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Comparison of the electromyographic activity of the muscles involved in low pulley horizontal rowing with different grips and bilateral widths

Comparación de la actividad electromiográfica de los músculos implicados en el remo horizontal de polea baja con diferentes agarres y anchuras bilaterales

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Abstract. There are different types of grip that can be used in horizontal row on a low pulley machine. The aim of this study was to carry out an electromyographic analysis of the muscle activation of latissimus dorsi muscle, biceps brachii, posterior deltoid and transverse part of trapezius, for different bilateral grips and widths. The sample consisted of 12 healthy male participants. The level of muscle activation, expressed as a percentage of a maximum voluntary contraction, was measured. The results showed that a significant difference ($\rho \leq 0.05$) was obtained in the biceps brachii, with the narrow neutral grip activating it the most. On the other hand, the posterior deltoid was more activated with the wider grips, with the wide neutral grip activating it the most. There were significant differences in the trapezius, which was activated the most with the medium width neutral grip. In the case of the latissimus dorsi muscle, although not significantly, it was the wide supine grip. We concluded that, although no differences were found in the latissimus dorsi muscle, the trapezius seems to be the muscle that is most activated with this exercise, with the narrow neutral grip showing the highest activation in the biceps brachii.
Keywords: muscle activation, grips, electromyography, voluntary maximum contraction, low pulley horizontal rowing

Resumen: Existen diferentes tipos de agarre que pueden utilizarse en el remo horizontal en máquina de polea baja. El objetivo de este estudio fue realizar un análisis electromiográfico de la activación muscular de los músculos dorsal ancho, bíceps braquial, deltoides posterior y parte transversa del trapecio, para diferentes agarres bilaterales y anchuras. La muestra estuvo formada por 12 participantes varones sanos. Se midió el nivel de activación muscular, expresado como porcentaje de una contracción voluntaria máxima. Los resultados mostraron una diferencia significativa ($\rho \leq 0,05$) en el bíceps braquial, siendo el agarre estrecho neutro el que más lo activaba. Por otro lado, el deltoides posterior se activó más con los agarres más anchos, siendo el agarre neutro ancho el que más lo activó. Hubo diferencias significativas en el trapecio, que se activó más con el agarre neutro de anchura media. En el caso del músculo dorsal ancho, aunque no de forma significativa, fue el agarre supino ancho. Concluimos que, aunque no se encontraron diferencias en el músculo dorsal ancho, el trapecio parece ser el músculo que más se activa con este ejercicio, siendo el agarre neutro estrecho el que muestra una mayor activación en el bíceps braquial.
Palabras clave: Activación muscular, agarres, electromiografía, contracción máxima voluntaria, remo horizontal de polea baja

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Introduction

Surface electromyography (EMG) is a technology that allows, in a non-invasive way, to evaluate the activation of certain muscles in specific exercises. EMG provides information on how an individual's neuromuscular system responds to different stimuli and movement patterns. This is carried out with a high-sensitivity voltmeter, which is placed on top of the muscles to be analyzed, showing the increases and decreases in voltage that occur in the sarcolemma (Vigotsky, et al., 2018). These data will facilitate the selection of exercises according to our objective, similarity to a sport discipline or depending on the muscular demands of the motor patterns thereof. In addition, from the perspective of injury prevention, rehabilitation, and health, they will provide us with information that helps us to optimize and individualize training plans with more specific exercises and actions according to the specific needs of each subject. In this regard, there are several studies to analyse the muscular activation of the latissimus dorsi muscle during different exercises, as it is undoubtedly a muscle of significant relevance to the kinematics of the upper limb. It functions as an adductor and internal rotator of the arm, but it has also been established as a stabilizer, rotator, and extensor of the trunk (Price et al., 2024). Furthermore, it is a muscle that should be considered from the perspective of injury prevention and lumbar pain (Mohamed et al., 2022). One study examining different movements indicates that the chest pull has better movement mechanics compared to the back of the neck, although the activation of the latissimus dorsi muscle is very similar (Sperandei, et al., 2009). Another study analyzed the same exercise and the authors concluded that the chest pull had significant differences in all the muscles analyzed, including the latissimus dorsi muscle (Signorile, et al., 2002). On the other hand, the effects of grip width on muscle strength in upright rowing were analyzed as different positions may lead to varying involvement of muscle groups, concluding that the activation using the optimal width and grip for latissimus dorsi is a prone grip and using a narrow or medium width, as they presented a greater application of force (Andersen, et al., 2014). In another exercise such as pull-ups, no significant differences were found in grip difference between pronated and neutral (Lehman et al., 2004). The muscular activation of the latissimus dorsi between the pull-down and pull-up exercises did not show any significant differences (Doma, et al., 2013). In addition to the various muscular patterns, different grips have been studied, and it has been shown that grip width is a determining factor in reducing the risk of injuries. In this context, research on the bench press exercise has demonstrated that wide grips (greater than 1.5 times the biacromial width) may increase the risk of shoulder injuries and pectoralis major tears, while narrower grips may reduce this risk (Green & Confort, 2007).

