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Research Article

Optimising Lat Activation: A Comparative Analysis of Grip Width in the Bent-Over Barbell Row

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Abstract

The aim of this study was to understand the effects of grip variation on muscle activation for the latissimus dorsi (LD) in the bent-over barbell row (BOBR). The consensus of surrounding literature is undecided, but still there is a general belief a wider grip warrants a greater level of LD activity. Twenty active male (age, 21.1 ± 1.05 years; stature, 179.6 ± 7.73 cm; mass, 86.1 ± 7.40 kg) university students performed a narrow (100% biacromial) and wide (150% biacromial) grip variation in the BOBR using an experimentally determined load of 60% one repetition maximum (1RM). Three trials of five repetitions were analysed for each grip type. Surface electromyography (sEMG) for both LD was recorded and root mean square (RMS) was captured at the peak of each repetition. sEMG amplitude (mV) was greatest in WG set 3 > WG set 2 > WG set 1 > NG set 3 > NG set 2 > NG set 1. Paired t-test analysis revealed a wide grip to elicit greater muscle activity than a narrow grip ($p < 0.01$). A significant difference was also found between limbs (left = 0.455 ± 0.294 vs. right = 0.361 ± 0.209 mV). Our findings suggest, despite fatigue warranting a greater level of activation, LD activity will always be greater at a wider grip width. Our findings also suggest muscle imbalances are prominent in young active males, meaning one limb often compensates for the other during BOBR.

Keywords: bent over barbell row, grip variation, latissimus dorsi, muscle activation, surface EMG.

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Introduction

In the 21st century, the popularity of resistance training has surged through an influx in fitness centres, driven by a worldwide attentive to health and wellbeing (Laperashvili, 2013). Not long ago, weight training was generally considered to be the domain of exceptionally strong men who competed in sports such as powerlifting, Olympic lifting, and body building, with many athletes believing resistance training would decrease performance in sport (Westcott, 2012). Now, national health organisations across the globe recommend resistance training as a means to deter illness and improve health, with 150 minutes of moderate intensity exercise a week being associated with the prevention of over 25 chronic diseases (Kraemer, Ratames, French, 2002; Garber et al., 2011; Warburton et al., 2007; Kaushal & Rhodes, 2015). A meta-analysis by Westcott (2012) highlighted the greatest effects on type 2 diabetes and lower back pain (Yu & Park, 2017). Furthermore, if practiced concurrently with aerobic training, resistance training has been known to; reduce all-cause mortality (El-Kotob et al., 2020), decrease risk of cardiovascular disease (Saeidifard et al., 2019), and reduce cancer mortality (Stamatakis et al., 2018). There are also several studies that highlight the potential adverse effects on coronary heart disease (CHD) but suggest further exploration (Hollings et al., 2017; Xanthos, Gordon & Kingsley, 2017).

Originally, strength and conditioning were heavily influenced by the bodybuilding philosophy, meaning traditional compound lifts used to dominate the strength development paradigm (Juan, 2001). As fitness enthusiasts continually seek to optimise each exercise, the significance of exercise variation and the impact on muscle engagement and overall performance cannot be overlooked. More recently, the increase in novice lifters has resulted in a shift to new exercise variations and machines designed to help novice lifters build strength more safely through a reduced stability stress (McCaw & Friday, 1994). However, a meta-analysis by Gentil, Fisher & Steele (2016) revealed no benefits in muscle activity when comparing single and multi-joint machine-based exercises. When compared with time-tested traditional compound movements, the surrounding literature suggests that machine-based exercises do not aid performance and rather induce more muscle damage, potentially through an increased eccentric stress (Byrnes, 1986). Nevertheless, resistance machines have demonstrated value in rehabilitation techniques and prolonging athletic careers (Aisen et al., 1997; Juan, 2001).

