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Morphological Determinants of Muscle Strength in Single and Multi-Joint Movements: Influence of Muscle Dimensions and Anthropometry

Determinantes Morfológicos de la Fuerza Muscular en Movimientos Monoarticulares y Multiarticulares: Influencia de las Dimensiones Musculares y la Antropometría

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KOJIC, F.; ARSENIJEVIC, R. & DURIC, S. Morphological determinants of muscle strength in single and multi-joint movements: Influence of muscle dimensions and anthropometry. *Int. J. Morphol., 44(3)*:821-828, 2026.

SUMMARY: The aim of this study was to investigate the predictive role of selected morphological and anthropometric factors on muscle strength performance in single- and multi-joint resistance exercises. The sample consisted of 16 university students (seven females). Muscle strength was expressed as total external load, calculated as the sum of the one-repetition maximum (1RM) and the estimated mass of the involved body segments, determined according to Dempster's anthropometric method. Strength performance was assessed using two exercises: a single-joint movement (preacher curl) and a multi-joint movement (parallel squat). Muscle thickness (MT) of the biceps brachii and cross-sectional area (CSA) of the quadriceps femoris were assessed using ultrasound imaging, while total and segmental skeletal muscle mass (SMM) were estimated by bioelectrical impedance analysis. Additionally, body height, body mass, and body mass index were measured. Pearson's correlation analysis revealed significant positive relationships ($p < 0.05$) between total external load in both exercises and all examined morphological variables ($r = 0.56$-0.94). However, regression analysis identified biceps brachii MT as the strongest predictor of strength performance in the preacher curl ($R^2 = 0.882$, $p < 0.01$), whereas leg SMM, body mass, and body height emerged as significant predictors of parallel squat performance ($R^2 = 0.873$, $p < 0.01$). These findings suggest that strength performance in single-joint elbow flexion is primarily associated with the size of the involved muscle, while performance in multi-joint exercises such as the squat depends on a combination of muscle mass and anthropometric characteristics, reflecting the greater mechanical and coordinative complexity of the movement.

KEY WORDS: Preacher curl; Parallel squat; Muscle thickness; Cross-sectional area; InBody 720.

INTRODUCTION

Muscular strength is defined as the ability to exert force against an external object or resistance. It is a key attribute essential for everyday activities, such as lifting, carrying, and climbing, and plays a critical role in various sports, including weightlifting, sprinting, and gymnastics. Strength testing is therefore vital for evaluating physical performance across the general population and for monitoring training adaptations in athletes (Jaric, 2002; Bohannon, 2019).

Typically, both neural (musculo-tendinous stiffness, motor unit recruitment, rate coding, motor unit synchronization, and neuromuscular inhibition) and morphological (i.e. muscle cross-sectional area and anthropometry) factors are known to determine production of maximal muscular strength (Suchomel *et al*., 2018). Neural adaptations, including increased motor unit recruitment, improved motor unit synchronization, and enhanced neuromuscular transmission, contribute substantially to strength gains, especially in the initial phases of training (Kojic *et al*., 2022). Increased motor unit recruitment allows the nervous system to activate more muscle fibers during contraction, leading to greater force production. Improved motor unit synchronization enhances the coordinated activation of muscle fibers, increasing the efficiency of force generation. Enhanced neuromuscular transmission improves the signal transmission between the nervous system and the muscle fibers, leading to more effective muscle activation (Folland & Williams, 2007; Suchomel *et al*., 2018). These neural adaptations are crucial

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for maximizing force production, and their interaction with morphological changes determines the overall strength capabilities (Folland & Williams, 2007).

Considering morphology, muscle size and anthropometric features (e.g., body mass and height, body composition) are known to profoundly impact a muscle's force-generating capability (Folland & Williams, 2007). Measures of muscle dimension such as muscle thickness (MT) and cross-section area (CSA), often measured using ultrasonography or computed tomography, provide direct assessments of muscle size (Bemben, 2002). These measurements frequently correlate positively with maximal strength, reflecting the increased force-generating potential of larger muscles (Akagi *et al*., 2008; Weeks *et al*., 2016; Balshaw *et al*., 2021; Kojic *et al*., 2021; Lanza *et al*., 2022). A larger CSA indicates a greater number of muscle fibers in parallel, leading to a greater potential for force development. Similarly, greater MT indicates increased muscle volume, which is often associated with increased strength (Folland & Williams, 2007; Akagi *et al*., 2008).

