

The Effect of Neoprene Elbow Sleeves on Bench Press and Shoulder Press Performance

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ABSTRACT

Aim: The aim of the present study was to investigate the effects of neoprene elbow sleeves on performance in bench press and shoulder press.

Methods: Nineteen resistance trained males and one female (24 ± 4 years; 181 ± 8 cm; 83 ± 11 kg) visited the laboratory on four occasions. Participants were randomly assigned in a crossover and counterbalanced design to one of two conditions: with SBD neoprene elbow sleeves and without sleeves. During each visit, participants completed one repetition maximum (1RM) followed by 'as many repetitions as possible' (AMRAP) to concentric failure at 85% of 1RM. Test day one and three were bench press; test day two and four were shoulder press.

Results: 1RM bench press was higher with sleeves than without sleeves (104.8 ± 17.7 kg vs. 103.2 ± 18.7 kg, $p = 0.015$). Bench press AMRAP was higher with sleeves than without sleeves (5.2 ± 1.4 vs. 4.1 ± 2.0 , $p = 0.006$). 1RM shoulder press was higher with sleeves than without sleeves (66.0 ± 13.9 vs. 64.0 ± 13.7 , $p = 0.008$). Shoulder press AMRAP was higher with sleeves than without sleeves (5.8 ± 1.3 vs. 4.6 ± 1.2 , $p = 0.001$). No significant differences were observed in mean or peak barbell velocity between conditions ($p > 0.05$).

Conclusion: Neoprene elbow sleeves improved 1RM and AMRAP in bench press and shoulder press, but not barbell velocity.

Keywords: Bench press, shoulder press, muscular performance, ergogenic tool, resistance training, SBD

INTRODUCTION

In the realm of strength training, athletes and fitness enthusiasts are continually seeking methods to enhance performance, whether through innovative training techniques, supplements, or equipment. Among the various accessories available, neoprene sleeves for elbow and knee joints have become increasingly popular. While neoprene sleeves are widely used, their effect on performance remains somewhat unclear. Studies on knee sleeves have shown equivocal effects, with reports of increased squat, front squat and leg press performance (1, 2) while others report no effect on performance (3, 4). Studies on the effect of elbow sleeves have to the author's best knowledge not previously been published.

The literature indicates that sleeves are used to provide support and compression for the joint, with various candidate mechanisms suggested to potentially increase performance (5). Perhaps most intuitive, increased performance may rely on the ability of neoprene sleeves to store elastic energy during the eccentric phase of a lift and release it during the concentric phase, similar to the way knee and elbow wraps function (2, 6). Elbow wraps, which provide a much more rigid support than neoprene sleeves have been found to increase bench press 1RM by 6.6% (7). Secondly, compression garments are shown to enhance proprioception and sensory feedback, which could in turn improve motor control and joint stability (8-10). Improved proprioceptive awareness may in theory enable lifters to maintain better form, reduce compensatory movements,

and optimize force output during exercises such as bench press and shoulder press. Lastly, psychological effects may also contribute, as studies have reported that subjects preferred to use neoprene knee sleeves if optional, due to subjective feelings of greater stability and support (2, 11).

A distinction between elbow and knee sleeves is that knee sleeves are allowed to use in IPF competitions, whereas elbow sleeves are not (11). Despite this, many strength athletes incorporate elbow sleeves in their training routines, and the widespread use warrants the question of whether elbow sleeves may increase lifting performance. The purpose of the present study was therefore to examine whether neoprene elbow sleeves increase bench press and shoulder press performance, as assessed by one repetition maximum (1RM) and 'as many repetitions as possible' to concentric failure at 85% of 1RM. This load was chosen for the AMRAP testing due to its proximity to the optimal training load to increase maximal strength (12, 13). We tested 20 subjects with and without elbow sleeves and hypothesized that elbow sleeves would increase 1RM and AMRAP in bench press and shoulder press.