Building an effective training programme takes careful exercise selection and a delicate balance between the 4 principles of training. These principles: individuality, overload, specificity and reversibility provide a foundation for creating effective personalised programmes. Fitness coaches often find themselves in a quandary: selecting exercises that must be specific enough to target adaptation, but still varied so reversibility doesn't occur, whilst ensuring the overload and individuality principles are met. While specificity is crucial for attaining set goals, variability ensures holistic development between muscle groups and reduces the risk of detraining (Lambert et al., 2008). Exercise variation can therefore be beneficial and detrimental to achieving set goals (Kassiano, 2022). Many studies have suggested exercise variation could cause greater benefits for strength and hypertrophy compared to simple overload (Fonseca et al., 2014; Costa et al., 2021). This provides undeniable evidence to the importance of exercise quantification, which in turn provides practitioners insight to make informed decisions regarding which exercises are optimal for performance enhancement and rehabilitation (Simenz et al., 2012).

One often overlooked but easily manipulated is the effect of grip width and orientation on upper body exercises (Lusk, Hale & Russel, 2010). Concerning the bench press, a grip too narrow or too wide has been shown to compromise strength and rotate the primary agonist (Wagner et al., 1992; Clemons & Aaron, 1997; Lehman, 2005). A further compound exercise: the deadlift is generally regarded as a leading exercise in strengthening the posterior chain and has been adapted into a diverse collection of variations. As a compound exercise, the deadlift offers remarkable potential for variation in; stance, grip width, grip orientation, posture and equipment used (Piper & Waller, 2001). Similarly, the lat-pull down is perceived as the most effective exercise for targeting the LD, but with little support (Andersen et al., 2014). Many variants of the LPD have been created, through a combination of newly developed equipment and enthusiasts aiming to determine their optimal use, with the general consensus being a wider grip to elicit greater LD activation (Sperandei et al., 2009; Handa et al., 2005; Signorile, Zink & Szwed, 2002; Lee & Lim, 2017). Some studies do not agree, suggesting medium grip width (100% biacromial) and hand orientation to have the greatest effect on LD activation (Andersen et al., 2014; Lusk, Hale & Russel, 2010). It has long been debated how best to develop this muscle, with most research focussing on grip width in machine-based exercises (Lusk, Hale & Russel, 2010; Sperandei et al., 2009; Signorile, Zink & Szwed, 2002). Yet, Alway (2015) has highlighted the importance of incorporating compound exercises like the barbell row. The bent-over barbell row is a compound, multi-joint upper body exercise intended to increase strength of muscles within the upper and middle back, posterior shoulder girdle, and anterior elbow joint consisting of an upward pull and a downward lower (Ronai, 2017). The bent-over barbell row is known to produce the greatest strength and hypertrophy gains, not only in the back but the torso as a whole, which can help stabilize the body in lifting greater loads in different movements (Alway, 2015). The general consensus on the BOBR is undecided, with some finding the greatest activation in the LD and others suggesting it is unsafe to perform (Fenwick, Brown & McGill, 2009; García-Jaén et al., 2021; Loturco et al., 2021). If differences in LD activation between grip widths exist, it is crucial to understand these differences for the application of the bent-over row in sports for most optimal development of the LD. Accordingly, this study aims to add an insight into grip variation in the bent-over barbell row to instruct its administration for optimal exercise efficacy.

Methods

Ethical Clearance

Institutional ethical approval was acquired from Northumbria University Ethics Department and informed consent was obtained in Visit 1.

Design

The presented study is a pilot study intended to add insight to the effectiveness of the current data collection method. This study has a quantitative experimental design that assesses the relationship between grip width and muscle activation. All participants were required to visit the Northumbria University Integrated Performance Lab twice. Firstly, as a familiarisation session to understand; what is required of them, the study, the equipment and to address any contemporary issues that may arise during the experimental session. This session will also give opportunity to have age, stature and mass recorded followed by a standardised warm-up and three sets of a gradually increasing load up to their estimated five rep max (5RM) of BOBR at their typical grip width to instruct the second session. Secondly, to complete the presented experimental protocol. Considerations were made to reduce fatiguing factor – 48hr exercise free period before each session and exercise order was randomised and counterbalanced using a random number generator.

