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Post Activation Potentiation – Effects on Number of Repetitions and Average Force Output in Moderately Heavy Overhead Press

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Abstract

Background: Post activation potentiation (PAP) is a temporary enhancement of a muscle's force producing capabilities that occurs after a muscle contraction. In the current literature, a preload (conditioning activity), for instance a heavy squat, has commonly been used in order to improve the performance of a following explosive activity such as a sprint. PAP effects appear to be relatively small when used to improve performance in explosive activities such as jumps and sprints. The currently most establish mechanisms behind PAP are phosphorylation of myosin regulatory light chains (MRLC), neural factors such as the increased recruitment of higher order motor units and an increased H-reflex. **Aim:** The aim of this study was to examine the effects of a PAP-protocol on performance (number of repetitions & Average Force output) in moderately heavy overhead press. **Method:** 10 trained young male subjects completed the study. Inclusion criteria were that they had at least two years of resistance training experience, along with practical knowledge of the execution of the overhead press. Exclusion criteria were injuries, illnesses or any other complications preventing them from performing the overhead press in a safe and correct manner. Each subject completed three different test sessions: Test 1: One repetition max (1RM) test in the overhead press, Test 2: A performance test examining how many repetitions the subjects could complete in the overhead press at 75% of 1RM, Test 3: A test examining the subjects performance when the same performance test was preceded by a heavy preload overhead press of 80% of 1RM (8 minutes of rest after the preload). Force output was calculated by a MuscleLab Linear Encoder during tests 2 and 3. **Results:** There was a significant difference in the number of repetitions between the baseline performance test and the PAP80 test (p=0.017), with the PAP80 test having the higher amount of repetitions. There was also a significant difference in the total force output between baseline and PAP80 (p=0.028), with PAP80 having the higher number. No difference was shown in the mean force output per repetition (total force output/number of repetitions) between baseline and PAP80 (p=0.40). **Conclusion:** A PAP-protocol can be used to improve performance in moderately heavy overhead presses following a heavy preload overhead press. More research is needed to determine if PAP is the determining factor causing this improved performance. It could be speculated that these results could potentially be used to increase hypertrophy training stimuli in future resistance training programs, but this single study alone can not be used to draw that kind of conclusion.

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Background

Post Activation Potentiation

A muscle's performance can be altered by its contractile history, for example when a preload stimuli is used to try and affect the results of a following performance test (Kildruff et al., 2007). Probably the most obvious effect of contractile history is fatigue, which essentially means that the muscle is unable to generate an expected level of force (Hodgson, Docherty & Robbins, 2005). However, there is another counter-acting effect of contractile history, known as the Post Activation Potentiation (PAP) which improves muscle performance (Wilson et al, 2013). Fatigue and PAP can coexist (Rassier & MacIntoch, 2000), and therefore, force output following contractile activity is determined by the net balance between these two processes, where PAP enhances force development (PAP) and fatigue diminishes it (Hodgson, Docherty & Robbins, 2005). Because the fatigue dissipates at a faster rate compared to the potentiation, there seems to be a period of time following a muscle action where a temporary enhancement of the muscle's force producing capabilities occur (Mitchell & Sale, 2011). PAP also seem to provide an altered rate of force development rather than an increased peak force production (Rixon, Lamont & Bemben. 2007).

Regarding the mechanisms of PAP, some of the major established ones are: Phosphorylation of myosin regulatory light chains (MRLC) (Rixon, Lamont & Bemben, 2007; Hodgson, Docherty & Robbins), higher order motor unit recruitment (Hodgson, Docherty & Robbins, 2005: Tillin & Bishop, 2009), and an increased Hoffmann-reflex (H-reflex) (Hodgson, Docherty & Robbins, 2005; Chiu et al, 2003; Ebben & Watts, 1998; Tillin & Bishop, 2009).

Phosphorylation of myosin regulatory light chains (MRLC)

An improved force production seems to occur due to the phosphorylation of MRLC during submaximal contractions by increasing the rate of which cross bridges move from a non-force producing state to a force producing state, as well as an increased number of force-producing cross bridges (Hamada, Sale & MacDougall, 2000; Stone et al, 2008). Additionally, increased phosphorylation of myosin regulatory light chains provides greater contractile filament sensitivity to calcium. A generation of action potential occurs as a result of the increased levels of calcium that act on specific molecular targets, besides the normal exocytotic release of neural transmitters (Rixon, Lamont & Bemben. 2007). Due to increased sensitivity to calcium at low myoplasmic levels, MRLC phosphorylation has its greatest effect at relatively low concentrations of calcium, as is the case during twitch or low-frequency tetanic contractions (Tillin & Bishop. 2009). However, this increased calcium sensitivity has no measurable effect at saturated calcium levels, such as during high-intensity contractions. Hence, force production is not increased by MRLC phosphorylation when calcium levels are saturated (Hodgson, Docherty & Robbins, 2005).

