JSES: Journal of Sport and Exercise Science
Volume 8, Number 2, September 2025
ORIGINAL ARTICLE

# The Relationship between Sitting Height with VO2max and Muscular Endurance in Junior Taekwondo Athletes

Aldi Karimullah[1ABCE], Dominikus Raditya Atmaka[2CD]

[1] Majapahit Islamic University, Indonesia
[2] Colorado State University, United States

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Corresponding Author: Aldi Karimullah, aldikarimullah@unim.ac.id

Received 21 July 2025
Accepted 16 October 2025
DOI https://doi.org/10.26740/jses.v8n2.p152-160

## ABSTRACTS

**Purpose** This study aims to analyze the relationships among sitting height, aerobic capacity (VO2max), and muscular endurance in junior taekwondo athletes.

**Materials and Methods** This study used an observational, cross-sectional research design. A total of 31 junior taekwondo athletes aged 10–17 years participated in this study (20 females and 11 males). This study conducted anthropometric tests (weight, height, and sitting height) and physical tests to assess muscular endurance and maximal oxygen uptake (VO2max). Muscular endurance was measured using a push-up test, while VO2max was measured using the Multistage Fitness Test (MFT) or beep test.

**Result** The study found a significant relationship between sitting height and VO2max (95% CI = 34.16–39.57; r = 0.405; p = 0.024). This relationship indicates that taller junior taekwondo athletes have higher VO2max values. Meanwhile, the analysis of the relationship between sitting height and muscular endurance showed no significant association (95% CI = 24.05 – 28.26; r = 0.114; p = 0.543).

**Conclusion** This study concludes that greater sitting height is associated with better VO2max capacity among junior taekwondo athletes. However, sitting height does not have a significant relationship with muscular endurance. These findings suggest that sitting height is a supporting factor in the development of aerobic capacity in this population. In practical terms, the results of this study can serve as recommendations for identifying and developing talent in young athletes.

**Keywords** Cardiorespiratory; Junior athlete; Muscular endurance; Taekwondo.

## INTRODUCTION

Taekwondo is a martial art from Korea, where "tae" means hand or fist, 'kwon' means foot, and "do" means art. It can be interpreted as a martial art that uses the hands and feet (Yılmaz, 2021). Taekwondo is one of the most well-known martial arts in the world and has been recognized as an official Olympic sport since 2012. Taekwondo is divided into two categories: kyorugi and poomsae. Kyorugi is a form of martial arts that involves complete physical contact, such as taekwondo, which is competed in the Olympics.

Meanwhile, poomsae is a form of martial arts that does not involve contact and focuses more on performance and demonstration (S. Kim, 2023). After being approved by the 103rd IOC session, taekwondo was first competed at the Sydney Olympics in 2000. Since then, taekwondo has also been competed at the National Sports Week (PON) and national junior championships in both poomsae and kyorugi categories. The junior level in taekwondo refers to athletes under 18 years old. According to Presidential Regulation No. 86 of 2021 concerning the National Sports Master Plan (DBON), competitive sports must be planned, structured, and sustainable. Therefore, DBON athlete development includes junior athletes. Since taekwondo athletes begin training and competing around the age of 10, competitions for young or junior athletes should be based on developmental principles appropriate to children's physiological characteristics, to protect them from excessive physiological stress and to facilitate the development of technical and tactical skills (Bergeron et al., 2024).