Despite the main activation of the latissimus dorsi, has been analyzed the involvement of different muscles in this type of exercise, and their variation with different types of grip. This is the case of the research performed by Dickie et al. (2017) who analyzed muscle activation during different variations in the pull-up grip (the pull-up with pronated grip, supinated grip, neutral grip and rope pull-ups). These authors observed that the middle trapezius, latissimus dorsi and infraspinatus muscles work at similar levels during the concentric and eccentric phases of each of the pull-up variations. The only significant difference they found was in the middle trapezius between the pronated grip and the neutral grip pull-up, being greater in the pronated grip. In the same way, 3 types of rowing were compared (inverted row, standing bent-over row, and the standing 1-armed cable row), concluding that the standing bent-over row leads to a great muscular activation of both the upper and lower back (Fenwick, et al., 2009). They took into account that this exercise must maintain the neutral curve of the spine, which guaranteed that the spine would maintain the highest tolerance level. The movement pattern used in other study allows not having to deal with that level of tolerance since being in the prone position on a bench, it is easier to keep the back neutral (Ronai & Taber, 2021).

The difference in muscle activation between different exercises has also been studied. the middle trapezius, lower trapezius, infraspinatus, latissimus dorsi and erector spinae were analyzed during eight back exercises (lat pull-downs, inverted rows, seated rows, bent-over rows, TRX rows, I-Y-T raises, pull-ups, and chin-ups) (Edelburg, 2017). The highest activation of the middle trapezius was found with I-Y-T raises, bent-overs, seated, and inverted rows. On the other hand, the lower trapezius had the highest activation with I-Y-T raises. And finally, the greatest activation of the latissimus dorsi was found with pull-ups and chin-ups (Edelburg, 2017).

However, despite the large number of studies that analyze the latissimus dorsi muscle with other exercises, the activation of the latissimus dorsi and other muscles involved in the horizontal row on a low pulley machine (HRLPM) with different grips has not yet been explored, being one of the most commonly used exercises in strength training routines. Therefore, the aim of this study was to conduct an EMG analysis of the activation of the latissimus dorsi muscle (LDM), brachial biceps (BB), posterior deltoid (PD) and transverse part of the trapezius muscle (TT) for the different bilateral grips (prone, neutral and supine) and widths (narrow [1], medium [2] and wide [3]) of the horizontal row on a low pulley machine (HRLPM). Our main hypothesis is that the neutral grip with medium width will activate the latissimus dorsi more, with wider grips (2 BAD) a greater activation of the TT will be obtained, whereas at a lower amplitude (1 DB), the activation of LDM and BB will be greater.

Materials and methods

Participants

The study sample consisted of 12 healthy physically active male participants. Inclusion criteria for participation in the study were: being over 18 years of age, consenting to participate in the study, and having a minimum of one year strength training experience. The causes for exclusion were: suffering from any disease or condition that could reduce their maximum effort, having any pathology or muscle and/or joint injuries (suffered over the past six months) for reasons unrelated to the object of the study, wearing a pacemaker or other devices that could interfere with the electric fields, and performing strength training 48 hours before attending the study.

This work was conducted in accordance with the principles of the Declaration of Helsinki and relevant local and national legislation. All participants signed the informed consent form and the measurement procedures were approved by the Autonomous Research Ethics Committee Research of Xunta de Galicia (Spain) (reference number 2023/124). The main characteristics of the sample are as follows (Table 1).