METHODS

Subjects

Nineteen males and one female between 18-35 years of age completed the study (Table 1). To be included in the study subjects had to regularly participate in resistance training for the last 1.5 years, with a minimum frequency of two sessions per week. Subjects were excluded if they had

any injuries or ailments in the upper body that restricted their ability to perform heavy bench press or shoulder press lifting. All subjects received detailed information about the study and gave their written informed consent prior to participation. The study was approved by the Norwegian Centre for research data (SIKT reg. 196225) and conducted in agreement with Nord University's research ethical regulations, as well as the latest version of the Declaration of Helsinki.

Testing

All participants visited the lab on four occasions during a two-week period. During each visit 1RM was assessed in either bench press or shoulder press, followed by a test of 'as many repetitions as possible' (AMRAP) at 85% of 1RM in the same exercise. Test day one and three consisted of bench press testing, and test day two and four consisted of shoulder press testing. Subjects had a minimum of three days between each session, and seven days between each session with the same exercise. All visits were performed at the same time of day. Two experimental conditions were used during the four testing sessions: two sessions without elbow sleeves and two sessions with elbow sleeves. The sequence of conditions was allocated by a randomized and counterbalanced crossover approach, to mitigate any learning or training effects between testing sessions. As part of the initial screening, participants were also asked about their prior experience using neoprene elbow sleeves, including the frequency of use. This screening revealed that none of the participants reported using these sleeves on a regular basis. During the 'with elbow sleeves condition' subjects wore SBD neoprene elbow sleeves (SBD Apparel, 2023), consisting of a 5mm panel for freedom of movement and a 7mm exterior panel for maximum joint support. The manufacturer size recommendation was followed.

During the first visit anthropometrics were collected, subjects were screened for training history, and grip width in bench press and shoulder press were recorded. Subjects had the freedom to choose their own preferred bench press and shoulder press style, however it was emphasized that lifting characteristics were upheld consistently throughout all testing sessions. The subjects were asked to estimate their 1RM in both exercises, when performed with a controlled stop in the bottom of the lift. This estimated 1RM was used to determine barbell weight during the warmup protocol. Subjects were explained the protocol and familiarized with

Table 1. Subject characteristics

N=20	
Age (yrs)	24 ± 4
Height (cm)	181 ± 8
Body mass (kg)	83.3 ± 11.3
Years with strength training	6.5 ± 3.4
Years with bench press training	6.0 ± 3.5
Grip width bench press (cm)	70.9 ± 6.7
Grip width shoulder press (cm)	65.8 ± 7.1
Circumference lower biceps (cm)	31.0 ± 2.3
Circumference forearm (cm)	28.8 ± 1.8
Wilks score	69.6 ± 10.5
Estimated bench press 1RM (kg)	104 ± 17
Estimated shoulder press 1RM (kg)	60 ± 11

Data are mean ± SD. 1RM, one repetition maximum.

the RPE/RIR scale in the same manner as described by Zourdos et al. (14). For both exercises a 20 kg powerlifting barbell (Eleiko, Sweden) was used to ensure stability and prevent excessive spinning or deformation (15). Lifting discs were calibrated to the nearest 0,25 kg (Eleiko, Sweden).

Bench press testing was performed in an IPF competition combo rack (Eleiko, Sweden). International powerlifting federation (IPF) rules were followed, which included that head, shoulders and buttocks had to be in contact with the bench through the lift. The subjects also had to perform a controlled stop in the position where the barbell touched the chest.

Shoulder press testing was conducted in a HD elite power rack seated on an adjustable bench (Hammer Strength, USA), with a barbell squat pad (C.P Sport Italy) placed in the center of barbell. The bench was adjusted to 80°, and a belt was strapped around the hip to prevent back rounding/spinal flexion. The safety bars of the power rack were adjusted to a height at which the barbell rested 2-3 cm lower than the subject's shoulder press starting position. At the beginning of each trial, the subject rolled the barbell up on the chest in a controlled manner, and the lift started and finished with the pad touching the top of the chest. For the lift to be approved, elbows had to be fully extended.

