conducted with the preferred leg in front, separated by 30-second rests. The fastest reaction time was analyzed.

Countermovement Jump (CMJ): Performed on pre-calibrated force platforms (VALD Force Decks FD4000 Dual Force Platforms Hardware, London, UK) to assess vertical jump capabilities.

Standing Broad Jump (SBJ): Evaluated horizontal jumping abilities(Wood, 2008).

10*5 Shuttle Run Test: Assessed change of direction capabilities, with participants completing the test twice with a 3-minute rest between trials(Wood, 2010).

Biering-Sorenson Test (Sorenson)(Shaw, Jacobs, Van Dillen, Beneck, & Smith, 2023): Conducted using a Glute Ham Developer (GHD) machine (Power Body, Canada) and an inclinometer (RISEPRO Digital) to measure maximum retention in one position.

Isometric Abdominal Hold (Ab_Hold) – Same as Biering-Sorenson Test except the athlete position was opposite, testing for maximum isometric hold in the anterior core musculature(Everett, 2023).

Statistical Analysis

The statistical package program IBM SPSS Statistics 26 (Chicago, IL, USA) was used for data processing.

For this study, a descriptive analysis was conducted to provide a comprehensive overview of the key features of the data set. Measures such as mean and standard deviation were calculated to summarize central tendencies and variability within the variables of interest.

After the descriptive analysis Shapiro-Wilk Test was conducted to check the normality of the data.

An independent t-test was then selected to compare the groups for the rest of the normally distributed variables.

Results

Table 1. Shapiro Wilk Test for judokas from different genders: S_Reaction = Start Reaction, CMJ = Countermovement Jump, SBJ = Standing Broad Jump, Ab_Hold = Isometric Abdominal Hold, Sorenson = Biering Sorenson Test

	Male			**Female**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Height	0.959	10	0.771	0.853	6	0.167
Weight	0.915	10	0.314	0.859	6	0.187
Reaction	0.95	10	0.667	0.945	6	0.7
Grip	0.915	10	0.314	0.859	6	0.187
CMJ	0.821	10	0.026*	0.962	6	0.834
SBJ	0.943	10	0.59	0.927	6	0.558
Shuttle_10_5	0.973	10	0.919	0.888	6	0.308
Ab_hold	0.928	10	0.425	0.929	6	0.574
Sorenson	0.944	10	0.598	0.884	6	0.286
**p < 0.05 statistical significance*						

Based on table 2, there was only one not-normally distributed variable CMJ in male (p-value = 0.026).

Table 2. Descriptive Statistics: S_Reaction = Start Reaction, CMJ = Countermovement Jump, SBJ = Standing Broad Jump, Ab_Hold = Isometric Abdominal Hold, Sorenson = Biering Sorenson Test

	Male (n=10)	Female (n=6)	95% CI for Mean Difference		
	mean±SD	mean±SD	**t**	**df**	**p-value**
Height	178.34±4.63	162.45±7.15	5.437	14	0.000*
Weight	61.22±6.52	56.67±7.55	1.277	14	0.222
S_Reaction	1.15±0.06	1.19±0.06	-1.327	14	0.206
Grip	61.22±6.52	56.67±7.55	1.277	14	0.222
CMJ	33.17±9.18	22.42±4.12	2.683	14	0.018*
SBJ	244.1±22.2	191.17±13.57	5.241	14	0.000*
Shuttle_10_5	16.31±1.09	17.31±1.31	-1.655	14	0.120
Ab_hold	67.5±18.69	49.83±15.17	1.953	14	0.071
Sorenson	134.8±32.18	114.83±24.05	1.309	14	0.212
**p < 0.05 statistically different than female*					

Based on the results in Table 2 we can conclude that statistically significant difference in height was found with male being higher than female (p = 0.000).

A statistically significant difference was also noted in the assessment of explosive power in the lower limbs (CMJ) through the non-parametric Mann-Whitney U test. The group of male judokas demonstrated markedly higher jumps compared to the group of female judokas (U = 5.0, 2-tailed p-value = 0.007, η^2 = 0.46). Similar results were obtained in the standing broad jump test (SBJ) revealing substantial and statistically significant difference in jump distance between male and female judokas (p = 0.000).