However, the relationship between muscle size and strength is not always straightforward. Several studies have investigated the predictive value of MT and CSA for estimating maximal strength in various muscle groups. The results have varied depending on the specific muscle, measurement technique and population studied (Akagi *et al*., 2008; Di Naso *et al*., 2012; Kojic *et al*., 2021; Kojic *et al*., 2022). For instance, in single-joint movements, such as elbow flexion, the correlation between muscle size and strength is typically stronger. The CSA of the primary mover muscle can explain up to 90 % of the variance in maximal strength in these movements (Akagi *et al*., 2011; Kojic *et al*., 2022). Since these exercises primarily rely on a single muscle group with minimal contribution from stabilizing muscles or complex coordination, the force-generating capacity of the targeted muscle is a primary determinant of performance. Studies have shown that MT and CSA are significant predictors of maximal strength in isolated contractions, as neural and mechanical factors are more straightforward (Akagi *et al*., 2011; Trezise *et al*., 2016). In contrast, multi-joint movements, such as the squat, bench press, or deadlift, involve multiple muscle groups working together, requiring greater neuromuscular coordination (Folland & Williams, 2007). The contribution of prime mover CSA to strength in these exercises typically ranges between 30 % and 50 %, suggesting that additional factors such as intermuscular coordination, motor unit recruitment and biomechanics play a role (Suchomel & Stone, 2017; Kojic *et al*., 2021). For instance, two individuals with similar quadriceps size may exhibit different squat performances due to differences in hip extensor contribution, core stability and technique. Additionally, neural adaptations such as motor unit synchronization, rate coding and agonist-antagonist coordination play a more significant role in multi-joint movements, contributing to greater variability in the muscle size-strength relationship (Folland & Williams, 2007).

Anthropometric characteristics, such as body composition (fat-free mass, regional muscle mass, body mass) and longitudinal dimensions (height and limb length), also modulate strength performance. Fat-free mass (FFM), which includes skeletal muscle mass, is a strong predictor of absolute strength, as individuals with greater FFM tend to produce higher maximal forces (Ferland *et al*., 2020). Still, the distribution of muscle mass is equally important; for example, lower-body muscle mass correlates more strongly with squat and leg press strength, whereas upper-body muscle mass better predicts bench press performance (Stanelle *et al*., 2021). Also, height and limb proportions influence mechanical efficiency in strength tasks (Jaric, 2002; Stanelle *et al*., 2021). Taller individuals with longer limbs may experience greater torque demands in certain lifts, potentially reducing relative strength in movements such as the squat (Vigotsky *et al*., 2019). However, they may benefit from a mechanical advantage in single-joint exercises like the triceps pushdowns or knee extension, where a longer range for force application can be advantageous (Stanelle *et al*., 2021). Additionally, segment proportions, such as the ratio of limb length to torso length, play a role in optimizing movement mechanics. For example, individuals with shorter femurs relative to their torso often have a biomechanical advantage in squatting, whereas those with longer arms may perform better in pulling exercises (Jaric, 2002).

Although the relationship between morphological determinants and maximal strength is well-established, uncertainty remains regarding which specific factors best explain strength performance in both single- and multi-joint movements. Notably, most prior studies have focused on single morphological variables - such as muscle CSA or MT - without fully considering the potential influence of anthropometric factors (and vice versa). Therefore, the aim of the present study was to develop an optimized predictive model for maximal strength integrating multiple morphological determinants such as muscle dimensions (CSA and MT), body composition and anthropometric characteristics.

MATERIAL AND METHOD

Subjects

The sample included 16 university volunteers (9 males and 7 females) with no experience of resistance training. During the sample selection, the study was advertised to all departments at the university. Both sexes were included to reduce gender sampling disparity in sports science and medical research. Participants were not professional athletes and did not suffer from any injuries. All participants voluntarily participated in the study and previously signed a written informed consent regarding the experimental procedure and potential risks. The study was approved by the Ethics Committee of the Faculty of Sport and Physical Education, University of Belgrade (protocol number: 2316/19-2) and conducted in accordance with the Declaration of Helsinki.