Table 1.
Characteristics of the participants (mean ± standard error of the mean, and range).

	X ± SD	Range
Age (years)	22.67 ± 1.37	21 - 25
Height (m)	1.71 ± .076	1.65 – 1.91
Weight (Kg)	77.95 ± 8.97	62.9 – 91.7
BMI	25.14 ± 1.73	23.10 – 29.70
% Muscle mass	79.93 ± 2.25	75.68 – 82.51
% Body fat	16.23 ± 3.21	13.10 – 24.40

[Body Mass Index (BMI); Mean (X); Standard Deviation (SD)].

Procedures

The intervention was carried out in three sessions: the first session included familiarization of the technique, anthropometric measurements and the 1RM test for a series of grips; the second session continued with the 1RM measurement for the missing grips and in the third session, the electromyographic activity was assessed (both the value of the maximum voluntary contraction and the register in HRLPM). Muscle activation was expressed as a percentage of a maximum voluntary contraction (MVC), of the latissimus dorsi muscle (LDM), brachial biceps (BB), posterior deltoid (PD) and transverse part of the trapezius muscle (TT) in three repetitions, using a load of 10 RM, in each of the grips and widths to compare the HRLPM. The technique applied for the HRLPM was described by Ronai (2019).

These sessions were separated by 72 hours of rest to eliminate the possible effects of muscle fatigue (Bompa & Buzzichelli, 2017). The measurements were carried out in the facilities of the Faculty of Education and Sport Sciences of the University of Vigo. All measurements and sessions were carried out by professionals of Physical Activity and

Sport Sciences and a physiotherapist.

Anthropometric measurements, body composition and 1 RM test

The anthropometric measurements taken into consideration were: height (m) with a stadiometer, weight (kg), muscle mass (kg), % muscle mass, % body fat, with a bioimpedance scale (Tanita bc-601), biacromial distance (BAD) (cm) with an anthropometer, and body mass index (BMI) (weight/height^2 (kg/m^2).

The BAD was the measurement used to control the width of the grip (Céspedes, 2021). Therefore, the different grips were analyzed: narrow supinated grip (SP1) of 1 BAD, medium supinated grip (SP2) of 1.5 BAD, wide supinated grip (SP3) of 2 BAD, narrow neutral grip (NT1) of 1 BAD, medium neutral grip (NT2) of 1, 5 BAD, wide neutral grip (NT3) 2 BAD, narrow pronated grip (PR1) 1 BAD, medium pronated grip (PR2) 1.5 BAD and wide pronated grip (PR3) 2 BAD.

Technical familiarization and test 1 RM

The exercises for learning the traction movement pattern were performed without load. The participants subsequently performed a warm-up protocol for the 1 RM test. The warm-up protocol was the one recommended by the National Strength and Conditioning Association (2008), also assuming that no significant differences are found between different protocols (Barrantes Segura & Aragón Vargas, 2013). The calculation of the 1RM was performed for each of the grips and widths in two different sessions, 72 hours apart to avoid possible fatigue when calculating 9 different grip types.

Attempts of 1 RM were performed, allowing seven minutes of rest between attempts since, as this is the most effective rest interval to be able to perform a greater number of attempts without significantly affecting performance (Barrantes Segura & Aragón Vargas, 2013). Due to the 7 kg jump of the weight discs of the pulley, in many cases it was limited to getting a maximum repetition, thus two or three repetitions were executed with its maximum weight, in cases that could not be achieved with a single repetition with the next increase in weight of the pulley. In these cases, we used the Brzycki equation (1RM=Weight lifted/(1.0278-(0.0278*Nº. reps)) which is widely used in strength training. This has no significant differences with a 1RM test, below 10 RM according to the study conducted by Nascimento et al. (2007), who analyzed the validity of the equation for the prediction of a maximum repetition 1RM in the bench press exercise.