Discussion

The aim of this study was to compare young judokas by dividing them into two groups based on gender (male-female) and use tests to evaluate anthropometrical characteristics and physical capacities.

When it comes to the height difference found in our study proportion of the variance in height can be attributed to different genders.These findings build on those already shown in the study of Ceylan et al, 2018. (Ceylan, Gürses, Akgül, Baydil, & Franchini, 2018).

The difference in weight between the groups was found to be non-significant, likely due to factors such as the relatively small sample size and the wide age range (12 to 17 years old). While males are typically associated with larger bodies, our participant characteristics require careful interpretation of these findings.

In a study that didn't directly compare between genders, authors noted that male judokas express higher numbers on the height in CMJ if to be compared to female ones (Engwerda, Lidor, & Elferink-Gemser, 2020).

Similarly like in the CMJ, the results in the standing broad jump test (SBJ) (Table 2) indicated a large impact of gender differences, with the observed variability in jump distance strongly influenced by gender-related factors.

To author knowledge there are no similar studies in the literature comparing youth judokas by gender, but there are ones comparing between different levels (Drid et al., 2015), between judo athletes and non-athletes (Stamenković, Stanković, Nurkić, Nikolić, & Petković, 2016) and between judo and other sports(Petkovic, Stamenković, Tankusheva, & Mladenović, 2017). There are also studies that look at gender differences in different sports in which male athletes obtain higher numbers than females (Gontarev, Zivkovic, Velickovska, & Naumovski, 2014).

The expected differences in CMJ and SBJ results can be partly explained based on gender variations in hormone secretion during and after puberty. Men have an advantage over women in terms of muscle hypertrophy, as bigger cross-sectional area (CSA) leads to higher force capabilities which have been correlated with increases in power. (Vuksanovikj, Jovanovski, Klincarov, Starc, & Sejkeroski, 2016).

The minor differences between groups in the Isometric handgrip test (Grip) comes from the relatively small number of motor units that need to be activated in the muscles of the arms and the palms compared with other maximum isometric tests that require full body activation (ex.IMTP). Thus, regardless of gender, the ability to express great forces is limited to a relatively small muscle region compared to the rest of the athlete's body.

When it comes to comparing young judokas in reaction times in different genders studies are limited. Therefore if we compare our results to similar studies but in other sports, some are similar to our findings (Deary & Der, 2005) but others are not (Dane & Erzurumluoglu, 2003). Based on this, concrete conclusions cannot be made.

The results obtained in the Shuttle Run 10*5 (Shuttle_10_5) indicated a substantial impact suggesting that despite lack of statistical significance, gender differences may still contribute significantly to the observed variability in the shuttle run test results.

In Judo, quick changes of body position are more prevalent than longer-distance changes of direction seen in team sports, which together with Judo's training culture leads to putting high emphasis on technical training as well as strength & power, eventually limiting components such as COD, Sprinting and similar.

Strength endurance of the trunk flexors and extensors evaluated through the Isometric Abdominal Hold (Ab_hold) and Biering-Sorenson's test showed statistically non-significant differences, and both can be interpreted through the view of architecture and the morphological characteristics of the muscles involved in both tests.

They are often referred to as tonic muscles whose main function is stabilization of the trunk (Janda, 1987), transfer of energy and forces between the upper and lower limbs and preservation of posture, which means that gender differences may be minor or insignificant.

Conclusion

In summary, this research aimed to assess the physical capacities of young judokas based on gender. Male judokas demonstrated significantly greater height and power/explosive strength compared to females, likely due to physiological differences in muscle mass and anatomical characteristics. However, no significant differences were found between genders in change of direction, handgrip strength, reaction time, and core endurance. These findings offer valuable insights into gender-based physical differences among young judokas, with implications for their training and development in the sport.

Limitations

The limitation of this study is that it was performed on a small group of participants, male (n=10) and female (n=6). The other limitation seems to be the big difference in age (12 to 17 years).

This leads to the need for a similar study to be done on higher number of participants which in addition to the division by gender, be grouped by age to avoid differences in terms of maturation among the athletes.

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