Experimental design

Morphological and strength variables were collected on two separate days. On the first day, the evaluation focused on morphological measurements including anthropometry, body composition, muscle CSA and MT. On the second day, maximal strength was assessed using biceps curl and squat exercises. Prior to the strength testing, two familiarization sessions were conducted. During these sessions, participants received instructions on the proper techniques for the biceps curl and squat exercises and performed two controlled sets of 8–10 repetitions for each exercise to ensure proper form and adaptation to the testing protocol.

Anthropometry

Body height was measured using a Martin's portable anthropometer (Siber-Hegner, Switzerland) with an accuracy of 0.1 cm. Body composition variables - including skeletal muscle mass (SMM), as well dominant arm SMM and leg SMM - were assessed using the In-Body 720 (Biospace Co., Seoul, Korea) via the Direct Segmental Multi-Frequency Bioelectrical Impedance Analysis (DSM-BIA) method. Prior to testing, subjects were instructed to refrain from eating in the morning, avoid any exercise for 24 hours before the body composition analysis, and attend to all physiological needs. In addition, subjects remained in a standing position for at least 5 minutes before the measurement to allow for the redistribution of body fluids. During the measurement, all subjects wore light sport clothing and removed any metal accessories. The dominant arm and leg were determined by asking each subject, "Which arm/leg would you use to throw/shoot a ball?" (Kojic *et al*., 2021), and these variables were used for further analysis.

Muscle dimensions assessment

Muscle dimensions were evaluated using an ultrasonic device (Siemens Antares, Erlangen, Germany) with the 2D ellipse diagnostic method for five muscles: the elbow flexor (biceps brachii muscle, BB) and four knee extensors (rectus femoris, RF; vastus intermedius, VI; vastus medialis, VM; and vastus lateralis, VL). Measurements were performed with subjects seated, with their elbows and knees extended and relaxed. The transducer, operating at variable high frequencies (7–13 MHz), was held vertically with minimal pressure against the skin. A water-soluble transmission gel was applied between the transducer and the skin to ensure optimal image quality. The imaging technique used was previously validated by our research group (Kojic *et al*., 2021; Kojic *et al*., 2022).

For biceps brachii, the muscle thickness (MT) was measured at two-thirds of the distance from the acromion to the antecubital crease. The MT was defined as the distance (in centimeters) from the superficial to the deep fascia layers, and the average of two measurements was used for statistical analysis. The CSA of the four knee extensor muscles were expressed in square centimeters (cm∑). Specifically, the CSA of the rectus femoris was measured at the proximal section of its distal third, above the musculoskeletal joint. The CSAs of the vastus intermedius and vastus medialis were measured at the distal part, just above the patella. For the vastus lateralis, the visible portion was measured at the distal third directly above the patella, below the level of the rectus femoris.

All measurements were performed by the same specialized musculoskeletal radiologist to ensure consistency.

Strength assessment

Muscle strength was expressed as external load (EL), incorporating both the one-repetition maximum (1RM) and the body mass segments involved, calculated using Dempster's method (Dempster & Gaughran, 1967). This approach was chosen because 1RM alone reflects only the lifted weight and does not account for the mass of other body segments (e.g., head, trunk, and upper legs during squats), which may contribute to the overall resistance during exercise. By including these segments, we aimed to provide a more accurate and comprehensive estimate of the external load encountered during resistance exercises (Kojic *et al*., 2021).

The 1RM test was utilized for two exercises: elbow flexion on Scott's bench (i.e., preacher curl) and parallel barbell squat. The testing protocol followed the guidelines proposed by (Baechle & Earle, 2008). After a 10-minute warm-up (5 min cycling and 5 min mobilization exercises), participants performed 8–10 repetitions with approximately 50 % of their 1RM, followed by 2–3 repetitions with 60–

80 % of their 1RM. Each participant was allowed up to 5 attempts to lift the maximum weight, with a 3-minute rest period between the trials.

For the preacher curl test, a curling bar was used while maintaining the radio-ulnar joint in a supinated position. The participant's axillae and the backs of the arms were supported by the pad, and the bench height was individually adjusted to ensure a straight trunk with both feet flat on the floor. Participants were required to complete the full range of motion. For the squat test, a straight barbell was placed across the acromion, and participants stood with their feet shoulder-width apart. The concentric phase of the exercise was performed until an upright vertical position was reached. During the eccentric phase, the movement continued until the femur bones were parallel to the floor, at which point the trochanter major and the lateral epicondyle of the femur were aligned (Kojic *et al*., 2021). The individual depth of the squat was measured for each participant and an elastic band was positioned at the appropriate height. Participants were required to touch the band during the eccentric phase to confirm that they had achieved a 90- degree knee angle. The weights were selected by coach/ researcher only.

