Sports Med (2014) 44:141–142
DOI 10.1007/s40279-013-0113-2

LETTER TO THE EDITOR

Scientific Rigour: a Heavy or Light Load to Carry?

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Published online: 25 October 2013

We read with interest the recent publication by Schoenfeld [1]. Whilst agreeing with the practicality of suggesting "a moderate repetition range (6–12RM) using a controlled lifting cadence" we write raising concerns about the scientific rigour used by the author to reach this conclusion.

Initially, we raise issue with use of the term *intensity* in reference to what is in fact *load* in resistance training (RT). Multiple publications have discussed definition and misuse of this term, clarifying why *intensity* is not scientifically accurate when referring to *load* [2, 3]. Whilst tradition suggests *intensity* is often accepted to mean *load*, we might consider the sage words of Leo Tolstoy—"Wrong does not cease to be wrong because the majority share in it" [4]. We ask that scientific terminology be expressed accurately. Researchers, authors, editors and reviewers might consider the term *load* as a reference to absolute weight lifted or *intensity of load* as a reference to relative load or %1RM.

Considering Table 1 of intervention studies (the only valid methodology examining training results), we are unclear as to how Schoenfeld used this evidence to reach his conclusions. Of nine publications cited, only three [5–7] reported any statistical significance in favour of high-load training. Campos et al. [5] and Schuenke et al. [7] measured muscle fibre hypertrophy using muscle biopsy from pre- to post-intervention. Whilst muscle biopsy is a validated method, it should be considered that anaesthetising and invasively withdrawing cells has the potential to affect those cells. In addition we might regard that most persons wishing to increase their muscularity might be less concerned with in vitro research and more concerned with change in cross-sectional area (CSA) or thickness of their muscles as a whole.

The other article that found significant differences in favour of high-load training was Holm et al. [6], which Schoenfeld [1] raised concerns with regarding the training method used for the low-load group. In this study [6], participants in the low-load group performed a single repetition with a load of 15.5 % 1RM every 5 s for a 3-min period totalling 36 repetitions per set, completing 10 sets in total. Schoenfeld [1] questions the extent of fatigue when performing this protocol due to the extremely low-load and significant rest between repetitions. Indeed we reiterate these concerns that this certainly represents a low intensity of effort. However, Schoenfeld [1] also failed to mention that the authors report muscle CSA, as measured by magnetic resonance imaging (MRI), at proximal, middle and distal locations of the thigh. In fact Holm et al. [6] only report a significant difference in favour of the high-load group at the middle location, with no significant differences between high- and low-load groups at the proximal and distal locations.

Of the other six studies, which do not support high-load RT for muscular hypertrophy, two [8, 9] are actually the same study published in two different articles reporting different outcome measures. This is evident looking at the participant information (e.g. age, height, weight and maximal oxygen uptake), which are identical between the publications. This has been confirmed by communication with the corresponding author (who was the same for each article). Although a relatively simple mistake to make, it seems that someone reading an article with the expected intricacy to discuss it in review might have noticed this. In addition, in Table 1 the *Design* column states of the Léger et al. [8] article "Random assignment to either low-

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intensity (3–5RM) or a high intensity (20–28RM) exercise"—one can only assume that this is a typographic error since the concept of the review [1] generally discusses higher intensity (load) as associated with lower repetitions, and vice versa.

Part of the rationale for Schoenfeld's [1] review was that recently a number of authors have suggested that low-load RT ($\leq$50 % 1RM) induces similar responses to high-load RT, assuming it is continued to momentary muscular failure (MMF), and thus maximum intensity of effort. However, if we consider only studies cited in Table 1 of Schoenfeld's review [1] that controlled for this between high- and low-load groups by having them train to MMF, and measured hypertrophy using whole muscle methods (MRI, computed tomography, ultrasonography), five of five studies examined suggest no difference between high- and low-load RT [8–13].

A difficulty with studies examining high- and low-loads is that volume is often not equated between groups and thus could be a factor responsible for the results observed independent of load. This is a point raised in discussion by Schoenfeld [1]. Léger et al. [8] and Lamon et al. [9], however, controlled for volume between the high- and low-load groups, had participants train to MMF and again report no difference between high- and low-load groups.

Finally, a number of other publications that compare high- and low-load training for muscular hypertrophy are inexplicably not included in the review [14–16]. Each of these papers report significant increases for both high- and low-load training interventions with no significant differences between the groups.

We question Schoenfeld's [1] comments that research is generally mixed and conflicting in this area as there is in fact a majority of better controlled studies suggesting no difference resulting from differing RT loads. In light of the lack of rigour regarding inclusion of appropriate research, combined with limitations discussed herein, Schoenfeld's conclusion that a particular load during training is more beneficial for hypertrophy than any other load when both are performed to MMF lacks evidence. Instead we suggest that the more rigorous and valid studies consistently support both high- and low-load RT continued to MMF yields similar hypertrophic adaptations. We note though that we share Schoenfeld's [1] concerns regarding the lack of research utilising trained participants examining this area and support further research looking to examine this.

Acknowledgments The authors have no conflicts of interest that are directly relevant to the content of this letter.

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