Recent studies on junior taekwondo athletes have provided insights into their physical characteristics and health issues. Research indicates that taekwondo training has a positive impact on bone mineral density in junior athletes, despite some potentially harmful weight-loss strategies they use. Research shows that taekwondo training significantly increases growth hormone and insulin-like growth factor (IGF) levels and improves children's physical and cognitive performance (Gama Linhares et al., 2022; Jeong et al., 2023). Anthropometric characteristics play a critical role in sports performance, especially in sports that require a combination of endurance, speed, and agility, such as taekwondo (Laurin, 2024). Seated height, which represents the relative length of the upper body compared to total body height, is an important characteristic in young athletes that varies due to growth stages and maturation (Burton & Burton, 2021). In young athletes, sitting height can vary significantly across growth and maturation stages, and this variation can influence biomechanical advantages or limitations in movement and energy efficiency (Tumkur Anil Kumar et al., 2021). Since taekwondo involves rapid kicks, body rotations, and dynamic movements, the proportion of body length to limb length may have important implications for physical performance. Height and sitting height are advantageous factors in taekwondo, as they influence reach distance and leg length (Mirali et al., 2022). During growth spurt phases, body proportions change rapidly and can temporarily disrupt coordination, power output, and neuromuscular control (Tumkur Anil Kumar et al., 2021).

Therefore, understanding how sitting height correlates with key performance indicators such as VO2max and muscular endurance in young taekwondo athletes can provide insights into talent identification and age-appropriate training strategies. Previous studies have analyzed the positive relationship between VO2max and lower leg length (J. S. Kim et al., 2024; Purba & Aprilia, 2022). Although several anthropometric factors have been examined in relation to aerobic capacity and muscular endurance, no study has specifically explored the relationship between sitting height, aerobic capacity, and muscular endurance in junior taekwondo athletes. This understanding is crucial for assessing athletic potential and interpreting performance variations influenced by developmental changes. However, from a physiological standpoint, the relationship between sitting height and muscular endurance is inherently weak because muscular endurance is primarily determined by local muscular characteristics such as the proportion of type I fibers, metabolic efficiency, and neuromuscular adaptations rather than static anthropometric parameters (van der Zwaard et al., 2021).

Additionally, previous studies have not controlled for pubertal stage, even though biological maturation significantly influences aerobic capacity, body size, and body proportions. They may therefore affect the relationship between sitting height and $VO_2$max as well as other


ISSN 2615-8744

physical performance outcomes. Considering these factors, this study aims to investigate the relationships among sitting height, aerobic capacity ($VO_2$max), and muscular endurance in junior taekwondo athletes. By analyzing these correlations, this study seeks to clarify the role of anthropometric variables in supporting athletic performance and to contribute to the development of training programs that align with the morphological characteristics of young athletes. To address this gap, this study conducted anthropometric and physical fitness assessments in junior taekwondo athletes.

## METHODS

### *Study Participants*

This study used an observational, cross-sectional research design. A total of 31 junior taekwondo athletes participated in this study, consisting of 20 females and 11 males. The sample size was calculated using G*Power software with a moderate effect size (r = 0.4), α = 0.05, and test power = 0.80, resulting in a minimum sample size of 28 participants. To anticipate dropouts, 10% of the total sample was added, resulting in 31 participants. The study was conducted in February 2025 at a taekwondo academy club that trains young athletes. The sampling technique used was total sampling. The inclusion criteria for this study were junior athletes aged 10–17 years who had never sustained a bone injury. The exclusion criteria were junior athletes undergoing treatment for serious illnesses that interfered with growth and experienced bone growth abnormalities. This study followed the ethical principles of the Declaration of Helsinki, and informed consent was obtained from all participants and their guardians.

### *Data Collection*

Data collection was conducted using interviews for personal data and measurements. Personal data collected from respondents included date of birth to determine age and gender. Anthropometric measurements were taken to determine height (cm), sitting height (cm), and weight (kg). Measurement reliability was ensured through duplicate measurements performed by the same examiner and standardized testing procedures. Physical tests were conducted to assess muscular endurance and aerobic capacity (VO2max). Muscular endurance was measured using a push-up test, and VO2max was measured using the Multistage Fitness Test (MFT) or beep test. Before the physical tests, respondents were asked to perform static and dynamic warm-ups for 5 minutes, followed by the push-up test.