Electromyography measurements

In this session, after the warm-up protocol, the MVC of each muscle evaluated was analyzed and then the electromyographic activation was taken into account for each of the variants of the exercise under study. A physioplux electromyograph with 4 channels, surface electrodes, sampling frequency: up to 3 kHz per channel, sampling resolution: 8 bits or 16 bits per channel. The wave amplitude was recorded in microvolts (µV). A system was utilized that incorporates both filters and an envelope rectification method. At the software level, a moving average filter was implemented, which functions as a digital low-pass filter, allowing for the transformation of the EMG signal into its envelope. Regarding the hardware aspect, electronic filters were employed to ensure an output bandwidth of 25 to 500 Hz.

The electrodes were placed parallel to the direction of the muscle fibers of the LDM, BB, PD and TT, 2 cm center to center according to the *Surface Electromyography for the Non-invasive Assessment of Muscles* (SENIAM) (Hermens et al., 2000) on the right side. Muscle activation was recorded with an MVC test (Konrad, 2005) in which the best of three repetitions was taken. The muscle activation measurements of each RHP variant were transformed into percentages of the MVC (% EMG. Act).

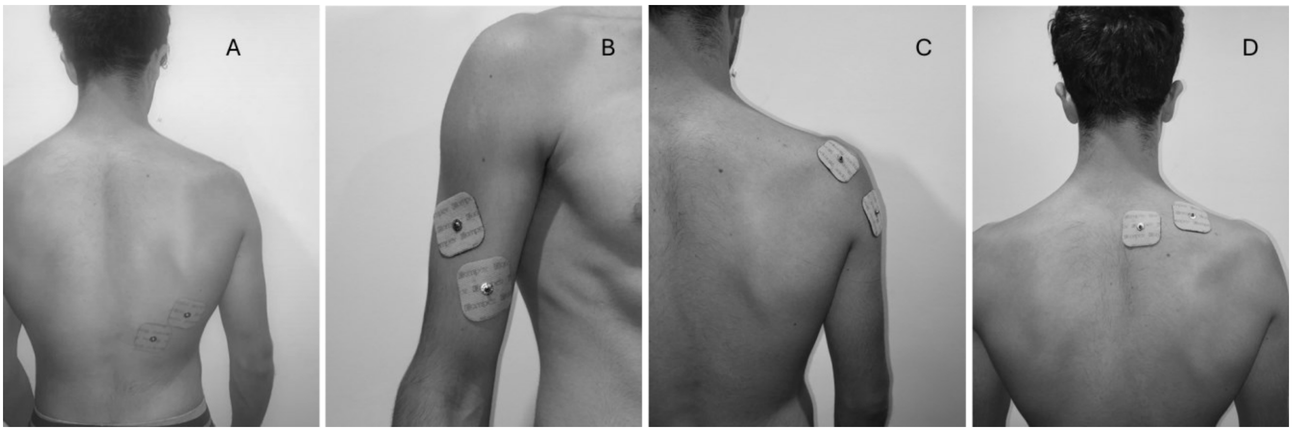

Figure 1 Location of the electrodes (A) latissimus dorsi muscle (B) Biceps brachii (C) posterior deltoid (D) transverse trapezius (D) trapezius transversus)

The tests conducted to register the MVC were as follows: for LDM, a fixed anchor grip was utilized, and the participant was asked to perform a horizontal pull; for the BB, the hand was held in a fixed position with the elbow close to the torso, and the participant was instructed to perform an elbow flexion; for the PD, with the arm extended and at a 90º angle at the glenohumeral joint, the participant performed an abduction backward and upward while keeping the hand fixed to prevent movement; finally, for the TT, in the same arm position with the hand on a fixed surface, the participant performed a scapular retraction. In all these movements, participants were instructed to exert maximum force possible against a resistance they were unable to overcome.

The electromyographic activity of the four muscles was then analyzed in the SP1, SP2, SP3, NT1, NT2, NT3, PR1, PR2 and PR3 exercises. A load of 10 RM was used for all the aforementioned movement patterns and the activation of the first three repetitions was measured (Signorile et al., 2002). The execution of the exercises followed the recommendations of Konrad (2005). The measurements were taken during the concentric phase, recording the peak maximum activity. To avoid muscle fatigue, a two min rest interval separated each set of different grip type exercise (Bompa & Buzzichelli, 2017). To adjust the weights to 10 RM and to alleviate the 7-kg difference in weight between pulley discs, dumbbells of 1, 2, 3, or 4 kg were added so that the weight was accurate for the participants' 10 RM.