Neural factors

According to Docherty et al. 2004, the physiological mechanisms behind PAP can best be explained by enhanced neural activation. Specifically, some of these mechanisms are: increased motor unit recruitment, enhanced motor synchronization of motor units, and/or decreased presynaptic inhibition. Ultimately, the combination of these mechanisms results in greater cross-bridge attachments in the muscle, increasing its force production capacity (Weber, Brown, Coburn & Zender, 2008). An increased number of type II-fibers can be recruited as a result of the increased excitability of muscle units. This can also enhance force production due to the high force-producing capacity of the type II-fibres (Hamada et al., 2000). In addition, delivery of neurotransmitters over the synaptic junction is improved, meaning a higher neurotransmitter release and a matching ratio of pre-synaptic release and post-synaptic uptake (Tillin & Bishop, 2009).

A mechanism that affects the amount and size of muscle unit recruitment is the H-wave (H-reflex) amplitude. With a constant submaximal moto neuron stimulation, an increased H-wave could lead to increased levels of presynaptic $Ca2+$ along with improved function of neurotransmitters at the synaptic junctions, resulting in increased recruitment of higher order motor units. PAP can also increase the amplitude of the H-reflex, and it has been suggested that this could be one of the factors causing its improvements in performance (Hodgson & Docherty, 2005; Tillin & Bishop, 2009).

Effects of training status on PAP

It is suggested that the PAP effect elicited by stronger individuals are greater than their weaker counterparts. A possible explanation is the greater number of type II muscle fibers in the muscles of these stronger individuals, resulting in a greater myosin light chain phosphorylation. In addition, stronger individuals may develop a fatigue resistance to heavier loads after a near maximal effort, which may affect the balance between fatigue and potentiation after a conditioning activity. Individuals with previous resistance training experience exhibit larger PAP effect than those without any resistance training experience. Accordingly, due to the probably lower strength levels of the inexperienced individuals compared to the more experienced individual, resulting in a lower PAP levels in the inexperienced individuals compared their experienced counterparts (Seitz & Haff, 2016).

Previous Research on PAP

A very recent meta-analysis by Seitz & Haff (2016) showed that even though there is considerable literature advocating the use of a conditioning activity (preload) to stimulate enhanced performance in subsequent jump, sprint, throw, and upper- body ballistic performance, conflicting results have been reported regarding the extent of improvement. E.g. performance has been improved in Counter movement jump height (Kilduff et al., 2007), impaired in jump height (Pearson & Hussain, 2014) and in shotput performance (Judge, Bellar & Judge, 2010), and shown no significant time changes in a 5-10 meter sprint test following a set of back squats (Crewther et al, 2011). In conclusion the precise effect of performing a conditioning activity (preload) in jump, sprint, throw and upper-body ballistic performance remain unclear. Based on the contemporary scientific literature, these possible PAP-effects also appear to be relatively small in the previously mentioned areas (jump, sprint, etc) (Seitz & Haff, 2016).

Post activation potentiation protocols

Most of the PAP-studies aiming to improve performance has been done in explosive activities such as sprints (Rahimi, 2007), Jumps and Ballistic bench throws (BBT) (Kilduff et al., 2007). Rahimi (2007) let his subjects perform preload squats (2 sets, 4 repetitions) in three different intensities (light, moderate and heavy) followed by a 40 m sprint test. The study showed that the heavy preload squats resulted in significantly increased sprint performance compared to the other preloads. Kilduff et al., (2007) used a preload of 3-repetition-max (3RM) squats followed by a performance test of Counter movement jumps (CMJ), and a preload of 3RM bench presses followed by a performance test of ballistic bench throws (BBT). The result of this study showed that the subjects improved their peak power output (PPO) the most when they performed the CMJ and BBT 8 and 10 minutes after the preload exercises. This goes in line with the general recommendations for rest times in PAP-protocols (Wilson et al., 2013).