### *Muscular Endurance Test*

The push-up test was conducted for 30 seconds. If the respondent was unable to maintain the correct technique for two consecutive repetitions, the test was stopped. According to the ACSM (2018), the push-up test is conducted differently for men and women. Men perform the test with their hands facing forward, positioned under their shoulders, a straight back, and the head facing forward, using the tips of their toes as the point of support. Women use a modified knee push-up position with feet together, lower legs touching the mat, ankles in plantar flexion, back straight, hands shoulder-width apart, head facing upward, and knees as the support point. Respondents lift their bodies by straightening their elbows, then lower themselves until their chins touch the mat, but their stomachs must not touch the mat. Participants were instructed to keep their backs straight throughout the test and push their bodies until their arms were fully extended (ACSM, 2018). To ensure measurement reliability, all tests were conducted using the same standard


ISSN 2615-8744

procedures, including consistency in timing, verbal instructions, body position, result recording, and environmental conditions during testing.

### *Aerobic Capacity Test*

The Multistage Fitness Test (MFT) was used in this study to measure aerobic fitness by predicting maximum oxygen capacity (VO2max) and performance. The MFT requires a 20-meter track with markers or cones at each end and an MFT form.

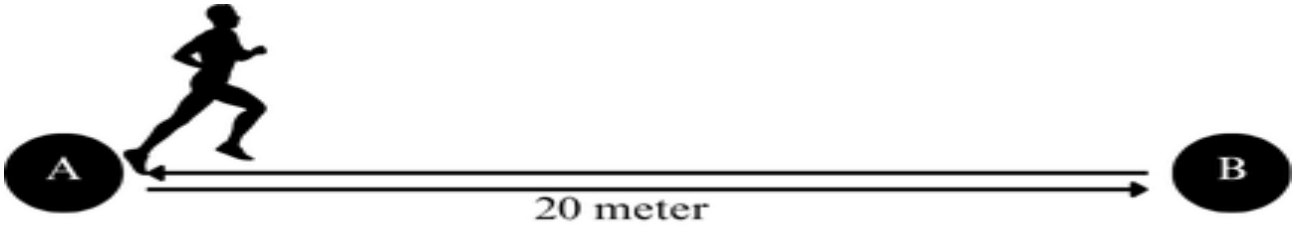


**Figure 1.** *Multistage Fitness Test* (MFT) Procedure.

Participants stand at point A; a 'bleep' sound from the audio signals the start of a run until reaching point B, and the next 'bleep' sound indicates the start of the next run (Figure 1). Participants perform similar movements in time with the sound's rhythm to the best of their ability. If participants fail to reach the point in time with the sound's rhythm on two consecutive returns, the test is terminated. The formula for calculating VO2max from MFT results is as follows: VO2max = 3.46 x (level + turn / (level x 0.4325 + 7.0048)) + 12.2.

### *Statistical Analysis*

Statistical analysis was performed using SPSS software, including descriptive statistics to determine the mean and standard deviation, and Shapiro-Wilk normality testing to determine whether parametric or nonparametric testing was appropriate. To determine the relationship between the dependent and independent variables, Pearson's correlation test was performed with a significance value of $p < 0.05$. Linear regression analysis was also performed to determine the direction of the relationship between the two variables.

## RESULT

Table 1 presents the characteristics and results of physical tests conducted on junior taekwondo athletes. This study involved 31 junior athletes (20 females and 11 males). The average age of male junior athletes was 12.54 ± 2.20 years, while that of female athletes was 13.25 ± 1.83 years. Based on anthropometric measurements of body weight and height, Body Mass Index (BMI) was calculated. The average BMI of male junior athletes was 18.49 ± 2.43 kg/m², indicating a more ideal body weight than that of females, whose average BMI was 26.30 ± 32.47 kg/m².

