Reviewer’s report

Title: Neuromuscular shoulder activity during exercises with different combinations of stable and unstable weight mass

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Reviewer: Thomas Muehlbauer

Reviewer's report:

* In your article you come to the conclusion that the inclusion of an unstable weight mass "may be beneficial … in shoulder prevention and rehabilitation programs." Your cross-sectional findings document a higher EMG-signal in most muscles tested, but how do you link that with a conclusion on interventions like prevention and rehabilitation programs?

* In line 36 you documented "four combinations of stable and unstable..". Isn’t it more precise to speak of conditions, as for example the first condition "pipe only" is not a combination?

* Throughout the text you used "greater muscle activation", "higher EMG-activity" and "higher neuromuscular activity" interchangeably. Higher EMG-activity may solely refer to the muscles tested in your study design, whereas higher neuromuscular activity could also refer to secondary movers not tested in your design. Thus, please clarify.

* In line 87 you reported that injuries are likely to occur in overhead athletes. Couldn’t it be wise, based on your results, to execute further investigations under sport-specific above-head movements (also with unstable mass/pipes)? This could make the transferability and link to injury prevention more comprehensible.

* In line 146 you stated that "only sport activities demanding a large involvement of the shoulder were included". How is that defined? Is table-tennis for example also a sport with "large involvement of the shoulders"?

* In line 197 you wrote about "constant-moderate exercise velocity" and "the principle investigator constantly checked proper exercise execution". Why didn’t you use a metronom?

Point 2.1 is about participants

* Did you perform an a priori power analysis? If not please calculate such an analysis to see the minimal amount of subjects needed to obtain results of practical relevance.

Point 2.4 is about the Exercise tool & conditions
The empty-pipe weighs 500 g. The water-pipe weighs 500 g of the empty pipe and 550 ml of water making it weigh 1,050 g. The weight-pipe had two additional weight plates (2 kg fixed at each side) making it together with the 500 g of the pipe 4,500 g. How do you come up with 4,500 g in the combined condition? From what I read, there are two additional weights 1.25 kg at each side + 500 g of the empty pipe + 400 ml of water, making it 3,400 g in my calculation. Please clarify.

Point 2.4 is about Data analysis

Please state why the Pearson's correlation coefficient was calculated for each muscle? What results did you expect? Please add a hypothesis addressing this issue to the Introduction section.

You base your conclusions on 2 points: a) higher weight leads to higher muscle activation and b) unstable mass leads to higher muscle activation. The difference of PG 4.5 kg and PWG 4.5 kg is the unstable mass, i.e. water (in the PWG condition). So you can attribute the higher muscle activation to that difference. However, the difference between P, the empty pipe, and PW, the water filled pipe, is the mass vs. unstable mass and the difference in weight 500 g vs. 1,000 g. Based on this it remains unclear whether the differences in muscle activation can be attributed to the unstable mass and/or higher training weight (as both differences are present from P to PW).

Results section:

Please calculate effect size f or Cohen’s d to show whether your observed difference are of practical relevance.

In line 261 you refer to Figure 1. Most probably, it should be Figure 2 or this is confusing.

The condition PG compared to PWG (Table 4) do not lead to any significant differences in the shoulder Ab/Ad for all six muscles tested. Do you have a hypothesis why this is the case? The same question arises in Table 5 for P vs. PW and PG vs. PWG in the diagonal shoulder F/E.

In line 381 you reported "the rise in total weight used during the exercise .... 0.5 kg, 1 kg, 4.5kg" leads to "a steady increase in the muscular activity". Importantly, condition 3, i.e. PG to condition 4, i.e. PWG is not an increase in weight as both weigh the same. Consequently, there is no steady progression. Please clarify.

One of your explanations of a missing increase in EMG-activity is a possible "faulty execution of the dynamic movement" (line 407) not generating enough water displacement (line 407). Is that really realistic in a movement amplitude of that magnitude?
In line 458 you mentioned "specific patient and athlete needs". Wouldn’t it be necessary to differentiate that. A higher muscle activation could be useful in patients' needs to stabilize the joints, while for athletes that aim for a high-power output increased muscular activation could also lead to a higher co-activation and antagonistic recruitment leading to less power output. Based on your study design, you can not draw conclusions on whether decreased or increased co-contractions were present.

In line 480 you mentioned that "it cannot be clearly stated if the same exercise intensity was performed between subjects". Surely, it was not the same exercise for all subjects, as it can be assumed that all subjects had different 1RM values leading to a different intensity of the % of 1RM for all subjects, as the weight was predetermined based on your study design. Please elaborate on this.

Based on your results: Would you rather recommend a higher training weight and a stochastic mass or a stochastic mass (with a certain weight) only?

Do you differentiate your results between the study populations? As you conclude that "Physio- and Sports- therapists should refer to the results of this study when implementing exercise programs for shoulder injury prevention" (line 498), do you transfer that finding to adolescents, in the same way as to elderly, and to previously injured subjects in the same way as to subjects with no history of injuries? Therefore your final thought is very valuable that "future controlled trials should investigate this aspect in different populations." (line 500-501).

**Are the methods appropriate and well described?**
If not, please specify what is required in your comments to the authors.

No

**Does the work include the necessary controls?**
If not, please specify which controls are required in your comments to the authors.

Yes

**Are the conclusions drawn adequately supported by the data shown?**
If not, please explain in your comments to the authors.

No

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