Procedure of the exercise to be tested

The technique applied for the HRLPM was described by Ronai (2019). It is started from an initial position of full plantar support with the surface of the machine. The knees are bent, whereas the back, neck and head are in a neutral position. The arms are placed in the corresponding grip and grip width, starting from a full extension. Subsequently, in the traction phase, a scapular retroversion is performed and the elbows are bent towards the torso until the bar touches the chest. In this phase, the air is inhaled progressively. In the return phase, the elbows are extended until reaching the starting position of the exercise.

Statistical analysis

A descriptive and comparative analysis of the variables studied was carried out, selecting the mean (X) as a measure of central tendency and the standard deviation (SD) as a measure of dispersion for numerical variables. A comparative analysis between groups was also performed. To check the normality of the groups, the data were evaluated using the Shapiro-Wilk test. An Anova test for repeated measures was performed to compare the numerical variables among 3 and more groups. Mauchly's test of sphericity and Greenhouse-Geisser and Huynh-Feldt adjustments were performed when necessary. The data were analyzed using the SPSS 22.0 statistical software, with a significance level for all tests of $p<.05$.

Results

1RM for different grips

The data followed a normal distribution. Significant differences ($p<.05$) were found between the 1RM achieved for the different grips. The SP2 grip obtained the highest 1RM load, whereas the NT3 mobilized the lowest load The pairwise analysis indicated that significant differences ($p<.001$) were only achieved when comparing both, but there were also statistically significant differences between NT3 and PR1, PR2, SP1, SP3 and NT1 (Table 2).

Table 2.
1RM test with different grips (mean ± standard error of the mean).

Grips	X (Kg)	SD
PR1	82.6	12.85
PR2	80.44	11.59
PR3	78.51	11.49
SP1	82.38	12.53
SP2	84.38	12.65
SP3	81.97	13.03
NT1	79.66	11.77
NT2	78.20	12.10
NT3	73.58	13.46

[narrow supinated grip (SP1); medium supinated grip (SP2); wide supinated grip (SP3); narrow neutral grip (NT1); medium neutral grip (NT2); wide neutral grip (NT3); narrow pronated grip (PR1); medium pronated grip (PR2); wide pronated grip (PR3); Mean (X); Standard Deviation (SD)].

EMG activation per muscle with different grips

No significant differences were found in the activation of the LDM among all types of grips. However, it can be observed that the highest activation values occurred in SP3, being the grip that caused the greatest activation of the latissimus dorsi muscle, while PR2 was the grip that presented the least activation. Secondly, the same comparison of BB activation was carried out, obtaining significant differences among the different types of grips ($p=.011$). The grip that showed the lowest activation was PR3 and the highest was NT1, with a significant difference ($p=.014$). In the rest of the pairwise comparisons, we found a greater activation in NT1 with respect to the other two pronated grips, these differences being significant in the case of PR1 ($p=.022$) and PR2 (p=.009). Thirdly, we analyzed the activation of the PD, in which significant differences were found between the different types of grips ($p=.016$). The most activating grip was NT3 and the least activating grip was SP2. Performing a pairwise analysis, there were significant differences with respect to SP2 with NT1 ($p=.004$), NT2 (p=.006) and PR2 ($p=.017$) grips. Finally, TT activation was compared with the different grips, finding significant differences among them ($p<.05$). The grip with the highest activation was NT2 and the lowest was SP1. When performing a pairwise comparison, we found significant differences between NT2 and the SP1 ($p=.014$) and SP2 ($p=.042$) grips (Table 3).

Table 3.
Electromyographic activity of LDM, BB, PD, and TT, with different types of grips (mean ± standard error of the mean).