**Table 1.** Characteristics of Respondents

| Variable | Mean ± SD |
|---|---|
| Age(years) | |
| Male | 12.54 ± 2.20 |
| Female | 13.25 ± 1.83 |
| Standing height (cm) | |
| Male | 157.30 ± 12.40 |
| Female | 154.65 ± 6.87 |


ISSN 2615-8744

| Variable | Mean ± SD |
|---|---|
| Sitting height (cm) | |
| Male | 79.87 ± 7.57 |
| Female | 79.81 ± 3.30 |
| Body weight (kg) | |
| Male | 46.49 ± 12.13 |
| Female | 45.58 ± 5.68 |
| BMI (kg/m²) | |
| Male | 18.49 ± 2.43 |
| Female | 26.30 ± 32.47 |

Note: BMI – Body mass index.

The results of the physical fitness tests. The push-up test and MFT are presented in Table 2. The results showed that the average muscular endurance, measured using the push-up test method, was 26.16 ± 5.74 times. Males scored higher than females at 28.81 ± 6.85 times. At the same time, females scored 24.70 ± 4.58 times. Based on the results of the correlation test. Sitting height was not associated with muscular endurance. Moreover, there was a very weak positive linear correlation between sitting height and the number of push-ups (95% CI = 24.05–28.26; r = 0.114; p = 0.543).

**Table 2.** Physical test measurement results

| Variabel | Mean ± SD | r | 95% CI | *p - value* |
|---|---|---|---|---|
| Push-up test (times) | | | | |
| Male | 28.81 ± 6.85 | 0.114 | 24.05 – 28.26 | 0.543 |
| Female | 24.70 ± 4.58 | | | |
| Total | 26.16 ± 5.74 | | | |
| $Vo_2max$ (mL/kg/min) | | | | |
| Male | 39.58 ± 8.66 | 0.405 | 34.16 – 39.57 | 0.024 |
| Female | 35.38 ± 6.30 | | | |
| Total | 36.87 ± 7.37 | | | |

Note: r value based on Pearson's correlation coefficient.

Based on physical tests using MFT to determine maximum oxygen consumption (VO2max), the average VO2max for the entire sample was 36.87 ± 7.37 mL/kg/min, with male junior athletes having higher VO2max than females. Based on the Pearson test, there was a significant positive linear relationship (95% CI = 34.16–39.57; r = 0.405; p = 0.024). These indicate that taller junior taekwondo athletes have higher VO2max values (Figure 2).

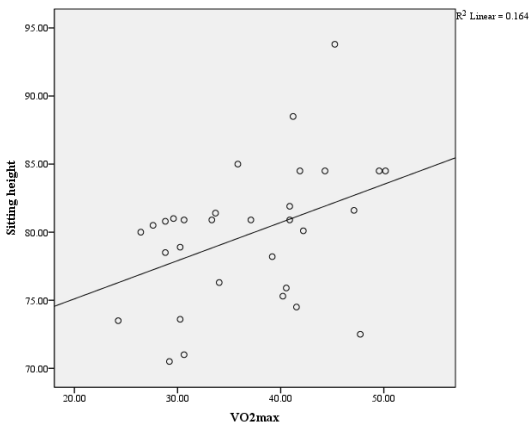


**Figure 2.** Linear regression analysis between sitting height and VO2max

Figure 2 illustrates the linear regression analysis showing the relationship between sitting height and $VO_2$max among junior taekwondo athletes. The regression line indicates a positive linear trend, demonstrating that athletes with greater sitting height tend to have higher $VO_2$max values. The analysis revealed a moderate positive correlation ($r = 0.405$; $p = 0.024$), indicating a statistically significant association between sitting height and aerobic capacity. Although data points are scattered, the overall distribution supports the upward direction of the regression line, confirming that taller athletes generally exhibit better cardiorespiratory fitness performance.

## DISCUSSION

This study aims to analyze the relationships among sitting height, VO2max, and muscular endurance in junior taekwondo athletes. The results show a significant relationship between sitting height and VO2max, but no significant relationship between sitting height and muscular endurance in junior taekwondo athletes. Mwagi's (2020) study found a strong correlation between sitting height and endurance capacity in boys. These contrasts with the present findings, suggesting that sport-specific demands, maturational differences, or distinct types of endurance measurements may explain the discrepancy.