Participants

A sample size of 16 was established using previous literature from McAllister et al. (2013) using a similar protocol in a separate row variant with weight-trained men. 20 young active healthy male Newcastle & Northumbria University students (age, 21.1 ± 1.05 years; stature, 179.6 ± 7.73 cm; mass, 86.1 ± 7.40 kg) volunteered to take part in this study. Inclusion criteria: 18–40 year-old males who regularly take part in gym-based exercise 3-4 times per week, with 6 months experience of weightlifting in the rowing position and a rough idea of 5RM. Exclusion criteria includes males above the age of 40 or under 18, females, injured, sedentary. Females were excluded due to the potential menstruation cycle effect between weeks (Rodrigues, de Azevedo Correia & Wharton, 2019). Participants were made aware of the potential exercise risks prior to data collection. When working with heavy loads in the BOBR improper execution can cause injury (Ronai, 2017). As with any form of exercise there may be a level of discomfort and muscle soreness post-exercise (Cheung, Hulme, Maxwell, 2003).

Surface Electromyography

sEMG was used to quantify muscle activation (millivolts [mV]). Participants were made aware of the potential contemporary issues that may occur when working with sEMG. Certain factors such as skincare products or body hair can affect the strength of the impulse read by the sEMG receptors (Hewson et al., 2003). Prior to data collection, EMG equipment was set up and tested by the researcher to ensure proper signal transmission and reception. The Delsys Trigno base station was connected to a nearby Northumbria University computer possessing Delsys EMGworks acquisition software. All respective skin sites were cleaned & abrased using alcohol wipes (Medisave Pre-Injection Swabs [70% IPA Alcohol]) and cases of excessive body hair were shaven (Hermens et al., 2000). The software was then opened and charged electrodes were assigned to each LD. The concerned electrodes were then removed from the base station and were also cleaned & abrased. Adhesive strips were then attached for placement. Electrode (Delsys Trigno Research + – DelsysInc, Natick, MA, USA) (Figure 1) placement was attempted in accordance with SENIAM (Surface Electromyography for the Non-Invasive Assessment of Muscles); however, no directions were published for the LD, as previously noted by Park & Yoo (2013). Electrode placement was located using previous literature from Soltani & Vilas-Boas (2016) by palpating the scapula; placing the electrodes approximately 4 cm below the inferior border of scapula, half the distance between the spine and the lateral edge of torso and positioned almost 25 degrees obliquely. Electrodes were turned on and participants were asked to contract their LD to ensure proper signalling. Data was then collected and exported to Delsys EMGworks analysis. One RMS sample was taken at the peak of each repetition for each LD.

Figure 1. Delsys Trigno base station employed in this study.

Procedures

Visit 1: Familiarisation Protocol

The familiarisation and strength testing took place within the Northumbria University IPL, January 2024. Participants age (years), stature (cm) (SECA 213 STADIOMETER – Medisave UK Ltd, Dorset) and mass (kg) (SECA Scales 711 – Seca Ltd, Birmingham) and biacromial diameter were recorded. Each participant was palpated in the back of both shoulder girdles to determine the location of their acromion process'. Biacromial diameter is defined as skeletal breadth which is the distance between both landmarks and was found using the exact same method as Stoudt (1970). Biacromial diameter was noted down for each participant and multiplied by 1.5 to achieve 150% biacromial. Each participant was run through a standardised warm-up of rotations, stretches and contractions consisting of; 10 iso arm circles, 8 elevation dead hangs, 10 banded medial & lateral shoulder rotations, 10 banded shoulder elevations, 12 banded face pulls followed by 5 band-assisted pull ups. Exercises were performed on a pull up bar situated within in the IPL and the band utilised was a Myprotein (2-16 kg) band. Exercises were performed in this order and when unilateral warranted the dominant hand was exercised first. Participants were then familiarised with both movements, environment, movement amplitude, body position and the cadence of movement that would be employed in the experimental session (Figure 2). Participants practiced each movement until both they and the researcher felt confident the correct technique had been executed. Participants were then asked to complete three sets of five repetitions BOBR at a gradually increasing submaximal load up to 90% 5RM. Participants were then asked to complete one set of their assumed 5RM at their typical grip width. If form was compromised, participants were instructed to take five minutes rest, and decrease the load by 2.5 kg until an actual 5RM value was achieved. Brzycki's equation was then used to assume 1RM, as previously demonstrating a valid and reliable method in college football players (DiStasio, 2014). Equation 1 displays Brzycki's equation (DiStasio, 2014). The value attained was then multiplied by 0.6 to attain 60%1RM to instruct the experimental session. This value was always lower than the 5RM.