For both bench press and shoulder press, 1RM was assessed using the exact same protocol, as adapted from Machek et al. and Wallace et al. (1, 16). Participants performed a standardized warm-up consisting of 10 repetitions with the 20kg barbell, 10 repetitions at 50% of (estimated) 1RM, five repetitions at 70% of 1RM, three repetitions at 80% of 1RM and a single repetition at 90% of 1RM. The load used during warm up sets were identical between conditions. Up to three minutes of recovery were allowed between each warmup set, but subjects were allowed to use shorter rest periods if preferred.

Starting from the last warm-up attempt at 90% of estimated 1RM, subjects were blinded to the barbell weight, using plastic bags. From this point the rest periods between each lift were kept strictly to five minutes, during which subjects were seated in an adjoining room while laboratory technicians altered the barbell load and covered the bar. Following a successful 1RM lift subjects were immediately asked to rate how heavy the lift was on an RPE scale from 1-10, adapted from Zourdos et al. (14).

The magnitude of increase in load was then based on the RPE of the previous successful lift: RPE 10 = 1% increase, RPE 9.5 = 1.5% increase, RPE 9 = 3% increase, RPE= 8.5 = 4.5% increase, RPE 8 = 6 % increase etc. For lifts above 100kg, if the subject failed an attempt and the increase in weight was three kg or more, the subject was allowed a new trial at a weight that was in between the failed attempt and the previously successful lift. For trials in which the load was below 100kg a new attempt at a lower weight was granted if the increase in weight was two kg or more.

The number of attempts varied between conditions and participants due to the nature of the algometric testing. On average, participants attempted the bench press 3.5 times without sleeves and 3.7 times with sleeves. For the shoulder press, the average were 4.5 attempts without sleeves and 4.9 attempts with sleeves. After the last lift of the 1RM protocol a five-minute rest period was given, before the subject performed AMRAP at 85% of 1RM in the same exercise. This test was performed as a single exhaustive set to the point of complete concentric failure, at which the barbell was secured by two laboratory technicians. 85% of 1RM from the first conducted 1RM test were used to ensure equal weight between conditions. To provide consistency a metronome was played to the subject during the trial, where a maximum of two seconds "pause" was allowed at the top position of the lift. Repetitions that did not meet the specified requirements were excluded from the count. The total number of valid repetitions was cross verified by two laboratory technicians.

Velocity assessment

During all lifts a linear encoder (Vitrue, 2023 Spain) was attached to the barbell, to assess barbel velocity. The Vitrue linear decoder is an isoinertial dynamometer featuring a cable- extension linear position transducer, which is commercially available and has been validated to assess movement velocity in different intensities in bench press (17). Data were recorded by differentiating displacement with respect to time at a sampling rate of 1,000 Hz. All data obtained were transmitted by Bluetooth to a tablet (iPad; Apple) running the Vitrue application. The cable was attached to the left side of the barbell using a Velcro strap. Barbell peak velocity and mean propulsive velocity were recorded starting from the first single repetition at 90% of the estimated 1RM and throughout all consecutive lifts of the 1RM protocol. The linear encoder was

also attached during the AMRAP test, to verify the number of repetitions completed during this test.

Wilks Coefficient

The Wilks coefficient (18) was used to calculate relative strength. It is determined by multiplying a bodyweight coefficient by the total load lifted, which in this study was the 1RM bench press performed with sleeves, and the body weight recorded on that day. To be classified as an experienced bench presser, a Wilks score greater than 70 has been suggested by Ormsbee et al. (19).