$VO_2$max is the primary measure of aerobic capacity. It indicates how well the cardiovascular system delivers oxygen during intense physical activity, which is necessary to accelerate recovery and maintain performance in martial arts (Mardius et al., 2025). Previous studies have shown that taekwondo athletes generally have higher VO2max levels than athletes in other disciplines (Kadir et al., 2024). Body proportions, including sitting height, can influence VO2max both directly, through lung volume and thoracic cavity size, and indirectly, by affecting running efficiency and limb mechanics. A study conducted by Bolboli et al. (2008) found that taller individuals generally have higher VO2max values. These are evident in the Queen's Step Test and treadmill test, where taller individuals demonstrated higher VO2max values than shorter individuals. Our findings are consistent with those of Bolboli et al. (2008), reinforcing the notion that body size parameters, including sitting height, can contribute to aerobic performance, this is supported by a recent study conducted by Burton & Burton (2021), which found that an individual's height has a significant effect on lung capacity, especially in children, adolescents, and young adults. A higher sitting height is generally associated with greater lung capacity, reflecting a larger thoracic volume and lung size. Sitting height affects lung capacity through anatomical and mechanical relationships in the upper body, particularly the trunk and chest cavity. Sitting height, which is measured from the head to the buttocks while sitting, reflects the length of the torso and the volume of the chest cavity where the lungs are located. A longer SH is usually associated with a larger chest cavity, allowing greater lung volume (Burton & Burton, 2021). However, a longer torso can also lead to biomechanical inefficiency during lower-body-dominated activities, which can affect VO2max results in specific sports tests (Mwagi, 2020). A study found a significant positive correlation between lower leg length and VO2max, suggesting that leg length may influence VO2max estimates (J. S. Kim et al., 2024). These indicate that sitting height, as a component of overall height, may contribute to VO2max. However, endurance capacity in children also has a complex relationship with other factors such as explosive strength, flexibility, and agility (Kasović et al., 2021).

In contrast, the absence of a significant relationship between sitting height and muscular endurance in this study is consistent with established physiological principles. Sitting height reflects the length of the trunk from the pelvis to the head, which is more related to postural


ISSN 2615-8744

aspects and overall body proportions than to the capacity of peripheral muscles to maintain repeated contractions. Muscular endurance is more influenced by functional factors, such as the number of type I (slow-twitch) muscle fibers, aerobic metabolic efficiency, and neuromuscular adaptations resulting from specific training (van der Zwaard et al., 2021). Type I muscle fibers, which are more common in endurance athletes, are more fatigue-resistant and support prolonged activity. In junior athletes, especially in sports such as taekwondo, muscular endurance is developed more through regular training and training intensity than by anthropometric characteristics such as sitting height (Prieto-González & Sedlacek, 2022). In addition, biological development and maturation in adolescent athletes vary widely, making the relationship between static body parameters, such as sitting height, and functional fitness components inconsistent. In several studies, anthropometry did not show a strong correlation with muscle endurance, especially in younger age groups, because the musculoskeletal and metabolic systems are still adapting to exercise stimuli (Tibana et al., 2021). The nonsignificant relationship observed in this study aligns with findings by Schlegel and Křehký (2024), who reported weak correlations between anthropometric measurements and muscular fitness tests among children aged 9–12 years, this explains why, although sitting height is related to VO2max capacity due to its association with lung volume and ventilation efficiency, it does not necessarily affect the ability of muscles to maintain submaximal work over a specific period of time.

Several limitations of this study should be acknowledged. First, the study did not collect information on menstrual status among female athletes or assess pubertal development among male athletes. Biological maturation plays a significant role in shaping cardiovascular capacity, musculoskeletal development, and proportional body growth, all of which may influence performance outcomes. Second, factors such as body composition and somatotype, which are known to contribute to athletic performance, were not fully explored. Future research should integrate assessments of biological maturation and body composition among junior athletes under 18 years of age to provide a more comprehensive understanding of how morphological and developmental factors interact with performance indicators such as $VO_2$max and muscular endurance.