Statistical analysis

The Shapiro-Wilk's test was used to test the normality of the distribution. For all variables in experiment descriptive statistics parameters are provided (Mean – average value, SD – standard deviation, Min – minimal value, Max – maximal value). To examine the associations between EL elbow flexion and its morphological variables (biceps MT, arm SMM, body mass, total SMM, body height), and EL squat and with its group of morphological variables (quadriceps CSA, leg SMM, body mass, total SMM, body height), Pearson's correlation coefficient was employed. Pearson correlation (r) strength categorization was used according to (Hopkins *et al*., 2009): trivial (0.01), small (0.1), moderate (0.3), large (0.5), very large (0.7), and extremely large (0.9). In the discussion section, the correlation coefficients were compared directly with their 95 % confidence intervals. Further, coefficient of determinants were also provided (r^2) and a backward multiple regression analysis was accessed to determine the most appropriate best fitting model of morphological variables for each external load (EL preacher curl and EL squat) item independently. Note that both EL elbow flexion and EL squat have its group of variables for fitting model, and some variables are included (i.e., body mass, SMM, body height) in both morphological groups of variables. Prior to the regression analysis, multicollinearity was assessed using a variance inflation factor (VIF), and any variable with a VIF of 10 or higher was excluded from the model (Duric *et al*., 2022). The statistical analysis was performed using Ibody mass SPSS Statistics software package (version 20, SPSS Inc, Chicago, IL, USA). All data are presented as mean and standard deviation. A significance level of $p \leq 0.05$ was considered statistically significant.

RESULTS

Descriptive statistics for measured variables are displayed in Table I. In correlation matrix between reached curl EL with morphological variables (Table II), numerous large-to-extremely large correlations (r: 0.564 - 0.940) were found. In particular, preacher curl EL was positively associated with all observed variables that were observed at the 0.01 level, except for body height, which was significant at the 0.05 level. Specifically, biceps MT and arm SMM have showed the highest (i.e., extremely large) correlation, followed by total SMM with very large association, and body mass as well body height accomplished large association with variable of interest (i.e., preacher curl EL).

Table I. Descriptive statistics for all variables.

Variables	Mean	SD	Min	Max
Biceps MT	20.925	6.498	12.800	33.700
Arm SMM	3.303	0.971	1.670	5.150
Body mass	70.438	12.312	50.000	100.000
Total SMM	33.499	7.213	20.100	45.100
Body height	1.753	0.085	1.600	1.890
Quadriceps CSA	1265.188	282.857	763.000	1786.000
Leg SMM	9.301	1.922	5.590	11.960
EL preacher curl	29.879	12.171	13.240	55.624
EL squat	140.913	29.808	96.960	205.300

Mean - average value; SD - standard deviation; Min - minimal value; Max - maximal value; MT - muscle thickness; SMM - skeletal muscle mass; CSA - cross-sectional area; EL - external load.

Table II. Correlation between elbow flexion EL with morphological parameters.

Variables		Biceps CSA	Arm	Body mass	Total	Body height
EL preacher curl	*r*	0.940**	0.919**	0.643**	0.891**	0.564*
	p	0.000	0.000	0.001	0.000	0.023

biceps MT – biceps brachii cross-sectional area; ASMM - arm skeletal muscle mass; body mass - body mass; Ubody mass - upper body mass; total SMM - total skeletal muscle mass; body height - body height; FM - forearm mass; preacher curl EL - external load of biceps brachii; r – correlation coefficient; p - statistical significance. *$p < 0.05$; ** $p < 0.01$

Correlation matrix data between squat EL and morphological variables is presented in Table III. Values of correlation coefficient were in a range of large-to-very large (r: 0.658 - 0.883). Squat EL accomplished very large relationship with leg SMM, body mass and total SMM, while large correlation was discovered with quadriceps CSA and body height. Additionally, squat EL has reached a positive association at the 0.01 level with the most variables (quadriceps CSA, leg SMM, body mass and total SMM), while 0.05 level achieved only one variable (body height).

Table III. Correlation between parallel squat external load with morphological parameters.