Statistical analysis

Statistical analyses were carried out using IBM SPSS statistics version 29.0. Figures were made using GraphPad prism version 8.0. The assumption of normality for the dependent variables was assessed using the Shapiro-Wilk test and visual inspection of quantile-quantile (QQ) plots and histograms, which indicated normal distributions. Differences in performance between the two conditions were analyzed using paired samples t-tests. Statistical significance was set at $p < 0.05$. Data are presented as mean $\pm$ SD in text and tables, whereas figures are presented as mean $\pm$ SE for illustrative purposes. Effect sizes (d) were calculated using Cohen's formula, and interpreted based on the following criteria suggested for strength training research on recreationally trained subjects (20): <0.35 trivial effect; 0.35 - 0.80 small effect; 0.80 - 1.50 moderate effect; >1.5 large effect.

Interrater reliability for the single rater was assessed using intraclass correlation coefficient (ICC) analysis and their 95% confidence intervals (CI), based on 2-way mixed-effects models. This analysis was applied to measurements of 1RM, AMRAP and velocity measurements. Reliability was categorized as follows: values <0.5 indicate poor reliability, values between 0.5 - 0.75 indicate moderate reliability, values between 0.75 - 0.9 indicate good reliability and values >0.9 indicate excellent reliability (21).

An a priori power analysis was not performed due to the lack of prior research on elbow sleeves. Based on a related study by Machek et al. (1) that included 15 participants, we recruited 20 participants for this investigation to enhance the potential to detect a meaningful effect.

RESULTS

Effect of elbow sleeves on one repetition maximum

Bench press 1RM was 1.6 ± 2.6 kg higher with sleeves than without sleeves (95%CI: 0.4 - 2.8 , $d=0.60$, $p=0.015$), indicating small effect size. Shoulder press 1RM was 2.0 ± 2.9 kg higher with sleeves than without sleeves (95%CI: 0.6 - 3.4 , $d=0.66$, $p=0.008$), indicating small effect size.

Intrarater reliability for 1RM bench press (ICC= 0.993 , 95% CI= 0.976 - 0.998 , $p<0.001$) and shoulder press 1RM (ICC= 0.984 , 95% CI= 0.938 - 0.996 , $p<0.001$), indicating excellent reliability.

Effect of elbow sleeves on 'as many repetitions as possible' at 85% of one repetition maximum

Participants completed 1.1 ± 1.6 more repetitions at 85% of 1RM in bench press with sleeves than without sleeves (95%CI: 0.4 - 1.8 , $d=0.69$, $p=0.006$), indicating small effect size. For shoulder press participants completed 1.2 ± 1.4 more repetitions at 85% of 1RM with sleeves than without sleeves (95%CI: 0.6 - 2.0 , $d=0.87$, $p=0.001$), indicating moderate effect size.

One participant did not complete the AMRAP test for shoulder press due to acute shoulder pain, leading to a reduced sample size for this variable.

Intrarater reliability for AMRAP bench press (ICC= 0.68 , 95% CI= 0.13 - 0.88 , $p=0.002$) and AMRAP shoulder press (ICC= 0.38 , 95% CI= -0.26 - 0.73 , $p>0.05$) indicating moderate and poor reliability, respectively.

Effect of elbow sleeves on lifting velocity

Mean propulsive velocity and peak velocity at the 90% of estimated 1RM trial were not different between the two conditions (Table 2). Similarly, at the heaviest completed lift, i.e. 1RM, no difference in mean propulsive velocity or peak velocity were observed between the two conditions ($p>0.05$).

During bench press at 90% of estimated 1RM, intrarater reliability for mean propulsive velocity (ICC= 0.944 , 95% CI= 0.861 - 0.978 , $p<0.001$). Peak velocity (ICC= 0.876 , 95%CI= 0.686 - 0.951 , $p<0.001$), indicated excellent and good reliability, respectively.

During shoulder press at 90% of estimated 1RM,

intrarater reliability for mean propulsive velocity (ICC=0.906, 95%CI=-0.760-0.963, $p<0.001$) and peak velocity (ICC=0.896, 95%CI=0.737-0.959, $p<0.001$), indicating excellent and good reliability, respectively.