Equation 1:

$$1RM = \text{rep wt} / (102.78 - 2.78\,[\text{reps}])$$

Brzycki (1993)

Figure 2. Image of the form employed in this study, as recommended by Ronai (2017).

Visit 2: Data Collection

One week later, data collection also took place within the Northumbria University IPL. Participants were once again made aware of the contemporary issues surrounding sEMG. All skin sites were cleaned & abrased and participants with disrupting body hair were shaven. Electrodes were then placed on both participants LD in accordance with guidelines from Soltani & Vilas-Boas (2016) (Figure 3). Participants were once again run through the standardised warm-up of rotations, stretches and contractions. Participants were then instructed to perform one set of eight repetitions of an empty barbell (20kg). The load of the bar was then increased to 30kg, a set of six repetitions was performed, the load was then increased to the studied 60%1RM. A measuring tape was used to instruct grip width for the participants. Participants were then instructed to grip the bar at either narrow (100% biacromial) or wide (150% biacromial) grip width, perform five repetitions of BOBR, rest for three minutes then repeat twice. Following the third set, participants rested for 5 minutes and then began the same protocol at the other grip width.

Data Analysis (EMG)

sEMG amplitude was extracted from Delsys EMGworks Acquisition software and opened in Delsys EMGworks Analysis. Maximal RMS amplitude values for both LD during each repetition was snapped and exported to excel.

Statistical Analysis

A paired samples T-test was used to identify EMG differences between grip widths. Statistical significance was accepted at $p < 0.05$. A separate paired samples T-test was also used to identify differences between limbs. Data was imported to SPSS to reveal differences between sets & repetitions. A paired samples correlations test was run between grip widths and limbs to identify participant patterns across protocols. Values presented are mean RMS ± SD to three decimal places (3 dp).

Results

Mean EMG amplitude was greater during wide (0.439 ± 0.263 mV) compared to narrow (0.378 ± 0.252 mV) grips ($F_{1.99, 792.05} = 13.9$, $p < 0.001$), with no interaction between grip width and sets performed ($p > 0.05$). A correlation was found between groups (0.861, $p < 0.05$) (Figure 4). A paired samples T-test revealed differences in mean muscle activation between the left (0.455 ± 0.294 mV) and right (0.361 ± 0.209 mV) LD. Differences in mean muscle activation across the three sets between repetitions were as follows; for the left LD NG: mean muscle activation decreased between repetitions. For the left LD WG: mean muscle activation increased at repetition 2 and then decreased. For the right LD NG: mean muscle activation decreased until the final repetition. For the right LD WG: mean muscle activation decreased (see Figure 5).

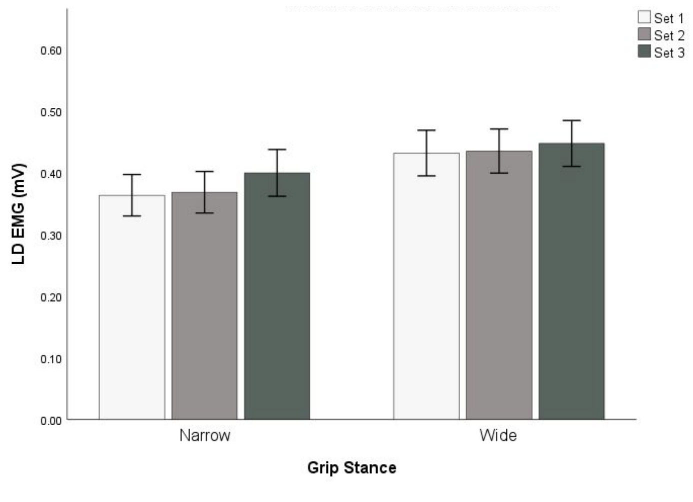

Figure 4. Mean (n = 20) RMS EMG for the LD during different grip widths (wide and narrow) across sets.

