CORRELATION BETWEEN HEIGHT, SITTING HEIGHT, PEAK GROWTH VELOCITY AND HANDGRIP STRENGTH IN BOYS PARTICIPATING IN THE FIGHT THAT TRANSFORMS PROJECT

CORRELAÇÃO ENTRE ESTATURA, ESTATURA SENTADA, PICO DE VELOCIDADE DE CRESCIMENTO E FORÇA DE PREENSÃO MANUAL EM MENINOS PARTICIPANTES DO PROJETO LUTA QUE TRANSFORMA

CORRELACIÓN ENTRE LA ALTURA, LA ALTURA SENTADA, LA VELOCIDAD MÁXIMA DE CRECIMIENTO Y LA FUERZA DE AGARRE EN NIÑOS QUE PARTICIPAN EN EL PROYECTO LUCHA QUE TRANSFORMA

Maria Antônia de Jesus Nogueira[1], João Vitor de Souza Moreira[2], Camille dos Reis Molina[3], Jefferson da Silva Novaes[4], André Calil e Silva[5], Aline Toledo de Oliveira[6], Aline Aparecida de Souza Ribeiro[7], Diogo Pantaleão[8]

ABSTRACT

Anthropometric measurements such as height and sitting height, peak height velocity (PGH), and handgrip strength are important for athletic success in judo and for children's ongoing physical development and maturation. In judo, handgrip strength (HGS) is essential for efficient technique execution, and this ability is crucial for controlling an opponent. The objective of this study was to verify the correlation between height, sitting height, peak height velocity, and handgrip strength of boys participating in the "Fight that Transforms" outreach project. Twenty-two male fifth-grade students from CIEP Luciano Gomes Ribeiro in Valença, RJ, participated in this study. Data on age, height, sitting height, body mass, body fat percentage (%Fat), HGS, and PGH were described. It is noteworthy that age and HGS

[1] Bachelor's Degree in Physical Education. Centro Universitário de Valença (UNIFAA).
E-mail: mantoniaj@gmail.com Orcid:https://orcid.org/0009-0009-5945-553X
Lattes: http://lattes.cnpq.br/3080181843494335
[2] Bachelor of Physical Education Graduate. Universidade Federal de Juiz de Fora (UFJF).
E-mail: joao.moreira@estudante.ufjf.br Orcid: https://orcid.org/0009-0005-0615-016X
Lattes: http://lattes.cnpq.br/3006026792443899
[3] Master's student in Exercise and Sport. Universidade Federal de Juiz de Fora (UFJF).
E-mail: camille.molina@hotmail.com Orcid: https://orcid.org/0009-0000-6590-7293
Lattes: http://lattes.cnpq.br/7152935671757421
[4] Dr. in Physical Education. Universidade Federal de Juiz de Fora (UFJF).
E-mail: jeffsnovaes@gmail.com Orcid: https://orcid.org/0000-0001-9304-6574
Lattes: http://lattes.cnpq.br/6229092816230905
[5] Dr. in Health Sciences. Universidade Federal de Juiz de Fora (UFJF).
E-mail: andre_calil@hotmail.com Orcid: https://orcid.org/0000-0003-4509-201X
Lattes: http://lattes.cnpq.br/1927654591838174
[6] Doctorate student in Exercise and Sport. Universidade Federal de Juiz de Fora (UFJF).
E-mail: alinetoledo13@hotmail.com Orcid: https://orcid.org/0000-0002-4253-5121
Lattes: http://lattes.cnpq.br/3032722039722486
[7] Dr. in Exercise and Sport. Universidade Federal de Juiz de Fora (UFJF).
E-mail: ribeiroasaline@gmail.com Orcid: https://orcid.org/0000-0003-3816-9306
Lattes: http://lattes.cnpq.br/2061132781436329
[8] Master in Exercise and Sport. Centro Universitário de Valença (UNIFAA).
E-mail: diogoptl@gmail.com Orcid: https://orcid.org/0000-0002-0398-5023
Lattes: http://lattes.cnpq.br/0882502914913637

presented non-normal distributions. The remaining data, due to their normal distribution, are presented as mean and standard deviation. The results revealed a strong correlation between height and HGS (r: 0.641; p<0.001); a strong correlation between sitting height and HGS (r: 0.743; p<0.001); and a strong and significant correlation between CVP and HGS (r: 0.670; p<0.001). It is concluded that height, sitting height, and CVP indices are valuable in the evaluation of potential athletes with sporting prominence. However, their primary use should be related to guiding young people toward sports that best fit their physical and social profiles, with constant monitoring of training and development over time. Furthermore, these variables have a strong correlation with HGS, which is extremely important in judo.