During bench press 1RM intrarater reliability for mean propulsive velocity (ICC=0.000, 95% CI= -1.523-0.602. $p>0.05$) and peak velocity (ICC=0.645, 95% CI=0.097-0.860 $p<0.05$), Indicating poor and good reliability, respectively.

During shoulder press 1RM intrarater reliability for mean propulsive velocity (ICC=0.081 95%CI=-1.471-0.645, $p>0.05$) and peak velocity (ICC=0.801 95% CI=0.494-0.921 $p<0.001$). Indicating poor and good reliability, respectively.

Rating of perceived Exertion (RPE)

There was no difference ($p>0.05$) in RPE recorded at 90% of estimated 1RM for bench press or shoulder press.

DISCUSSION

This is the first study to explore the effects of neoprene elbow sleeves on bench press and shoulder press performance. The main finding was that elbow sleeves increased 1RM and AMRAP in bench press and shoulder press.

Effect on one repetition maximum and 'as many repetitions as possible'

Our data revealed a small yet unmistakable increase in performance across all four measured performance variables. Being the first study to examine the effects of elbow sleeves on 1RM, direct comparisons to previous experiments are

not available. Elbow wraps, which consist of elastic wraps that are very firmly wrapped around the elbow joint, have been shown to increase bench press 1RM by approximately four times the magnitude of that observed in the current study (6.6% vs. 1.6%) (7). The larger effect is likely due to larger elastic potential (3). With regards to practical applications wraps are time-consuming to manage and quite painful to use, especially in context of daily training routines. Neoprene sleeves may offer a simpler and less painful alternative, although the effect on performance is likely smaller.

With respect to 'sleeve studies' in the lower extremities, our findings are in line with experiments on neoprene knee sleeves in trained males (1, 2), which have shown to increase 1RM in back squats by ~4% (1), and front squats by ~5% (2). Another study on knee sleeves reported no effect on 1RM in back squats (3), albeit the average weight lifted was numerically higher with sleeves also in this study (~2%), but not statistically different between conditions.

Direct comparisons to experiments on AMRAP performance are unavailable. As for 1RM the most relevant comparison is Gomes et al. (7), who reported elbow wraps to increase AMRAP in bench press at 70% of 1RM from 14 to 18 repetitions in a group of trained males (7). One study on knee sleeves reported no effect on AMRAP leg press at 80% of 1RM in a group of resistance trained men and women (4). In this study the depth of leg press repetitions was only 90° knee flexion, which may have been insufficient to exploit the elastic potential of the neoprene sleeves. Notably, for AMRAP shoulder press interrater reliability indicated poor reliability, hence these data should be interpreted with caution.

From the suggested interpretation of effect sizes in

Table 2. Concentric velocities at 90% of estimated 1RM trial and at 1RM

N=20	Without sleeves	With sleeves
Mean propulsive velocity, bench press, 90% of 1RM	0.27 ± 0.09	0.28 ± 0.08
Mean propulsive velocity, shoulder press, 90% of 1RM	0.37 ± 0.11	0.38 ± 0.12
Peak velocity, bench press, 90% of 1RM	0.43 ± 0.12	0.44 ± 0.11
Peak velocity, shoulder press, 90% of 1RM	0.58 ± 0.15	0.58 ± 0.17
Mean propulsive velocity, bench press 1RM	0.13 ± 0.04	0.13 ± 0.05
Mean propulsive velocity, shoulder press, 1RM	0.21 ± 0.17	0.20 ± 0.16
Peak velocity, bench press, 1RM	0.27 ± 0.08	0.26 ± 0.11
Peak velocity, shoulder press, 1RM	0.31 ± 0.11	0.31 ± 0.13

Data are mean ± SD. All velocity data are presented in m·s⁻¹. 1RM: one repetition maximum. AMRAP: as many repetitions as possible.

