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Over time, load mediates muscular hypertrophy in resistance training

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Morton *et al.* [1] recently published a thoughtful paper on resistance exercise training (RET) for strength and hypertrophy. In the paper, they highlight that hypertrophy is similar between lower-load (~30 to 50% 1RM) and higher-load (>70% 1RM) RET when loads are lifted to the point of volitional fatigue, convincingly showing that heavier loads are not necessary for RET-induced muscular hypertrophy. This is an important contribution in light of current practice and guidelines favouring heavy loads.

However, the authors further argue that 'load does not mediate RET-induced muscular hypertrophy.' We believe this to be incorrect and to have important implications for athletes looking to increase hypertrophy, thus deserving clarification. In our opinion, over time, load does mediate RET-induced muscular hypertrophy; we further believe it should be a variable of major focus.

In Figure 1 of the paper [1], the authors list five variables as evidence-based recommendations to augment RET-induced hypertrophy. Load is not listed, but 'intensity of effort' is. The authors argue that 'maximizing RET-induced muscular hypertrophy is chiefly determined by intensity of effort.' As the authors point out in the paper, loads as low as ~30 to 50% 1RM lifted to the point of volitional fatigue (i.e. with a high intensity of effort) have been shown to cause hypertrophy. However, 20% 1RM loads have been shown to cause less hypertrophy [2], even when lifted with a high intensity of effort. This emphasises the importance of load, and limits the view that 'the most potent regulator of RET-induced muscular hypertrophy is intensity of effort' [1] since hypertrophy was lower, even when intensity of effort was high [2]. Also, citing Schoenfeld *et al.* [3], the authors write: 'focusing on maximally contracting a muscle group throughout the exercise's range of motion (i.e. increased internal focus) results in superior RET-induced increases in muscle thickness'. This is not entirely correct: in the cited study, elbow flexors and quadriceps thickness were measured; a significant difference was observed only in elbow flexors (1 of 2 muscle groups assessed) [3].

In addition, we argue that increasing load (in any repetition range above ~30 to 50% 1RM) is necessary to increase hypertrophy over a long period of time. Indeed, an athlete who never increases load will inevitably come to train with loads lower than ~30 to 50% 1RM, which have been shown to be subpar [2]. Moreover, over time, that athlete would be training with more and more repetitions, to keep intensity of effort constant. This poses another limitation, as the athlete would need to invest considerably more time lifting to achieve the same hypertrophy. For instance, the authors cite evidence that up to ~15 sets per muscle group per week lead to superior increases in muscle size [4,5]. An athlete training 8 muscle groups per week for 15 sets each would be performing 120 sets; 120 sets of 10 repetitions lasting four seconds each is 80 min. The same athlete carrying out sets of 30 repetitions would be lifting for 240 min (4 hours)—three times more lifting for the same hypertrophy. Indeed, data from the same group have shown that approximately 62% more volume is needed when training with loads of ~30 to 50% compared to ~75 to 90% 1RM for similar increases in muscle fibre size [6]. Furthermore, there is evidence that sets performed with lower loads (30% 1RM) to failure prolong recovery compared with higher loads (80% 1RM) [7], potentially interfering with successive training sessions. We argue that this poses serious practical limitations and further emphasises the importance of load, while limiting the view that 'the most potent regulator of RET-induced muscular hypertrophy is intensity of effort' [1].

Since increasing load is necessary to increase hypertrophy over a long period of time, we argue that load does mediate RET-induced muscular hypertrophy. Also, since increasing repetitions to maintain intensity of effort prolongs recovery and becomes time-consuming to the point of being impractical, we further argue that progression in load should be a variable of major focus when the goal is to increase hypertrophy.

In conclusion, we praise Morton *et al.* for their contribution, and for highlighting that heavier loads are not

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necessary for RET-induced muscular hypertrophy, in contrast with current practice and guidelines favouring heavy loads. Thus, athletes who cannot lift heavy loads because of injury or other limitations can indeed achieve substantial hypertrophy, albeit at the cost of longer training times. However, we do not agree with the authors that 'load does not mediate RET-induced muscular hypertrophy.' We believe the opposite to be true, and argue that: (1) load does mediate RET-induced muscular hypertrophy; (2) progression in load should remain a variable of major focus for athletes looking to increase hypertrophy over a long period of time; (3) lifting in the 'higher-load' (>70% 1RM) range should be emphasised in hypertrophy recommendations for healthy athletes, as it is more efficient. In the interest of science, and to guide practice for athletes, we hope that consensus can be reached on this important topic, and look forward to the authors' thoughtful response.

Conflict of interest statement

Carl-Etienne Juneau is founder and CEO of Dr. Muscle, a muscle building mobile workout app. https://drmuscleapp.com/.

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