RESUMO

As medidas antropométricas estatura e estatura sentada, o pico de velocidade de crescimento (PVC) e a força de preensão manual são importantes para o sucesso esportivo no judô e no processo contínuo de desenvolvimento físico e maturacional das crianças. No judô a demanda da força de preensão manual (FPM) para a execução eficiente de técnicas é essencial, sendo esta capacidade fundamental para o controle do adversário. O objetivo do estudo foi verificar a correlação entre a estatura, estatura sentada, pico de velocidade de crescimento e a força de preensão manual dos meninos participantes do projeto de extensão "Luta que Transforma". Participaram desta pesquisa 22 alunos, do sexo masculino, do 5° ano do Ensino Fundamental do CIEP Luciano Gomes Ribeiro na cidade de Valença/RJ. Os dados referentes a idade, estatura, estatura sentada, massa corporal, percentual de gordura (%Gordura), FPM e PVC foram descritos. Destaca-se que a idade e a FPM apresentaram distribuições não normais. Já os demais dados, por apresentarem distribuições normais, foram apresentados em média e desvio padrão. Os resultados revelaram que há correlação forte entre a estatura e a FPM (r: 0,641; p< 0,001); correlação forte entre a estatura sentada e a FPM (r: 0,743; p<0,001) e correlação forte e significante entre o PVC e a FPM (r: 0,670; p<0,001). Conclui-se que, os índices de estatura, estatura sentada e PVC apresentam valores na avaliação de potenciais atletas com destaque esportivo, porém seu uso principal deve estar relacionado a orientação dos jovens para as modalidades que melhor se encaixem em seus perfis físicos e sociais, com constante monitoramento do treinamento e de seu desenvolvimento ao longo do tempo. Além disso, essas variáveis possuem forte correlação com a FPM que é importantíssima no judô.

RESUMEN

Anthropometric measurements such as height and sitting height, peak height velocity (PGH), and handgrip strength are important for athletic success in judo and for children's ongoing physical development and maturation. In judo, handgrip strength (HGS) is essential for efficient technique execution, and this ability is crucial for controlling an opponent. The objective of this study was to verify the correlation between height, sitting height, peak height velocity, and handgrip strength of boys participating in the "Fight that Transforms" outreach project. Twenty-two male fifth-grade students from CIEP Luciano Gomes Ribeiro in Valença, RJ, participated in this study. Data on age, height, sitting height, body mass, body fat percentage (%Fat), HGS, and PGH were described. It is noteworthy that age and HGS presented non-normal distributions. The remaining data, due to their normal distribution, are presented as mean and standard deviation. The results revealed a strong correlation between height and HGS (r: 0.641; p<0.001); a strong correlation between sitting height and HGS (r: 0.743; p<0.001); and a strong and significant correlation between CVP and HGS (r: 0.670; p<0.001). It is concluded that height, sitting height, and CVP indices are valuable in the

evaluation of potential athletes with sporting prominence. However, their primary use should be related to guiding young people toward sports that best fit their physical and social profiles, with constant monitoring of training and development over time. Furthermore, these variables have a strong correlation with HGS, which is extremely important in judo.

Palabras clave: Handgrip Strength. Height. Sitting Height. Peak Height Velocity. Judo. Children.

1 INTRODUCTION

Judo is a combat sport between two opponents, where the control and manual contact force that one fighter exerts on the other is fundamental for the execution of throwing techniques and for the dispute on the ground, being one of the most important aspects of the fight. This phase of the dispute represents a significant fraction of the entire time of the match, and the greater efficiency in these moments can be a differential in determining the winner and loser of the match (Junior *et al* ., 2023; Aboelwafa, 2024).

This contact occurs through the hand grip force exerted by the fighters, when they grip the specialized judo garment, the judogi. Judokas use this mechanism to maintain an adequate distance for the application of blows and protect themselves from offensive techniques performed by their opponents, in addition to being an important way to maintain their posture and later interrupt the opponent's balance (Sterkowicz *et al*., 2016; Aboelwafa, 2021).

One of the most important fundamentals of judo, the *Kumi-Kata* (judogi grip), depends directly on the hand grip strength of the fighters. This is largely responsible for the success and efficiency of the sport's training and competition practices (Aboelwafa, 2024). The relevance of this foundation for judo can be observed by the fact that athletes in the modality have higher handgrip strength than non-judo practitioners, regardless of age group (De Honorato *et al*., 2020).