## CONCLUSION

This study showed that the higher a junior taekwondo athlete's sitting height, the higher their VO2max. Meanwhile, sitting height was not related to muscular endurance. These findings indicate that sitting height can be considered as one of the factors in developing VO2max capacity in junior taekwondo athletes, while improving muscular endurance depends more on training and functional adaptation. In practical terms, the results of this study can serve as recommendations for identifying and developing talent in young athletes.

## ACKNOWLEDGMENT

We want to thank all the coaches at the Gresik Taekwondo Academy for their help and support throughout this research process. We would also like to thank the Faculty of Teacher Training and Education at Majapahit Islamic University for the excellent facilities provided for this research.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this matter.


ISSN 2615-8744

**REFERENCES**

ACSM. (2018). *ACSM's guidelines for exercise testing and prescription* (D. Riebe, J. K. Ehrman, G. Liguori, & M. Magal, Eds.; 10th ed.). Wolters Kluwer.

Bergeron, M. F., Côté, J., Cumming, S. P., Purcell, R., Armstrong, N., Basilico, L., Burrows, K., Charrin, J. B., Felix, A., Groesswang, H., Iwasaki, Y., Kocher, M. S., Martowicz, M., McConnell, K., Moran, J., Holm Moseid, C., Mountjoy, M., Soligard, T., Tetelbaum, E., … Erdener, U. (2024). IOC consensus statement on elite youth athletes competing at the Olympic Games: Essentials to a healthy, safe, and sustainable paradigm. *British Journal of Sports Medicine*, *58*(17), 946–965. https://doi.org/10.1136/bjsports-2024-108186

Bolboli, L., Siahkouhian, M., Poorrahim, A., Narimani, M., Ganji, M., & Barahmand, U. (2008). Is cardiorespiratory fitness affected by the height of young girls? *Pakistan Journal of Biological Sciences*, *11*(11), 1510 – 1513. https://doi.org/10.3923/pjbs.2008.1510.1513

Burton, R. F., & Burton, F. L. (2021). When is sitting height a better measure of adult body size than total height, and why? The contrasting examples of body mass, waist circumference, and lung volume. *American Journal of Human Biology*, *33*(1), 1-11. https://doi.org/10.1002/ajhb.23433

Gama Linhares, D., Dos Santos, A. O. B., Dos Santos, L. L., Cordeiro, L. de S., de Castro, J. B. P., & Vale, R. G. de S. (2022). The effects of taekwondo practice on physical and cognitive variables in children and adolescents: a systematic review. *The European Journal of Human Movement*, *49*, Miguel Hernandez University. https://doi.org/10.21134/eurjhm.2022.49.2

Jeong, G., Jung, H., So, W. Y., & Chun, B. (2023). Effects of taekwondo training on growth factors in normal korean children and adolescents: A systematic review and meta-analysis of randomized controlled trials. *Children*, *10*(2). 1-12. https://doi.org/10.3390/children10020326

Kadir, S., Haryanto, A. I., Suardika, I. K., & Muktiani, N. R. (2024). Analysis of maximal volume of oxygen for gorontalo contingent martial arts athletes. *ACTIVE: Journal of Physical Education, Sport, Health and Recreation,* 1-12. https://doi.org/10.15294/peshr.v13i2.7561

Kasović, M., Štefan, L., Petrić, V., Štemberger, V., & Blažević, I. (2021). Functional endurance capacity is associated with multiple other physical fitness components in 7–14-year-olds: A cross-sectional study. *BMC Public Health*, *21*(1). 1-13. https://doi.org/10.1186/s12889-021-10702-2

Kim, J. S., Oh, J. S., & Kim, S. G. (2024). Assessing maximal oxygen uptake: Influence of leg length in the harvard step test and queen's college step test. *WSEAS Transactions on Biology and Biomedicine*, *21*, 227–233. https://doi.org/10.37394/23208.2024.21.23