Variables		Quadriceps	Leg SMM	Body mass	Total SMM	Body height
EL squat	*r*	0.678**	0.852**	0.839**	0.883**	0.658*
	p	0.004	0.000	0.000	0.000	0.006

QFCSA - quadriceps femoris cross-sectional area; leg SMM - legs skeletal muscle mass; body mass - body mass; total SMM - total skeletal muscle mass; body height - body height; squat EL - external load of quadriceps femoris; r - correlation coefficient; p - statistical significance. * $p < 0.05$; ** $p < 0.01$

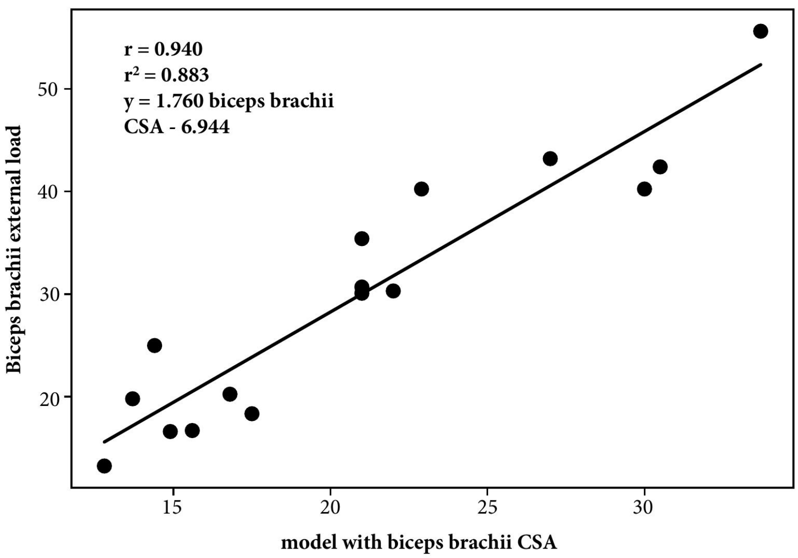

Fig. 1. Best-fit regression model with biceps brachii cross-sectional area (BBCSA) in predicting external load biceps brachii (ELBB)

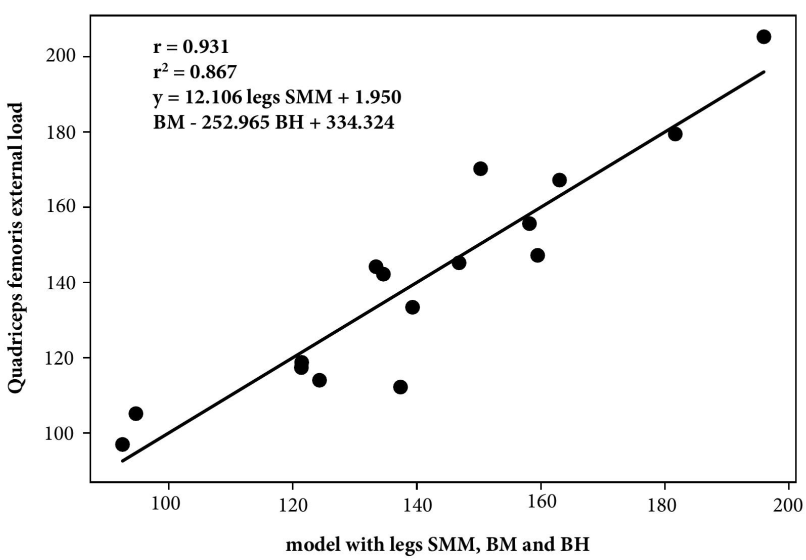

Fig. 2. Best-fit regression model with leg skeletal muscle mass (LSMM), body mass (BM), and body height (BH) in predicting external load biceps brachii (ELBB)

Subsequent regression analysis (backward regression model), yielded the best fitting model, which included biceps MT as the most important independent factor in the performance of the preacher curl EL. This model has explained about 88 % of the mentioned dependent test (biceps MT: p = 0.000), and equation and r, r2 values are shown in Figure 1.

In the case of the squat EL, as dependent variable, backward regression model singled out variable leg SMM, body mass and body height as best fit in describing around 87 % of variance (leg SMM: p = 0.004; body mass: p = 0.006; body height: p = 0.012). This model equation and r, r^2 values are presented in Figure 2.

DISCUSSION

This study aimed to examine the predictive value of various morphological characteristics, specifically muscle dimensions and anthropometric variables, on maximal strength in single- and multi-joint movements. The findings support the established view that while localized muscle morphology is a key determinant of strength in single-joint exercises, multi-joint strength performance is influenced by a broader set of anatomical characteristics.