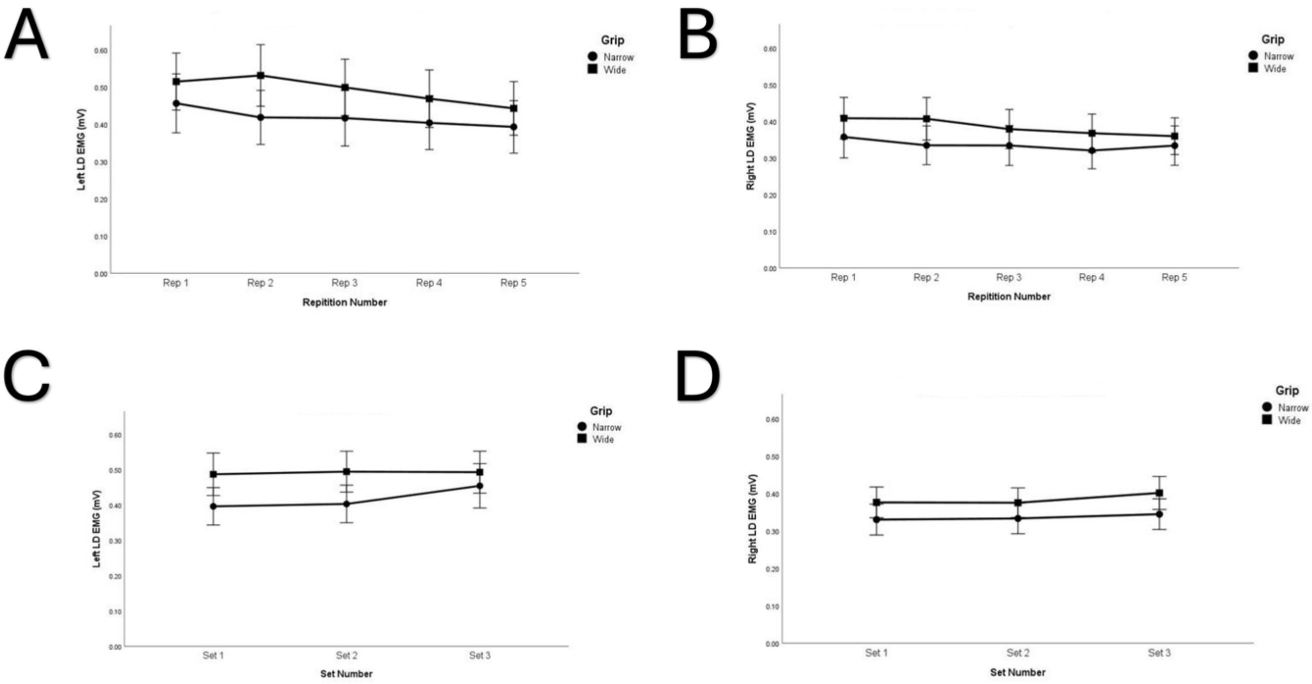

Figure 5. Mean (n = 20) RMS EMG for the left (A & C) and right (B & D) LD during narrow and wide grip widths between sets (C & D) and repetitions (A & B)

Discussion

The selection of grip width is a fundamental facet in any weightlifting programme, playing a pivotal part in exercise kinematics, thus playing an indespensable role on muscle recruitment patterns and overall performance. From the bench press to the deadlift, the width at which an individual grips the bar profoundly influences the biomechanical demands placed on the respective joints and muscles (Wagner et al., 1992; Kasovic, Martin & Fahs, 2019). Consequently, the safety and efficacy of the exercise can be enhanced, adapted or diminished. If a relationship between grip width and muscle activation exists, this would be crucial for athletes, coaches, fitness entheusiasts and future researchers to know, as insight could help optimize training routines, reduce injury risk, and above all, enhance performance. The aim of this study was to investigate the impact of grip variation on muscle recruitment in the bent-over barbell row.