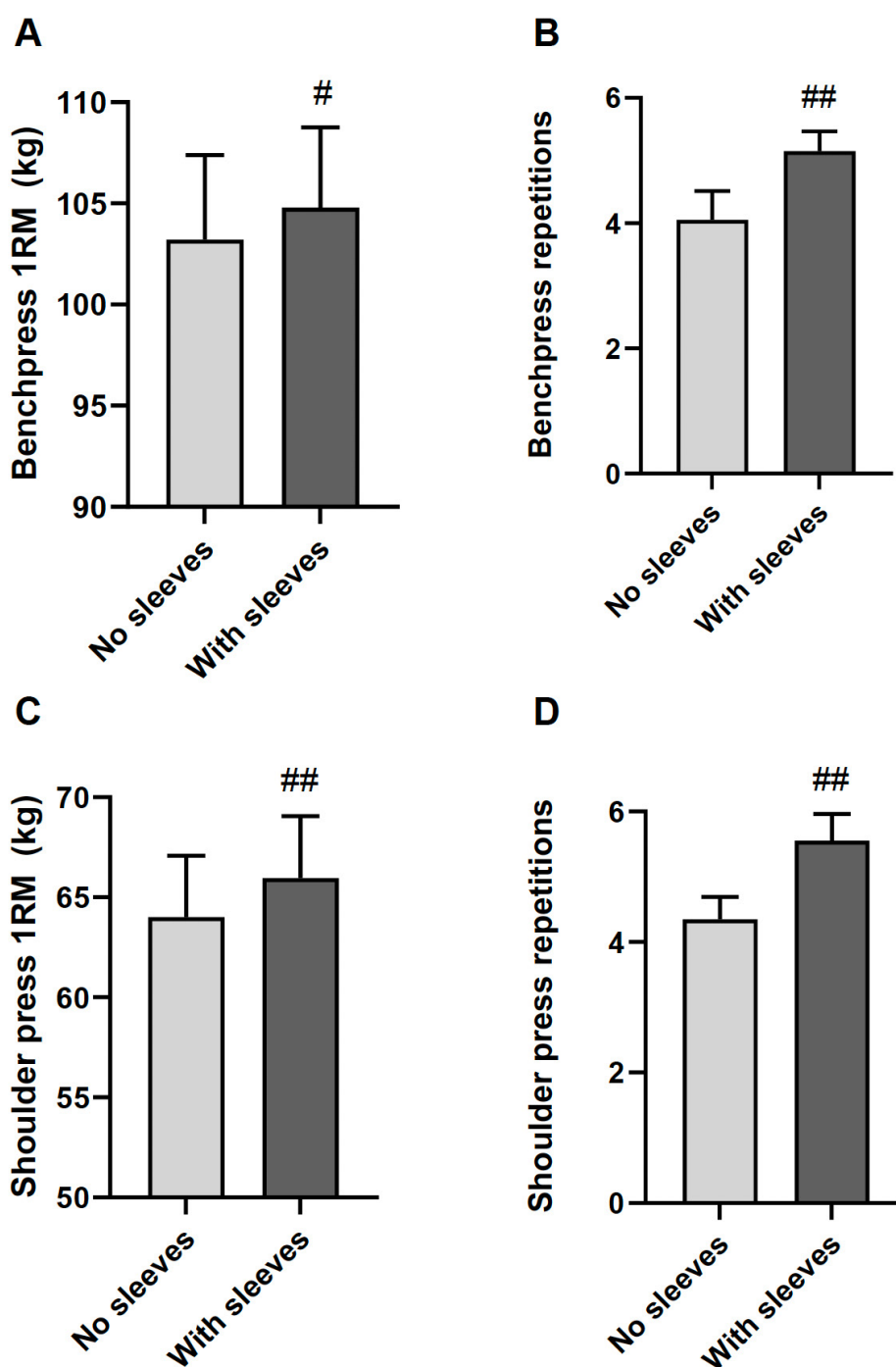


Figure 1. (A) Bench press one repetition maximum, with and without elbow sleeves (B) Bench press, as many repetitions as possible at 85% of one repetition maximum, with and without elbow sleeves (C) Shoulder press one repetitions maximum, with and without elbow sleeves (D) Shoulder press, as many repetitions as possible at 85% of one repetition maximum, with and without elbow sleeves. [#] $p < 0.05$, ^{##} $p < 0.01$ significant different from 'no sleeves' condition.