The importance of this physical valence within the sports context has instigated studies on its relationship with other anthropometric indices, especially with height (Alkholy *et al.,* 2016). The height of these individuals, despite being constantly changing and being only a prognosis of the final height of children and adolescents, is an index that has shown a positive correlation with handgrip strength (Junior *et al* ., 2023).

Other indices that have not been previously correlated with handgrip strength, such as sitting height and peak growth velocity, are related to total height in children and adolescents (Masanovic *et al*., 2019; Cao *et al* ., 2019). In this way, it is possible to prospect about connections between these characteristics and handgrip strength. Sitting height refers to the measurement from the highest point of the head to the surface on which the individual is sitting (Ramoshaba *et al*., 2017) standing out as a measure that can give a prognosis on: final height, body mass index and blood pressure (Marcato *et al*., 2014; Masanovic *et al.,* 2019).

Peak growth velocity is an index that predicts the speed and at what point puberty is in children and pre-adolescents of both sexes (Cao *et al*., 2019). Thus, it is relevant as a measure that can indicate moments of greater growth in the physical valences of these

individuals, including handgrip strength and height, which in turn is also related to sitting height (Marcato *et al*., 2014; Mills *et al*., 2017).

Granados, Gebremariam and Lee (2015) found that peak growth speed is an important marker of height for boys and girls. Similarly, sitting height is an important measure for inferring final height (Marcato *et al*., 2014). These relationships indicate that the correlation between handgrip strength and height may also be present in these other anthropometric indices that would significantly affect judo performance.

In view of the above, it is important to assess height, sitting height, peak growth speed and handgrip strength both for the child's maturational development and for the improvement of physical performance. However, there is a lack of Brazilian studies that study children and adolescents who practice judo and that analyze height, sitting height, peak growth speed and their relationship with handgrip strength. Thus, the objective of the present study was to verify the correlation between height, sitting height, peak growth speed and handgrip strength of the girls participating in the extension project "Luta que Transforma".

2 METHODOLOGY

This study was approved by the Research Ethics Committee of UNIFAA, according to Resolution CNS 466/2012, under CAAE number: 67147723.0.0000.5246. All the parents or guardians of the participants in this study signed the Informed Consent Form (ICF). As an inclusion criterion, boys should be participants in the "Struggle that Transforms" Project. The exclusion criteria were: the presence of physical disabilities (permanent or temporary) that made the evaluations impossible; use of pacemakers; use of medications that could interfere with body composition or physical capacities; non-agreement of parents or students.

Anthropometric measurements of body mass and height were performed according to Lohman, Roche and Martorell (1988). Height was measured in centimeters using a portable stadiometer (Portable Stadiometer 210, Wiso, Florianópolis, Brazil), with a precision of 0.1 cm. Body mass and body composition were analyzed using a segmental multifrequency bioimpedance scale (Inbody 270, Biospace Co, Seoul, Korea).

Body mass and body composition were analyzed using a segmental multifrequency bioimpedance meter. The system is a tetrapolar with 08 (eight) electrodes, emitting frequencies of 20kHz and 100 kHz, of the Inbody brand and model 270. The values of relative fat percentage, skeletal muscle mass and hydration level were verified. The students were instructed about the collection protocols before and 24 hours before the tests. The pre-test protocols were in accordance with the recommendations of Heyward (2013).

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- Fasting from food and beverages in the 04 hours prior to the exam time.
- Drink two glasses of water (500ml) two hours before the test.
- Do not consume alcoholic beverages 48 hours before the exam.
- Avoid excessive consumption of caffeine-rich foods (chocolates, dark teas, and coffee) the day before the exam.
- In the 12 hours prior to the exam, do not perform moderate or intense physical exercise.
- Not being on your period.
- Not be feverish on test day.
- Urinate at least 30 minutes before the exam.

Sitting height was performed by measuring the length of the torso and head of the boys, using a stadiometer with a stool for support, ensuring that the legs do not interfere with the measurement. The subject sat with his back straight, knees bent at 90 degrees, and feet supported. The head should be on the plane of Frankfurt, with its gaze fixed in front.