An unpublished study by Bjork (2014) used a PAP-protocol where the subjects performed moderately heavy squats following a heavy preload squat, in order to examine its possible effects on power output and number of repetitions performed. The results from the study showed a significant increase in the number of repetitions performed after a heavy preload squat compared to baseline, and significant increases in power or force output was found. To the authors knowledge this is the only study that has used a PAP-protocol to both examine its effects on the number of repetitions performed, and power and force output in a resistance training exercise.

In a general sense, a meta-analysis by Wilson et al. (2013) suggests that preloads at 60-85 % of the one repetition max (1RM), using rest times of 7-10 minutes between the preload and the performance test is optimal to maximize the effectiveness of the PAP-protocol. Both recent meta-analyses by Wilson et al. (2013) and Seitz & Haff (2016) has found that multiple sets is more effective compared to single sets in eliciting PAP to improve performance. As was mentioned previously, there is a great majority of PAP-studies aimed to improve explosive performance, and even though they have been frequently done, their effects appear to be relatively small (Seitz & Haff, 2016). This might lead to speculations that the field has come as far as it can in this area, and that researching PAP from a new perspective might be useful to break new ground. The unpublished study by Bjork (2014) showed some interesting theories on how PAP-protocols can be used to increase the number of repetitions performed in a resistance training exercise (squat). To the author, this type of protocols would be interesting to research further, and can be used as a source of inspiration on how to design PAP-protocols aiming to increase the number of performed repetitions in resistance training exercises. Furthermore, the purpose of this study was to try and use a PAP-Protocol to increase training stimulus in a common resistance training exercise, defined as an increased amount of repetitions performed and possibly an increased total force output and an increased mean force output per repetition (total force output / amount of performed repetitions). If this shows to be true, this information might be used to inspire further research on this topic, possibly finding a future usage of PAP-protocols as a method to increase training stimuli in strength and hypertrophy training.

Aim

The aim of this study was to examine the effects of a PAP-protocol on performance (number of repetitions & Force output) in moderately heavy overhead press.

Hypothesis

The author's hypothesis was that a preload overhead press (80% of 1RM) would improve performance in the following overhead press performance test (75 % of 1RM), defined as an increased number of repetitions performed and increased total average force output (TAFO), and a slight increase in the average force output per repetition (AFOR).

Method

Subjects

16 trained young male subjects were invited to participate in the study, and 10 of them agreed to participate and completed the study. The subjects were 182.9 ± 6.2 cm tall (mean ± standard deviation), weighed 81.6 ± 7.9 kg and were 24 ± 1 years old. Six of these subjects declined participation due to time restrictions. The subjects were recruited from personal contacts at Halmstad University with the help of social media (Facebook). A Facebook message was sent to the subjects with an attached letter informing the subjects about all the relevant details of the study (see appendix 1). Inclusion criteria were that they had at least two years of resistance training experience, along with practical knowledge of the execution of the overhead press. Exclusion criteria were injuries, illnesses or any other complications preventing them from performing the overhead press in a safe and correct manner.

Test Protocol

Each test subject attended three test sessions each. In the first test session the subjects were tested on their 1RM in the overhead press in order to determine the relative intensities (% of 1RM) to be used in the two following tests. In the second test session (performance test) the subjects tested the amount of repetitions they could perform at the relative intensity of 75% of their 1RM. The third and last session (PAP-80-test) tested the number of repetitions the subjects could perform in the overhead press at 75 % of their 1 RM when the performance test was preceded by a single overhead press repetition at 80% of their 1RM (a preload), with 8 minutes rest in between the two sets. The baseline data from the performance test was compared to that from the PAP-80-test to see if there was any differences in the number of repetitions performed, TAFO and TFOR. Most of the test subjects (7 out of 10) did the performance test 30 minutes after the 1RM test.

Even though multiple preload sets seem to result in greater PAP responses (Wilson et al, 2013), this increased volume could possibly cause increased levels of fatigue that can impair the results (Chiu et al, 2003; Chiu et al, 2004). Based on this, I chose a single set preload of one repetition at 80 % of the 1RM, instead of multiple repetitions, and I also decreased the volume of the standardized warm up protocol of McArdle, Katch & Katch (2010) in order to prevent increased levels of fatigue during both the warmup and the PAP80-test (McArdle, Katch & Katch, 2010, p492-495). 75 % of the 1RM has used as the performance test intensity due to its placement in the middle of the spectrum for relative training loads optimizing hypertrophy gains (67-85% of 1RM) (Baechle & Earle, p. 401). If this PAP-protocol would show to increase the amount of repetitions performed at this relative intensity, this could possibly be used to increase hypertrophy training stimuli in future resistance training programs.