Grips	LDM X (% EMG. Act) ± SD	BB X (% EMG. Act) ± SD	PD X (% EMG. Act) ± SD	TT X (% EMG. Act) ± SD
PR1	63.43 ± 16.84	45.83 ± 17.79	70.81 ± 7.66	76.58 ± 11.05
PR2	62.86 ± 16.98	48.81 ± 17,77	75.76 ± 8.59	74.91 ± 11,04
PR3	63.25 ± 19.58	45.28 ± 18.33	75.17 ± 11.17	75.24 ± 10.72
SP1	69.14 ± 15.95	55.97 ± 14.13	67.05 ± 7.05	69.50 ± 10.84
SP2	72.55 ± 20.29	60.19 ± 15.68	66.99 ± 9.82	72.23 ± 11.21
SP3	73.47 ± 20.04	56.54 ± 16.94	71.86 ± 10.16	72.81 ± 7.97
NT1	69.16 ± 15.18	64.39 ± 13.85	75.92 ± 9.98	78.96 ± 11.56
NT2	71.56 ± 12.11	58.65 ± 13.6	74.53 ± 8.06	80.72 ± 8.5
NT3	66.99 ± 19.38	57.45 ± 13.87	76.89 ± 12.96	78.62 ± 13.79

[latissimus dorsi muscle (LDM); brachial biceps (BB); posterior deltoid (PD); transverse part of trapezius muscle (TT); narrow supinated grip (SP1); medium supinated grip (SP2); wide supinated grip (SP3); narrow neutral grip (NT1); medium neutral grip (NT2); wide neutral grip (NT3); narrow pronated grip (PR1); medium pronated grip (PR2); wide pronated grip (PR3); Mean (X); Standard Deviation (SD); percentage of peak electromyographic activity (%EMG. Act)].

EMG of all muscles according to each grip type

Next, the activations of the different muscles with each type of grip were compared, so that we can see which muscle achieves the highest activation with each grip when performing HRLPM.

First, we analyzed the prognostic values of strength grips, among which we found significant differences ($p<.001$) with PR1, PR2 and PR3. In all three cases, activation was greater in the TT, while the lowest was obtained in the BB. Performing a pairwise comparison for PR1 of the muscles, we found that TT was statistically significantly activated with respect to LDM ($p=.038$) and BB ($p=.002$). We also found significant differences between PD and BB ($p=.005$). For PR2 we also found statistically significant differences where TT was more activated than BB ($p=.03$). On the other hand, the PD also showed statistically significant differences compared to BB ($p=.04$). In the last prone grip PR3, we found statistically significant differences with greater activation of TT over BB ($p=.001$). Finally, the PD also showed statistically significant differences with respect to BB ($p=.001$) (Figure 2).

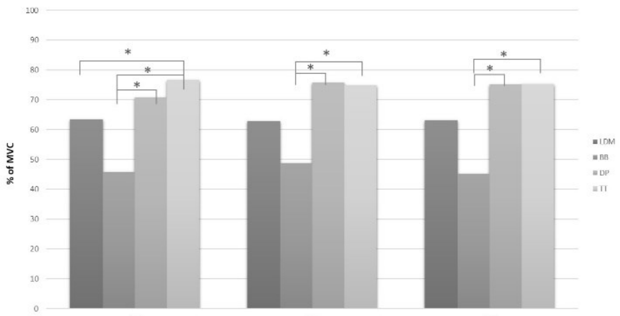

Figure 2. Comparison of the electromyographic activation of the different muscles for each type of prone grip [latissimus dorsi muscle (LDM); brachial biceps (BB); posterior deltoid (PD); transverse part of the trapezius muscle (TT); narrow pronated grip (PR1); medium pronated grip (PR2); wide pronated grip (PR3) (*p<0.05).

Subsequently, the supine grips were analyzed, among which no significant differences were found. Nevertheless, we can see that the most activated muscle was the LDM for SP2 and SP3, while for SP1 it was the TT, but without having statistically significant differences with the rest interval (Figure 3).

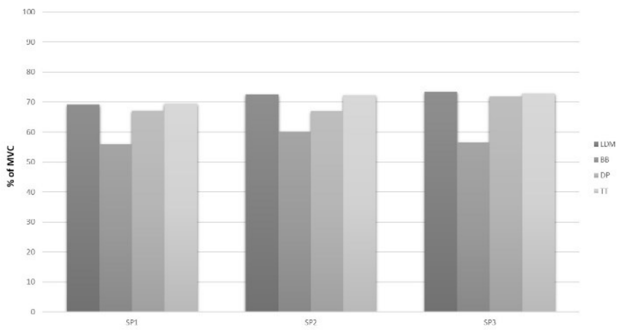

Figure 3. Comparison of the electromyographic activation of the different muscles for each type of supine grip [latissimus dorsi muscle (LDM); brachial biceps (BB); posterior deltoid (PD); transverse part of the trapezius muscle (TT); narrow supinated grip (SP1); medium supinated grip (SP2); wide supinated grip (SP3)].