The maturational state of the research subjects was evaluated according to the methods described by Mirwald *et al*. (2002). This approach has been suggested as an indicator of somatic maturity and predicts the years from peak growth velocity (YPHV) using anthropometric variables such as age, weight, height, sitting height, and leg length, according to the following equations:

Male CVP = − 9.236 + [0.0002708 * (Leg Length (Cm) * Torso Height (Cm))] + [− 0.001663 * (Chronological Age * Leg Length (Cm))] + [0.007216 * (Chronological Age * Torso Height (Cm))] + [0.02292 * (Body Weight (Kg) / Height) * 100]

Based on the final values of the results of the equations, in relation to chronological age, the subjects can be classified into three stages of somatic maturation: 1) Pre-PVC (PVC<-1); 2) During PVC (PVC ≥-1 or PVC ≤+1); and 3) Post-PVC (PVC >+1).

To evaluate the handgrip strength (HGS), a manual dynamometer was used, which consists of a hydraulic gauging system. As the participant presses the bars, they cause an alteration of the gauges, being directly proportional to the force exerted on the bars. The participants performed this handgrip for 03 (three) seconds, with the greatest possible force, sitting in a chair with their feet resting on the floor and the lumbar back resting on the back of the chair. The shoulders were adjusted so that they were close to the torso, the elbows flexed at 90º. The participant had three opportunities to perform with the dominant member. The highest measure among the executions was noted.

All evaluations were supervised by at least two people inside the evaluation room to avoid embarrassment or anything of the sort. The presence of the person in charge was also

allowed to monitor the evaluations, if he deemed it necessary. The girls wore a blouse and shorts or similar two-piece attire.

3 RESULTS

Statistical analysis was performed using the SPSS software (v.27, Chicago, IL). The normality of the data was verified by the *Shapiro-Wilk* test (p > 0.05). Normally distributed data were expressed as mean and standard deviation; Data that were not normally distributed were presented as median and interquartile range. Correlations were evaluated using *Pearson*'s coefficient, if both variables had a normal distribution; otherwise, Spearman's coefficient was used. A significance level of p < 0.05 was adopted for all analyses.

22 male students from the 5th year of Elementary School at CIEP Luciano Gomes Ribeiro in the city of Valença/RJ participated in this research. Data regarding age, height, sitting height, body mass, fat percentage (%Fat), handgrip strength, and peak growth velocity (CVP) are described in Table 1. It is noteworthy that age and handgrip strength presented non-normal distributions, so their values were expressed as median and interquartile range. The other data, on the other hand, as they presented normal distributions, were presented as mean and standard deviation.

Table 1

Results of the variables age, height, %Fat, body mass, sitting height, handgrip strength

Variables	Average Value ± Change
Age (years)	11,25 [10,95; 12,07]
Height (cm)	151.35 (± 9.49)
Sitting Stature (cm)	74.45 (± 4.30)
Body mass (kg)	50.47 (± 14.34)
% Fat	29.14 (±12.62)
PVC (years)	-2.20 (±0.84)
Handgrip Strength (Kgf)	21,50 [18; 27]

Legend: Kg=kilogram; Kgf=kilogram force; cm=centimeters.

The individuals were 11.25 [10.95; 12.07] years old, 151.35±9.49 cm tall, body mass 50.47 (±14.34) kg, % fat 29.14 (±12.62) and PVC -2.20 (±0.84) years. It is observed that the handgrip strength obtained a value of 21.50 [18; 27] Kgf.

To correlate the variables, we chose to use *Spearman's correlation* (p<0.05) because handgrip strength data did not respect the normality of the data. *Spearman*'s correlation

indicated a strong and significant correlation between the variable height and handgrip strength (ρ: 0.641; sig.<0.001). In addition, the association between the variable sitting height and handgrip strength was also strong and significant (ρ: 0.743; sig.<0.001). With the variable CVP correlating with handgrip strength, the correlation was also strong and significant (ρ:0.670; sig.<0.001). Table 2 below presents the correlations mentioned above.

Table 2

Results of *Spearman*'s correlation between handgrip strength

Variable (n:22)	Handgrip Strength (ρ)	Significance
Stature	0,641**	<0.001
Sitting Stature	0,743**	<0.001
PVC	0,670**	<0.001

PVC: Peak Growth Velocity; **: Strong Correlation Coefficient

4 DISCUSSION

The objective of the present study was to verify the correlation between height, sitting height, peak growth speed and handgrip strength of the girls participating in the extension project "Luta que Transforma" (Struggle that Transforms). It was found that there is a strong correlation between height and handgrip strength (r: 0.641; p< 0.001); strong correlation between sitting height and handgrip strength (r: 0.743; p<0.001) and strong and significant correlation between CVP and handgrip strength (r: 0.670; p<0.001).