Session 1: Testing of the 1RM in the Overhead Press:

A standardized warm up session was performed (based on: McArdle, Katch & Katch, 2010, p492-495) with relative intensities being the percentage of the estimated 1RM in the overhead press. It consisted of: 10 repetitions on 20 % of 1RM in the overhead press, 7 repetitions on 40 % 1RM, 5 repetitions on 60% 1RM, 3 repetition on 70 % of 1RM, and 1 repetition 80 percent of 1RM. This was followed by 1 repetition sets at a successfully increased load with 3-5 minutes of rest between sets, until they reach their 1RM.

Session 2: Performance Test (Baseline)

A standardized warm up was performed, consisting of: 10 repetitions at 20% of the 1RM determined in the previous test, 7 repetitions at 40 % 1RM and 5 repetitions at 60% 1RM. The subject got 1 minute of rest in between the warm-up sets. After 3 minutes of rest after the end of the warm up, the subjects did a performance test. The aim of the performance test was to complete as many repetitions as possible on a load of 75 % of the 1RM.

Session 3: PAP-Test: 80% of 1RM + performance test (PAP80)

After the same standardized warm up used in session 2, the subjects performed one single repetition at 80% of 1RM (preload). This repetition was followed by a resting period of 8 minutes. After the rest the subjects performed the same performance test as was done in session 2.

Force calculations

Muscle Lab Linear Encoder (Ergotest, Langesund, Norway) is a computerized muscle function measuring system that was used to calculate average force output from each repetition. The wire of the Linear Encoder was attached to the end of the barbell and placed directly underneath. The Linear Encoder measured time and displacement of the barbell, allowing the Muscle Lab software to calculate average force (N) (Neeter et al., 2005). To ensure accurate measurements from the Linear Encoder, the wire was adjusted before and after each set making sure that it was vertical in relation to the barbell. The Muscle Lab linear encoder has been proved to be valid and reliable tool for registration of power and force output (Ravier, 2011, Cronin & Newton, 2011). When it comes to the average force output per repetition it was calculated by dividing the AFOR by the total amount of performed repetitions.

Exercise Execution:

The bar was held on the shoulders forearms pronated, elbow fully flexed and shoulders in slight flexion (Dalziel, Neal & Watts, 2002). The barbell was pushed overhead until the shoulder joint was in a 180 degree flexion, meaning that the arm was vertical, parallel in relation to the rest of the body. After a completed repetition, the subject lowered the bar to the starting position and started over. No bending of the knees were allowed to prevent the stretch-shortening cycle of that movement to affect the force measurements. The grip width that the subjects used was up to their own preference, but the width was measured for standardization purposes, making sure that they used the same grip width during all of the test sessions. One spotter was placed on each side of the test subject during the tests to ensure the test subjects complete safety. If the subject were to reach fatigue, not being able to finish the repetition in a safe manner, the spotters helped the subject to re-racking the barbell safely. A repetition done with even slight help from the spotters was not counted as a proper repetition in the data. During all the test sessions Barbells, a squat rack and Olympic weight plates from Eleiko (Halmstad, Sweden) were used.

Statistical Analysis

Data analysis was performed using statistical software from IBM SPSSA version 20. Wilcoxon's signed rank test was used to identify potential differences between the Performance Test (Baseline) and the PAP80-test. Significance was set at $p<0.05$. Data were presented as mean (±Standard deviation). Because of the low amount subjects (n=10) I choose to use a non-parametric test, assuming that my subjects were not normally distributed. Even though I used non-parametric statistics, I chose to use the parametric statistical components of Mean and Standard deviation to make it possible for my results to be comparable to other parametric studies in the future.

Ethical and social considerations

All subjects were informed of the study design and the possible risks involved with participation. The subjects were informed that ethical principles were to be followed in the study process. All the subjects signed an informed consent and were informed that their participation was completely voluntary and could be discontinued at any time with no questions asked. Subjects were also informed that this research might be helpful in order to design high quality resistance training programs in the future (see Appendix 1).

If the results from this study were to show that a PAP-protocol can increase the number of repetitions and average force output compared to a baseline test, these results might be used to inspire further research on this topic, possibly finding a future usage of PAP-protocols as a method to increase training stimuli in strength and hypertrophy training. In a societal perspective this could be positive in order to further increase the knowledge of how physiological mechanisms can affect human exercise performance. Furthermore, if some of the many people that participate in strength or hypertrophy training could be able to improve their performance, it can be speculated that it would benefit both their health and general well-being.