The regression analysis revealed that biceps brachii CSA was the strongest predictor of elbow flexion strength, explaining approximately 88 % of its variance. This aligns with prior studies (Akagi *et al*., 2008, 2011) demonstrating the high predictive power of muscle CSA in isolated, single-joint tasks. The extremely large correlations between elbow flexion strength and both biceps MT (r = 0.940) and arm SMM (r = 0.919) highlight the mechanical specificity of the task: the biceps curl minimally engages other joints or stabilizing muscles, allowing the size and mass of the prime mover to dominate performance outcomes. An interesting methodological consideration arises from Akagi *et al*. (2015), who showed that contraction-induced increases in CSA at 80 % MVC are more predictive of maximal voluntary contraction than resting CSA. Their findings suggest that muscle deformation and fibre recruitment under high tension may offer a more functionally relevant measure of size-strength relationships. Although our study assessed MT at rest, such contraction-based metrics may offer additional explanatory value and warrant further exploration.

In contrast, lower-body strength during the parallel squat was best predicted by a combination of leg SMM, total body mass, and height, jointly explaining 87 % of the variance. This agrees with previous work (Keogh *et al*., 2005; Vigotsky *et al*., 2019; Stanelle *et al*., 2021) emphasizing that multi-joint tasks such as the squat are influenced by multiple interacting factors, including muscle mass distribution, limb proportions, and whole-body leverage. Although quadriceps CSA demonstrated a large correlation with squat strength (r = 0.678), it did not emerge as an independent predictor, indicating that single-muscle morphology alone is insufficient to explain performance in more complex movements. Interestingly, despite body height showed positive correlation with squat strength, further regression analysis revealed that this relationship reverses and that longitudinal dimensions have negative impact on squat performance. Still, whether this finding may appear counterintuitive, it is biomechanically plausible. Greater stature is typically associated with longer limb segments, particularly longer femurs, which increase external moment arms at the hip and knee during squatting (Jaric, 2002). This elevates the torque demands placed on the extensor musculature for a given external load, thereby reducing mechanical efficiency when muscle mass is held constant. Consequently, taller individuals may demonstrate reduced squat performance relative to shorter individuals unless compensatory factors such as greater lower-body muscle mass or favourable segment proportions are present (Jaric, 2002; Vigotsky *et al*., 2019).

The discrepancy between the predictors of single- versus multi-joint strength becomes clearer when considering the biomechanical and neuromuscular demands of compound movements (Folland & Williams, 2007; Vigotsky *et al*., 2019). Single-joint tasks, such as the biceps curl, involve constrained degrees of freedom, minimal intermuscular coordination, and rely mainly on a single prime mover (Akagi *et al*., 2011, 2015.). In such cases, localized morphology directly reflects functional capacity. In contrast, the squat requires simultaneous hip, knee, and spinal extension, where biarticular muscles such as the hamstrings contribute to hip extension while imposing a knee flexion moment, increasing quadriceps demands (Bryanton *et al*., 2015; Vigotsky *et al*., 2019). Due to these mechanical interactions, net joint moments during squatting rarely approach the maximumtorque each joint can produce in isolation (Vigotsky *et al*., 2019). Thus, performance emerges from a complex interplay of muscle size, limb proportions, segmental mass distribution, kinematics, and neuromuscular coordination (Jaric, 2002; Vigotsky *et al*., 2019; Stanelle *et al*., 2021).

These nonlinear interactions help explain why quadriceps CSA did not independently predict squat strength. Instead, broader anthropometric variables like body mass, height, and leg skeletal muscle mass captured the integrative, whole-body nature of force generation (Keogh *et al*., 2005; Stanelle *et al*., 2021). This finding supports the notion that increasing the size or strength of a single muscle group does not guarantee improved performance if synergists, stabilizers, or segment lengths impose limiting constraints. Multi-joint strength therefore reflects coordinated intermuscular function rather than isolated muscular capacity (Folland & Williams, 2007; Vigotsky *et al*., 2019).