Finally, the neutral grips were analyzed. With the NT1 grip, no statistically significant differences were obtained, but we observed a greater activation of TT and a lower activation of BB. On the other hand, with NT2 we did find significant differences, among which BB showed the lowest activation with respect to PD ($p=.03$) and TT ($p=.01$), this muscle obtaining the greatest activation. With the NT3 grip, it was found that there were significant differences for BB, which showed the lowest activation with respect to PD ($p=.33$) and TT ($p=.027$) (Figure 4).

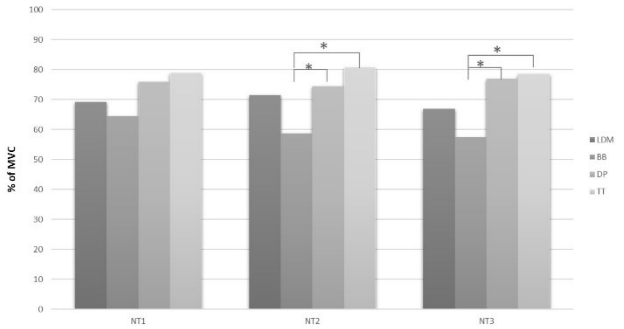

Figure 4. Comparison of the electromyographic activation of the different muscles for each type of prone grip [latissimus dorsi muscle (LDM); brachial biceps (BB); posterior deltoid (PD); transverse part of the trapezius muscle (TT); narrow neutral grip (NT1); medium neutral grip (NT2); wide neutral grip (NT3) *p<0.05].

Discussion

This work aimed to determine which grip activates the most the latissimus dorsi muscle in the HRLPM exercise, and the involvement of other synergistic muscles. This study is the first, to the authors' knowledge, to be carried out in the field of EMG in the HRLPM, comparing different grips. The results obtained did not coincide with the hypothesis proposed, since the LDM was more activated with a wide supine grip and not with a medium neutral grip, as well as the LDM and TT did not present any significant differences in terms of pairwise comparison of narrow and wide grips. On the other hand, it did coincide regarding the BB, since the most activation occurred with a narrow grip.

Since this is an exercise that had not been analyzed in previous studies using EMG, the results cannot be fully compared with others. However, regarding execution with different widths, there are precedents in exercises that involve the upper extremities, such as the lying bench press, where a wide grip generates greater activation of the pectoralis major and less activation of the triceps brachii compared to the same exercise with a narrow grip (Calatayud et al., 2018; Muyor et al., 2023). Along with the results obtained in our study, where the highest activations of the BB were recorded with a narrow grip and the greatest, albeit not significant, activation of the LDM was achieved with the widest grip, these findings suggest that in the biomechanics of the upper limb, both in pushing and pulling, trunk muscles are more engaged with wider grips, while arm muscles are more engaged with narrower grips. However, analyzing pulling in the vertical plane is dependent on the direction of the movement. While pull-ups show greater activation of the LDM with wide grips (1.5 BAD) and greater activation of the biceps brachii with a front grip (1 BAD) (Urbanczyk et al., 2020), upright rowing indicates greater activation of the LDM with a prone and narrow or medium-width grip (Andersen et al., 2014).

However, regarding execution with different widths, there are precedents in exercises involving the upper extremities. For instance, in the lying bench press, a wider grip results in greater activation of the pectoralis major and reduced activation of the triceps brachii compared to the same exercise performed with a narrow grip. (Calatayud et al., 2018; Muyor et al., 2023). Alongside the results obtained in our study, where the greatest activations of the BB were recorded with a narrow grip and the greatest, albeit not significant, activation of the LDM was observed with a wider grip, these findings appear to contrast with the biomechanical principles of the upper limb. In both pushing and pulling movements, trunk muscles are more engaged with wider grips, while arm muscles are more activated with narrower grips. However, when analyzing vertical pulling, this is dependent on the direction of the movement. For instance, in pull-ups, greater activation of the latissimus dorsi is achieved with wide grips (1.5 BAD), while greater activation of the biceps brachialis is noted with a front grip (1 BAD). (Urbanczyk et al., 2020) In the upright row, a greater activation of the LDM was observed with a prone grip and either a narrow or medium width grip. (Andersen et al., 2014).