Results

The mean 1RM (±SD) for the subjects was 53.70 kg (±11.20) with a significant difference in the number of repetitions between the baseline performance test and the PAP80 test ($p=0.017$), with the PAP80 test having the higher amount of repetitions. There was also a significant difference in the total force output between baseline and PAP80 ($p=0.028$), with PAP80 having the higher number. No difference was shown in the mean force output per repetition (total force output/number of repetitions) between baseline and PAP80 ($p=0.40$).

Table 2: Summary of results from Baseline and PAP80 (mean ± standard deviation), n=10.

Variable	Performance Test (Baseline)	PAP80
Number of Repetitions	10.70 ± 1.42	12.30 ± 1.77
Total Force Output (N)	4437 ± 1136	5026 ± 870
Mean Force / Repetition (N)	413.70 ± 85.15	414.40 ± 84.51

Discussion

Results discussion

The major findings of this study is that a pre-load overhead press of 80% of the 1RM can increase the amount of performed repetitions and enhance the total average force output in a following performance test of moderate intensity overhead press (75% of 1RM) compared to baseline. Because the average force output per repetition was not enhanced in the PAP80-test compared to baseline, one can assume that the increased number of repetitions completed was not caused by an increased peak force production, but rather by an altered rate of force production. This goes in line with earlier findings regarding the PAP phenomenon (Rixon, Lamont & Bemben. 2007). Previous studies have shown that PAP can be used to enhance performance in explosive activities like sprints (Rahimi, 2007), counter movement jumps and ballistic bench throws (Kilduff et al., (2007), but no other published study has investigated the effects of PAP on the total amount of repetitions in common resistance exercises to the author’s knowledge. Although, one unpublished study from Halmstad University (Bjork, 2014) showed that a heavy preload squat of 85% of 1RM increased the amount of squat repetitions performed in a following performance test at 80% of the 1RM. These results are pointing in the same direction as the current study, even though it used a different exercise and also used slightly different relative intensities in both the preload and the performance test. More studies of a similar kind needs to be done before any clear conclusions can be drawn, but as the results of these two studies point in the same direction regarding PAP's effect on the number of repetitions in two common resistance training exercises, this might be seen as an interesting trend to investigate further. Even if these two studies shows a trend towards an increase of repetitions performed in the PAP-performance-tests compared to baseline it is hard to be sure whether PAP is the determining factor causing these improvements in performance or if it is just one of the affecting mechanisms.

Methods discussion

The resting periods between the 3 sessions is a factor that probably has a great impact on the results from these sessions. The majority of the subjects in this study (7 out of 10) did the 1RM-test (session 1) and the Performance test (session 2) on the same day with 30 minutes of rest in between. Between the Performance test and the PAP80-test (session 3) the subjects had a minimum of 3 days of resting time. This was due to the limited time that was available to use the testing lab where the tests were done. Theoretically this rest time should be enough to recover from single repetition sets, which is the case when it comes to the 1RM-test (Willardson, 2006). One can not rule out the possibility that the significantly longer resting time between session 2 and 3, compared to session 1 and 2 could have affected the results.

High quality scientific literature about how to standardize the overhead press exercise was very limited. This made standardization harder than it would have been, had I chosen a more commonly studied exercise such as the squat. Although the author's observation was that all of the test subjects performed the overhead press in a correct manner, more guidelines regarding the exercise execution could have been added in order to further enhance the quality of the standardization. Despite that this standardization might not have been completely ideal, the most important thing to control regarding the execution was weather the subjects used the same technique during all of the test sessions, in order for them to be comparable to each other. Because all of the subjects had experience of using the overhead press in their own training, they seemed to have no problem executing the exercise in the same way in all of the sessions. Although, it is hard to fully conclude that the subjects did not alter technique between the sessions, especially as they were only controlled visually by the test leaders. Using some kind of tool for video analysis could have resulted in a higher quality control of the subjects' performance. Another way of better controlling the subjects' techniques would have been to add test leaders with the specific task to control technique. Even though the test leaders had the task of controlling technique, they had a number of other tasks in mind simultaneously, which could possibly have impaired the quality of their control.

Conclusion

The major findings of this study is that a pre-load overhead press of 80% of the 1RM can increase the amount of performed repetitions and increase the total average force output in a following performance test of moderate intensity overhead press (75% of 1RM) compared to baseline. In a practical sense, it could be speculated that these results could potentially be used to increase hypertrophy training stimuli in future resistance training programs. Although, this single study can not be used to draw that kind of conclusion, far more similar studies have to be done in order to consider that.