The distinction between predictors of strength in single- versus multi-joint tasks underscores the importance of context-specific assessments in strength profiling and training program design. In practical terms, assessments relying solely on muscle CSA or segmental mass may be adequate for estimating isolated joint capacity (Akagi *et al*., 2008; Trezise *et al*., 2016) but may underestimate performance in compound exercises where intermuscular coordination and biomechanics are decisive (Jaric, 2002; Folland & Williams, 2007). This has clear implications for strength diagnostics in sport and rehabilitation (Suchomel *et al*., 2018). Moreover, the differential predictive models observed in this study reinforce the principle of training specificity (Reilly *et al*., 2009). Interventions aimed at improving single-joint strength may rely more heavily on hypertrophy-focused strategies targeting the involved musculature (Akagi *et al*., 2008), whereas multi-joint strength development may require more holistic approaches incorporating neuromuscular coordination, motor learning, and postural control (Suchomel *et al*., 2018).

Limitations and Future Directions

A limitation of the current study is the relatively small sample size (n = 16), which may restrict the generalizability of findings. While statistical significance and strong effect sizes were observed, larger cohorts would enhance model stability and permit subgroup analyses (e.g., by sex or training background). Furthermore, the cross-sectional nature of the study precludes causal inferences. Longitudinal studies examining changes in muscle morphology alongside strength development could clarify the temporal dynamics of these relationships.

Future research should also explore the integration of neuromuscular variables, such as motor unit recruitment patterns, rate of force development, or muscle architecture parameters (e.g., pennation angle), to complement morphological predictors. Additionally, expanding the battery of exercises to include upper-body multi-joint and lower-body single-joint tasks would provide a more comprehensive understanding of morphology-strength dynamics across functional movement patterns.

CONCLUSION

The findings of this study highlight the differential role of morphological characteristics in predicting maximal strength across single- and multi-joint exercises. Consistent with previous literature, significant correlations were observed between strength performance in both the biceps curl and parallel squat and a range of morphological variables. However, the regression analyses provided more nuanced insights. Specifically, the MT of the biceps brachii was identified as the most influential predictor of arm strength, as measured by biceps curl 1RM. In contrast, squat strength was best explained by a combination of morphological factors, including body mass, body height, and the muscle mass of the lower limbs. These results suggest that while localized muscle morphology may be sufficient to predict upper-body single-joint strength, lower-body multi-joint strength appears to be influenced by a broader set of anatomical characteristics.

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RESUMEN: El objetivo de este estudio fue investigar el papel predictivo de determinados factores morfológicos y antropométricos en el rendimiento de la fuerza muscular en ejercicios de resistencia monoarticulares y multiarticulares. La muestra estuvo compuesta por 16 estudiantes universitarios (siete mujeres). La fuerza muscular se expresó como carga externa total, calculada como la suma de la repetición máxima (1RM) y la masa estimada de los segmentos corporales implicados, determinada según el método antropométrico de Dempster. El rendimiento de la fuerza se evaluó mediante dos ejercicios: un movimiento monoarticular (curl de bíceps en banco Scott) y un movimiento multiarticular (sentadilla paralela). El grosor muscular (GM) del músculo bíceps braquial y el área de sección transversal (AST) del músculo cuádriceps femoral se evaluaron mediante imágenes de ultrasonido, mientras que la masa muscular esquelética (MME) total y segmentaria se estimó mediante análisis de impedancia bioeléctrica. Además, se midieron la altura, la masa corporal y el índice de masa corporal. El análisis de correlación de Pearson reveló relaciones positivas significativas ($p < 0{,}05$) entre la carga externa total en ambos ejercicios y todas las variables morfológicas examinadas ($r = 0{,}56$-$0{,}94$). Sin embargo, el análisis de regresión identificó el GM del músculo bíceps braquial como el predictor más fuerte del rendimiento de fuerza en el curl predicador ($R^2 = 0{,}882$, $p < 0{,}01$), mientras que la MME de la pierna, la masa corporal y la altura corporal surgieron como predictores significativos del rendimiento en la sentadilla paralela ($R^2 = 0{,}873$, $p < 0{,}01$). Estos hallazgos sugieren que el rendimiento de fuerza en la flexión de codo monoarticular se asocia principalmente con el tamaño del músculo implicado, mientras que el rendimiento en ejercicios multiarticulares como la sentadilla depende de una combinación de masa muscular y características antropométricas, lo que refleja la mayor complejidad mecánica y de coordinación del movimiento.

PALABRAS CLAVE: Curl de predicador; Sentadilla paralela; Grosor muscular; Área de sección transversal; InBody 720.

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