strength training research on recreationally trained subjects (20), Cohens d indicated a moderate effect of sleeves on AMRAP shoulder press performance ($d=0.87$), and small effects on AMRAP bench press ($d=0.69$), 1RM bench press ($d=0.60$) and 1RM shoulder press performance ($d=0.66$). As highlighted by Rhea (20), effect sizes must be interpreted in context of the strength training status of the subjects. Given a mean Wilks score of 69.6 and an average of 6.5 years consistent strength

training, the sample in the current study is arguably on the border between 'recreationally trained' and 'highly trained', the latter being defined by Rhea as more than 5 years of consistent strength training. In his analysis, Rhea advocates that for a highly trained sample, effect sizes between 0.5-1.0 should be considered moderate. On this basis it could be advocated that the effect size for all four performance variables in the current study should be classified as moderate rather than small.

Despite a consistent improvement across all performance variables, no differences were observed in lifting velocity at 90% of 1RM between conditions. In theory, one would expect velocity at the same absolute load to be slightly higher with sleeves, however it is possible that the 1.5-2kg improvements in 1RM induced by elbow sleeves were too small to have any detectable impact on lifting velocity.

Mechanisms of increased performance

Since mechanisms of increased performance were not examined in the current study, we can only speculate why elbow sleeves increased 1RM and AMRAP performance. The most likely mechanism is the elastic properties of the neoprene, which stores energy as the material is stretched during the eccentric phase of the movement, and assists elbow extension during the concentric phase, as the material returns to its original state (2, 6). A psychological effect from wearing sleeves may also have been present, although similar RPE values during lifts at 90% of estimated 1RM between conditions did not support this notion.

Practical implications

While elbow sleeves are not permitted in powerlifting competitions, they are widely used in training. In theory, it is possible that the observed increase in 1RM and AMRAP may increase the accumulated training load, which could in turn influence performance progression over time. If allowed in competitions, elbow sleeves may have potential to enhance performance in strength sports in which elbow extension constitute an important part of the movement (i.e. powerlifting and weightlifting).

Experimental considerations

Considerable efforts were made to measure 1RM as accurately as possible in the present study. In addition to strict adherence to 5-minute rest periods between each trial, the testing protocol allowed determination of 1RM to the closest 1kg-interval for measurements below 100kg, and the closest 2kg-interval for measurements above 100kg. Moreover, we advocate that the algorithm-based approach to determine magnitude of load increase between each trial, instead of human judgement, strengthens the integrity of the 1RM assessment.

Although PRE scores were similar across conditions, the possibility of a placebo effect from

wearing sleeves cannot be ruled out. This limitation may have been addressed by including a third condition, with a non-elastic placebo sleeve (1). It is also worth noting that the participants in this study reported no regular prior use of neoprene elbow sleeves, which might influence the observed effects. Future research could investigate the response of individuals with more extensive experience using such sleeves. Lastly, the study included 19 males and only one female, limiting the generalizability of the findings to females.

CONCLUSION

Our data coherently suggest that neoprene elbow sleeves increase 1RM and AMRAP performance in bench press and shoulder press.

ABBREVIATIONS

AMRAP: as many repetitions as possible

RPE: rating of perceived exertion

IPF: international powerlifting federation

1RM: one repetition maximum

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

FUNDING

This study received no specific funding in order to be completed.

ETHICAL APPROVAL

All subjects received detailed information about the study and gave their written informed consent prior to participation. The study was approved by the Norwegian Centre for research data (SIKT reg. 196225) and conducted in agreement with Nord University's research ethical regulations, as well as the latest version of the Declaration of Helsinki.

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