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Appendix 1:
Introduction Letter to the Subjects

Hej!

Mitt namn är Jacob Blickander och jag studerar på kandidatprogrammet i Biomedicin med inriktning Fysisk Träning. Jag söker just nu testpersoner till en studie som ska inkluderas i min C-uppsats. Det som ska utföras vid studien är en stående militärpress (axelpress) omkring 80 % av din maximala lyftkapacitet. Syftet med studien är att undersöka ett visst fysiologiskt fenomen, men för att få korrekta studieresultat kan jag inte avslöja vad det är förrän testerna är avslutade. Det enda jag kan säga är att det är helt naturligt och ofarligt för dig som testperson.

Studien kommer bestå av 3 testtillfällen och kommer utföras i labbet på Halmstad Högskola (kontakta mig för vägbeskrivning).

Testtillfälle 1: Korta instruktioner om korrekt utförande av övningen, följt av ett test av testpersonens maximala lyftkapacitet för övningen (1 repetitions max). Efter en längre paus (*skriv ungefär hur länge här*) för återhämtning från maxtestet kommer testpersonen få utföra ett repetitionstest på 75% av sitt maxresultat (1RM). Repetitionstestets syfte är att fastställa hur många korrekta repetitioner testpersonen kan utföra på 75% av sitt 1RM. Kraftutveckling kommer även att mätas under repetitionstestet med hjälp av en Linear Encoder, vars vajer fästs på ena sidan av skivstången.

Testtillfälle 2: 1 lyft på 80% av 1RM följt av en viloperiod. Efter viloperioden utförs ett repetitionstest på 75% av 1RM. Kraftutveckling mäts på samma sätt som vid testtillfälle 1.

Testtillfälle 3: 1 lyft på 88% av 1RM följt av en viloperiod. Efter viloperioden utförs ett repetitionstest på 75% av 1RM. Kraftutveckling mäts på samma sätt som vid de tidigare testtillfällena.

<u>För att delta ska du:</u>

Ha minst 2 års erfarenhet av regelbunden styrketräning.

Ha kunskap om hur man utför en stående militärpress/axelpress, och ha erfarenhet av att utföra övningen.

Vara fri från skador och/eller sjukdomar som hämmar din prestation i övningen, utlöser smärta under övningen, eller som hindrar dig från att utföra övningen på ett korrekt sätt.

Avstå från kosttillskott som eventuellt kan förbättra din prestation i övningen, exempelvis koffeintillskott eller andra Pre-Workout-(PWO)tillskott under testdagarna.

Avstå från drycker innehållande koffein, exempelvis kaffe, té eller energidrycker under testdagarna.

Avstå från tung styrketräning 24 timmar före varje testtillfälle.

Varför ska jag delta i den här studien?

Du kommer att få chansen att testa dina förmågor i militärpress/axelpress under 3 helt kostnadsfria träningspass. Dessutom kan du genom ditt deltagande hjälpa till att få fram information som förhoppningsvis kan hjälpa till i utformningen av framtida träningsprogram och inspirera fortsatt forskning på ämnet.

Övrig viktig information:

All tung styrketräning medför självklart en viss skaderisk, men eftersom du som testperson kommer få tydliga instruktioner om hur övningen ska utföras på ett optimalt sätt, kommer riskerna vara minimala.

Du kommer att ha personer vid din sida hela tiden under testtillfällena. Exempelvis vid muskeltrötthet som hindrar dig från att slutföra ett lyft, kommer dessa personer hjälpa dig att avsluta lyftet på ett säkert sätt.

Tidigare testprocedurer har används i liknande studier utan rapporterade skador.

Deltagande i studien är självklart frivilligt, och du som testperson har rätt att avbryta ditt deltagande när som helst under processen utan efterföljande frågor.

Personuppgifter som längd, vikt och namn kommer att hanteras på ett varsamt sätt utan att några obehöriga får tillgång till dem. Testresultaten kommer att redovisas på gruppnivå i studien, vilket gör det omöjligt att identifiera individuella resultat. På begäran raderas alla dina personliga data efter godkänt uppsats.

Vid fler frågor, tveka inte att kontakta mig på:

Telefon: 070-6969834

Mail: jacbli12@student.hh.se

Tack på förhand!
Jacob Blickander – Biomedicinprogrammet

Testpersonens Underskrift:_______________________________________

Underskrift innebär att du som testperson har förstått studiens upplägg och innebörd.

Jacob Blickander

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