The key finding of this investigation is that LD sEMG amplitude increases with corresponding grip width. This finding is in accordance with our original aim to determine the relationship between grip width and LD activation. This finding is also in agreement with 4 previous investigations that have shown significant changes in muscle activation in response to a wider grip during upper-body pulling exercises such as the upright row and LPD (Signorile, Zink & Szwed, 2002; Lusk, Hale & Russel, 2010;

McAllister et al, 2013; Lee & Lim, 2017). Lee & Lim (2017) employed a near identical protocol, using the same measurement scale, when reviewing muscle activity between grip widths in the LPD. Exhibiting similar findings, proving a greater level of activation in the anterior trunk muscles (pectoralis major & rectus abdominis) when using a narrow grip (100% biacromial) and a greater level of activation in the LD when using a wide grip (150% biacromial). Signorile, Zink & Szwed (2002) investigated further, aiming to determine the most optimal grip for LD activity in the LPD between four grips: wide grip anterior (WGA), wide grip posterior (WGP), supinated grip (SG) and close grip (CG). Reporting the WGA to be optimal for maximally recruiting the LD. Other researchers have added to this, offering the WGP and seated row to elicit the most activation, suggesting the BOBR to be suboptimal for recruiting the LD, but optimal for the upper, middle and lower trapezius (Handa et al., 2005; Lehman et al., 2004). However, the WGP has been shown to cause injury by stressing the glenohumeral ligaments extensively and should be avoided (Crate, 1997; Sperandei et al., 2009). Lusk, Hale & Russel (2010) set out to determine if grip orientation had a greater effect than width. Finding no difference between grip width but significant differences between orientation, recommending a pronated grip (2010). Lehman et al. (2004) found the opposite, reporting no differences between grip orientation, but differences between LD targeted exercises, but stated the relative changes were small, and may have no effect on weight training significance. Our finding is also comparable to those surrounding compound exercises for different muscle groups. The deadlift is an exercise targeted on strengthening the lower body and posterior chain. Many variations have been developed and researched, with each varying activation across a range of muscles (Martín-Fuentes, Oliva-Lozano, & Muyor, 2020). A wide grip is typically only employed in the Romanian deadlift (RDL) & snatch deadlift and holds advantage over other variations by warranting a greater level of upper back strength and scapular & spinal stabilization (Piper & Waller, 2001). Concerning the bench press, Clemons & Aaron (1997) reported activity increases in the prime movers when employing a wider grip. This finding was credited to the potential increase in torque around the shoulder joint (Clemons & Aaron, 1997). Similarly, one possible explanation for our finding is due to the greater degree of humeral abduction; a wider grip better aligns with the muscle fibers and is more specific to the LD movement plane (McAllister et al., 2013; García-Jaén et al., 2021).

This study also found amplitude differences between limbs. Paired T-test analysis of mean sEMG revealed significantly greater activation in the left LD. Similarly, Flint et al. (2015) also found the left LD to activate more and creditted the finding to the potential effects of; a small sample size, hand dominance, or a limited familiarisation period. With the high level of detail in the familirisation session, it is unlikely our finding can be creditted to this. However, the present sample size is small and is a viable cause. Yet, despite hand dominance not being recorded in this study, it is thought to be the most likely cause of this finding. Muscular imbalances can occur through a variety of means, particularly by hand dominance. Daily preferential use has been shown to alter physiological and mechanical properties of skeletal muscle (Adam, Luca & Erim, 1998). Thus, during compound lifts, it is not uncommon for bilateral muscle pairs to activate at different rates and to different extents. With an estimated 10.6% of people being left handed, it is fair to assume the left LD often had to activate more to keep up with the right (Papadatou-Pastou et al., 2020). Further research is needed to understand the true cause of this finding, with a greater sample size and a measure of hand dominance. Further insight could be valuable to coaches, athletes and physiotherapists as muscular imbalances are related to acute injuries (Croisier, 2004). This insight could help identify muscular imbalances earlier and allow for informed targetted exercise selection to prevent injury.