Taking into account the muscle groups studied in this work, but exercised with different exercises, Signorile et al. (2002) carried out a study in which they compared EMG activation in the vertical pulley pull-up. Similarly to this work, a comparison of different exercise variations was performed, using 10 RM to standardize the load, analyzing the performance of the LDM, PD, long head of the triceps, teres major muscle and pectoralis major. Although these authors also took into account the neutral, supine and prone grip, they did not consider the different hand position widths, which may be due to significant differences in activation within the neutral, supine or prone grip. In the PD, no significant differences were found among the variations of the exercise, pointing out that the neutral closed grip activated the most this muscle. We found coincidences in this conclusion, since in our analysis the neutral grip was also the one that presented the most significant differences. Likewise, there are no coincidences in the width, since in this case we found that the NT3 grip was slightly superior to the NT1 for the PD, although this comparison did not present any statistically significant differences. In the case of LDM, significant differences were found among the exercise variations, with the prone grip achieving the most activation of the LDM (Signorile, et al., 2002). The findings in the current study do not agree with this conclusion, as we found no statistically significant differences among the variations. Furthermore, supine grips achieved a greater activation than prone grips, with SP3 being slightly more activated compared to SP1, SP2, NT1, NT2 and NT3.

With reference to the type of grip, while Signorile et al. (2002) found greater activation of the LDM with pronated grips in exercise with vertical orientation such as the pull up, Lehman et al. (2004) found no differences between pronated and neutral grips. Therefore, it is not possible to establish a clear pattern of activation in this regard. However, regarding BB, it appears that pronated grips generate greater activation (Urbanczyk et al., 2020).

However, in the TT, Dickie et al. (2017) found significant differences in the type of grip, obtaining higher levels in the pull up with pronated grip than in rope style. Their findings do not agree with our results, since we found a greater activation of the TT with neutral grips and a lower one with supinated grips. This fact could also be conditioned by the biomechanics of the pull-up orientation.

The main limitation of this research study was the small sample size, it would therefore be interesting to carry it out with a larger number of participants, and also to count on the participation of women. For further research, we would like to compare the effect of the electromyographic muscle activity on the latissimus dorsi, and the other muscles involved, with the use of lifting straps. The aim of the study would be to test whether their use could improve muscle activation in the horizontal row exercise, as well as in other traction movement patterns, to compare horizontal and vertical patterns. In the present study, a sample of people with previous experience and a certain technical mastery of the movement pattern was chosen. Therefore, it could be interesting to check whether the experience and automation of the technical pattern of the HRLPM could affect the activation level of the latissimus dorsi, comparing the results of two groups: one with experience and another without experience in strength training.

In short, it is important to keep in mind that there are no better or worse grip variations, only variations that are more or less adapted to the desired effect, varying the distribution of activation in the different muscles. The latissimus muscle and the traction movement pattern is fundamental in various sports such as swimming, wrestling, climbing, water sports or gymnastics, thus it is especially important to take into account all the results obtained in this study. The exercise selection should be as specific as possible to the expected effects of the training, according to the discipline and similarity of the motor pattern of competition or when readapting from an injury.

Conclusions

After the analysis of the different grips, we observed that they presented different muscle activation patterns. Significant differences were found in the muscle activation of the BB, showing the greatest activation with the NT1 grip. Statistically significant differences were also found in the EMG activation of the PD and TT, with the neutral and prone grips showing greater activation compared to the supine grips. However, no statistically significant differences were found in the activation of the LDM when performed with different hand widths and positions, with SP3 achieving slightly greater activation and pronated grips showing the lowest activation. All the grips analyzed individually had greater activation in the TT, except for SP2 and SP3, which showed greater activation in the LDM, but without significant differences in the TT. This suggests that the HRLPM may be a better choice for a developmental emphasis on TT.

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Conflicts of Interest

The authors declare that they have no conflict of interest. We declare that the results of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation.

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