Kim, S. (2023). Joint injury and rehabilitation in taekwondo-short review. *International Journal of Innovative Research in Computer Science & Technology*, *11*(1), 52–54. https://doi.org/10.55524/ijircst.2023.11.1.11

Laurin, L. L. (2024). Anthropometry and athletic performance in elite American taekwondo athletes with Zybek Sports. *Scientific Journal of Sport and Performance*, *3*(2), 282–290. https://doi.org/10.55860/xqkj6685

Mardius, A., Sofyan, D., Hadi, R. S., Barlian, E., Ihsan, N., Astuti, Y., & Ockta, Y. (2025). *Effectiveness of interval training in increasing VO2max in pencak silat athletes*. *14,* 1-12.

Mirali, M., Faradjzadeh Mevaloo, S., Bridge, C., & Hovanloo, F. (2022). Anthropometric characteristics of elite male taekwondo players based on weight categories. *Journal of Science in Sport and Exercise*, *4*(1), 91–97. https://doi.org/10.1007/s42978-021-00137-x

Mwagi, F. M. (2020). Relationships between anthropometric, spirometric, cardio-respiratory, and endurance performance values among male Kenyan runners. *Russian Journal of Physical Education and Sports*, *15*(1), 1-12. https://doi.org/10.14526/2070-4798-2020-15-1-5-14

Prieto-González, P., & Sedlacek, J. (2022). Effects of running-specific strength training, endurance training, and concurrent training on recreational endurance athletes' performance and selected anthropometric parameters. *International Journal of Environmental Research and Public Health*, *19*(17), 1-15. https://doi.org/10.3390/ijerph191710773

Purba, R. H., & Aprilia, T. (2022). An analysis of leg length and vo2max of junior athletes in basketball and volleyball. *Jurnal Sains Keolahragaan Dan Kesehatan*, *7*(1), 27–36. https://doi.org/10.5614/jskk.2022.7.1.3

Schlegel, P., & Křehký, A. (2024). Comparative analysis of muscular fitness tests and their correlation with anthropometric data in children aged 9–12. *Journal of Human Sport and Exercise*, *19*(3), 737–747. https://doi.org/10.55860/ZRME6W41

Tibana, R. A., Neto, I. V. de S., de Sousa, N. M. F., Romeiro, C., Hanai, A., Brandão, H., Dominski, F. H., & Voltarelli, F. A. (2021). Local muscle endurance and strength were strongly associated with performance in the CrossFit® Open 2020 among amateur athletes. *Sports*, *9*(7), 1-17. https://doi.org/10.3390/sports9070098


ISSN 2615-8744

Tumkur, T. A. N., Oliver, J. L., Lloyd, R. S., Pedley, J. S., & Radnor, J. M. (2021). The influence of growth, maturation, and resistance training on muscle-tendon and neuromuscular adaptations: A narrative review. *Sports*, *9*(5). 1-12. https://doi.org/10.3390/sports9050059

van der Zwaard, S., Brocherie, F., & Jaspers, R. T. (2021). Under the hood: Skeletal muscle determinants of endurance performance. *Frontiers in Sports and Active Living*, *3*, 1-11. https://doi.org/10.3389/fspor.2021.719434

**INFORMATION ABOUT THE AUTHORS**

**Aldi Karimullah;** https://orcid.org/0009-0005-5483-8532; aldikarimullah@unim.ac.id; FKIP, Majapahit Islamic University, Indonesia.

**Dominikus Raditya Atmaka;** https://orcid.org/0000-0001-5124-4580; dominikus.atmaka@colostate.edu; Food Science and Nutrition, Colorado State University, United States.

**CITE THIS ARTICLE AS**

Karimullah, A., & Atmaka, D. R. (2025). The Relationship between Sitting Height with VO2max and Muscular Endurance in Junior Taekwondo Athletes. JSES : Journal of Sport and Exercise Science, 8(2), 152–160. https://doi.org/10.26740/jses.v8n2.p152-160