Irrespective of grip width, both LD exhibited a linear increase between sets at 60% 1RM, with the acception of the left LD WG set 3 and right LD WG set 2 which both saw a non-significant decline. Mean scores from the repeated measures ANOVA indicate sEMG amplitude will increase with sets linearly. Many studies have examined the relationship between sEMG amplitude and muscle activation, with it now being an accurate measure of fatigue index (Lowery & O'Malley, 2003; Cifrek et al., 2009). However, very few studies report sEMG amplitude between sets and repititions when not working to failure. When investigating muscle activation to failure at 80 & 30% 1RM, Jenkins et al. (2015) found, in the 80% 1RM group, only one of eight subjects to exhibit a linear increase in EMG amplitude between sets, suggesting muscle activation at 80% 1RM remained at similar levels across all repititions and sets. However, in the 30% 1RM group, Jenkins reported a significant decline in EMG aplitude between sets. This contrasts with our findings and suggests fatigue index may differ at different %1RM. This also contrasts with previous literature from Jenkins et al., finding the same decline between sets in the 80% 1RM group, but a linear increase in the 30% 1RM group (2015). The main differences between our investigation and both of Jenkins' is the studied muscle groups and extent of fatigue (failure/nonfailure). Factors such as location, architecture, bloodflow (Yasuda et al., 2009), or fiber type compisition of the musculature may influence the recruitment response to different %1RM and to what extent. Combined, the present findings suggest muscle recruitment in response to different %1RM loads must be specific. Future studies should look to define these specifics, investigating the same muscle group at different %1RM.

Despite increasing between sets, a decrease in sEMG amplitude was observed between repetitions. Agreeing with previous research from Augustsson et al. (2003), who found a reduction in activity across repititions when reviewing activation for lower limb muscles in the leg press. This finding contrasts previous literature from Sundstrup et al. (2012). When reviewing the physiological effects of training to or near to failure (3RM) with elsastic resistance in untrained women, normalised sEMG values for the failure group increased in a curvilinear fashion until hitting a plateau in the final repititions, whereas the 3RM group displayed very similar levels throughout (Sundstrup et al., 2012). Suggesting going to complete failure is unnecessary when aiming to recruit the entire motor unit (Sundstrup et al., 2012). The main differences in this study are the social group, musculature and type of resistance investigated. Several studies have investigated the effects on recruitment between mode of resistance, with those agreeing mode can heavily influence lifting velocity and thereby muscle coordination and activation, particularly in elastic resistance (Duffey & Challis, 2012; Izquierdo et al., 2006; Aboodarda, Page & Behm., 2016). It is no secret muscles respond differently under the manipulation of different training variables (rest, velocity, load, mode, volume) (Sundstrup et al., 2012). By such means, this finding could have a similar explanation to that of Sundstrup et al. (2012). Amplitude cancellation occurs when the respective elecrtodes underestimate the amount of motor unit activity due to the loss of information that occurs when overlapping positive and negative phases of motor unit potentials cancel one another out and reduce the signal (Keenan et al., 2005; Day & Hulliger., 2001). With the back being one of the largest and complex muscle groups, it is a valid explanation for the observed decrease in amplitude (MacDonald, Moseley, Hodges, 2009). Amplitude cancellation has been recognised for decades, yet only one study has quantified amplitude interference using intramuscular EMG (Keenan et al., 2005). With Day & Hulliger (2001) finding a 50% reduction in intramuscular EMG amplitude in cats, suggesting a MVC to be necessary for more accurate and reliable results. Future studies should explore the use of intramuscular EMG, with a measure of MVC.

Conclusion

This is the first study to assess bilateral activation of the LD between grip widths. The primary findings indicate that in the BOBR, LD activity remained greater at the wide grip when compared to narrow. This is thought to be through the greater degree of humeral abduction, being more specific to the LD movement plane. A greater level of activation was observed in the left LD, this finding was attributed to hand dominance. LD activity increased between sets, this finding was credited to fatigue, as the demand increases, greater activation of the muscle is required to maintain performance. LD activity decreased between repititions, this finding was credited to cross-talk cancelling out sEMG amplitude. Future studies are needed to determine the optimal grip width for LD activation and to further examine the interaction with articulating muscles at varied loads to determine a load-activation relationship for the LD in the BOBR.

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