Previous studies (Pua *et al.,* 2023*;* Chang *et al.,* 2024) demonstrated the existence of a correlation between height and handgrip strength, but in adults. Greater stature can be an indicator of higher lean mass indices of individuals, which in turn positively correlates with handgrip strength, including in young judokas (Junior *et al*., 2023). Aboelwafa (2024) also finds a positive correlation between total weight and handgrip strength of judokas aged 18 to 20 years. Although these studies show a relationship based on data from adults, the evidence created shows that the relationship between height and higher handgrip strength values is mainly linked to greater total body mass and greater mass of the arm segment, a relationship that can also be made for children and pre-adolescents. This fact justifies the strong correlation found between height and handgrip strength of the sample.

Directly related to height, the values found for sitting height also showed a strong correlation with handgrip strength. Used as a strong prognosis of the final height of children and adolescents (Ramoshaba *et al*., 2017), sitting height is also an indicator of the individual's total mass amount, which correlates positively with handgrip strength. Sitting height does not consider the weight and length of the lower limbs in its measurement, being an index with a

good ability to tell about the body mass of the upper limbs of individuals, which is effectively the engine of handgrip strength (Marcato *et al*., 2014; Junior *et al*., 2023). This circumstance possibly explains the greater correlation found by sitting height than by total height, despite the fact that both are directly connected. The higher value obtained from sitting height shows that this may be a better value to be used in prospecting new talents for judo than total height.

Peak growth velocity is the period when children and adolescents show the greatest growth in their height (Tsutui *et al*., 2022). Thus, it is strongly related to total height and sitting height, so that the strong correlation between CVP and HGS is possibly linked to higher values of both heights. CVP represents the period of the growth spurt of boys and girls, which is an indicator phase of biological and anatomical changes in adolescents, such as greater release of hormones and increased lean body mass, responsible for increased muscle strength and activation, influencing higher HGS values (Philipparets *et al*., 2005; Tsutui *et al*., 2022). This PVC maturation signal gives an additional view not present in the total height index, possibly justifying the higher correlation value found by this index when compared to the height index.

According to Ribeiro *et al*. (2023), Brazilian coaches point to the grip in judogi (*Kumi-Kata*) as an essential skill for young judokas, indicating a possible success that this individual has in the future of the sport. Largely responsible for this foundation, handgrip strength showed a strong correlation with height, sitting height, and CVP values, which should be carefully observed by coaches to prospect for new talents in the sport.

However, caution should be exercised regarding the exclusion of athletes who do not present good indices of these characteristics. Although a good HGS is important for the practice of judo, the time of practice in the modality is responsible for the increase in this characteristic (Lima *et al.,* 2014*).* Enabling young judokas to evolve in the foundation of the footprint throughout their practice. In addition, changes in other physical characteristics such as speed, endurance, and agility are also of paramount importance in judo and are developed over time on a continuous basis, serving as an important form of talent identification that does not involve HGS (Ramos *et al*., 2021).

Thus, the height, sitting and CVP indices present values in the evaluation of potential athletes with sports prominence, but their main use should be related to the orientation of young people to the modalities that best fit their physical and social profiles, with constant monitoring of training and its development over time (Miranda *et al.,* 2019; Norjali *et al*., 2017). The evidence created from the data from this research demonstrates not only important indices for the prospection of good athletes, but also for the guidance and direction of the members of the "Luta que Transforma" Project.

5 CONCLUSION

The results of this study suggest that the evaluation of height, sitting height and peak growth velocity of the members of the "Luta que Transforma" Project is essential for the best progression of HGS and for their health and quality of life. Scientific evidence shows that overweight children and adolescents have lower muscle strength when compared to eutrophic adolescents. For Brazilian judo coaches, the technical ability of grip is an important factor and indicator of the sporting potential for the development of talented young judokas. Thus, the results of this research indicate the correlation between height, sitting height, peak growth speed and HGS to guide students from the point of view of sports performance and health.

It is worth noting that it is necessary to be cautious about excluding athletes who do not have good rates of these characteristics, because although a good FPM is important for the practice of judo, the time of practice in the modality is responsible for the increase in this characteristic. Thus, the height, sitting height and CVP indices present values in the evaluation of potential athletes with sports prominence, but their main use should be related to the orientation of young people to the modalities that best fit their physical and social profiles, with constant monitoring of training and its development over time. The evidence created from the data from this research demonstrates not only important indices for the prospection of good athletes, but also for the guidance and direction of the members of the "Luta que Transforma" Project.

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