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The Resistance Training Volume Load on Muscle Hypertrophy when Low Loads are Used

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Abstract

The old premises of resistance training were that only high loads, above 80% 1RM (1 repetition maximum), could induce hypertrophy. With the advancement of science, emerging research proves that high loads are indeed hypertrophic, but low loads can also be hypertrophic at similar levels when there is an assessment of the load volume (sets x repetitions x weight) of the training. This communication presents recent articles that used this theme to demonstrate that low loads can be well used when the purpose is muscle hypertrophy aiming at an increase in the load volume of the training.

Abbreviations: 1RM: One Maximum Repetition; RT: Resistance Training

Introduction

The neuromuscular adaptations caused manipulation of RT (Resistance Training) variables, such as volume, intensity, frequency of training, rest interval, selection and order of exercises, velocity of execution, muscular actions, and range of motion, can be used to improve muscle hypertrophy. A simple method to quantify training volume if all the other variables are kept constant would be the volume load, the total amount of load worked in the training sessions [1], this method use a mathematical product of the sets, repetitions and weights used in resistance training. Knowing that, previous studies have shown that a moderate (5-9 sets per muscle group) to high (10 sets per muscle group) weekly training volume is indicated to induce muscle growth as compared to lower training volume (5 sets per muscle group) [2], implying that training volume can be an effective variable to induce muscle hypertrophy. But what if there was a comparison between training loads, using high and low loads, does volume load remain relevant? Thinking about these questions about the loads used in RT and their results on muscle hypertrophy, gaps arise that could be better elucidated, such as: are high loads always more hypertrophic than low loads? The objective of this letter is to bring a discussion about the importance of volume load in RT correlating it with high and low loads for results on muscle hypertrophy.

Methods

The present systematic bibliographic review is based on existing evidence on the volume load and muscle hypertrophy when low loads were used. The literature search was conducted independently and separately by the author in the electronic PubMed database up to the 20th of December 2024. The search was performed using a Boolean search strategy (operators "AND" and "OR") and a combination of the following keywords: ("low load" OR "load" OR "volume load" OR "muscle hypertrophy" OR "hypertrophy" OR "muscle") AND ("hypertrophy load" OR "muscle architecture" OR "cross sectional area" OR "muscle volume" OR "muscle circumference") AND ("adolescent" OR "adult" OR "young adult" OR "older Adults" OR "aged" OR "seniors" OR "elderly") AND ("controlled trial" OR "randomized controlled trial"). These keywords were identified using literature searches, expert opinion, and a controlled vocabulary (e.g., Medical Subject Headings [MeSH]). Inclusion criteria for eligible studies were defined according to the PICOS (Population, Intervention, Comparison, Outcome, Study Design) approach [3]. The following criteria were defined: (1) Population: healthy participants without restriction regarding age, sex, or training status, (2) Intervention: SS interventions with a minimum duration of two weeks, (3) Comparison: active/passive control group/leg, (4) Outcome: at

least one measure of muscle hypertrophy (i.e., muscle thickness, muscle cross-sectional area) in a stretched muscle group, and (5) study design: (randomized) control trials with measurements at baseline and after completion of the intervention (within and/or between subjects).

Results

The primary search resulted in 1849 references. Of this number of search results, a total of 50 full-text papers were read, and 6 studies, with a total of 12 study groups were included in the review. Secondary search resulted in another 3131 results; however, no additional studies were included. The training program in the included studies lasted from 8 to 22 weeks. In all studies, muscle biopsy samples were taken from the quadriceps muscle.

Discussion

Twenty-seven participants were randomized in 3 experimental groups to be performed 16 weekly sets per muscle group for a group (G16, n=9), or 24 weekly sets for others (G24, n=9), or 32 weekly sets per muscle group for another (G32, n=9). At the study, a higher RT volume (32 weekly sets per muscle group) augments muscular strength and establishing a dose-response relationship for the increase in muscle hypertrophy in to relationship with volume load [4]. In another paper, thirty health young men were selected within-subject design, in which one leg and arm trained at 20% 1RM (G20; n=30) and the contralateral limb was randomly assigned to one of the three conditions: 40% (G40; n=10); 60% (G60; n=10), and 80% 1RM (G80; n=10), respectively. In summary, this study demonstrated that both intensities were effective for increasing muscle strength and hypertrophy [5]. Twenty-three untrained women were selected for a RT to failure intervention at either 30% 1RM (n=11) "low load" or 80% 1RM (n=12) "high load". During weeks 2–7, the subjects completed 2 sets to failure for each exercise and 3 sets during weeks 8–11. The results of this study demonstrated RT failure at low (30% 1RM) and high (80% 1RM) loads are effective for increasing 1RM strength in untrained women [6]. Eighteen men had each leg was randomly assigned in counterbalanced fashion to one of three possible unilateral training conditions: one set of knee extension performed to voluntary failure at 80% of 1RM (80%-1); three sets of knee extension performed to the point of fatigue at 80% of 1RM (80%-3); or three sets performed to the point of fatigue with 30% of 1RM (30%-3). In summary, both intensities were effective for induced muscle hypertrophy [7]. On another study, 24 male volunteers were selected to a low-load RT routine (LL; N=12) in which 25–35 repetitions (approximately 30–50% 1RM) were performed to failure per exercise or a high-load RT routine (HL; N=12) where 8–12 repetitions (approximately 70–80% 1RM) were performed per exercise. At the final, the augments in muscle size from low-load training were equal to that achieved with training in a repetition range normally recommended for maximizing muscle hypertrophy [8]. Twenty-seven cadets were allocated to either a high-load group (HL; n=14, 10RM) or a low-load group (LL; n=13, 30RM). The training protocol consisted of 3 sets of 7 exercises per session, performed 2 days a week during the first 10 weeks and 3 days a week during the last 9 weeks. The volume load was 13,687 (12,324 - 15,049) kg to HL group and 25,119 (23,720 - 26,518) kg LL group. The mean total lean mass among men increased from 60.2 kg to 62.8 kg (difference of 2.6 kg) in the LL group, while in the HL group it was from 57.7 to 59.7 (difference of 2 kg) [9]. The main study findings were as follows: (a) a volume load using 20% or 30% 1RM appears to influence muscle hypertrophy to the same extent as 80% 1RM and (b) high-load (80% 1RM) may be superior in strength generation when compared to low-load (20% or 30% 1RM). When compared to 20% 1RM com 40%, 60%, and 80% 1RM, the results demonstrated that the intensities ranging from 20% to 80% 1RM are effective for increasing muscle strength and hypertrophy. At this study, the 20%1RM group did on average 67 repetitions compared to 28 repetitions, 14 repetitions and 10 repetitions for the 40%1RM, 60%1RM and 80%1RM groups, respectively. The volume load foi de aproximadamente 20,000 kg para o treino aplicado de flexor de cotovelo e de aproximadamente 160,000 kg para unilateral leg press 45º [5], what demonstrated volume load may be an important marker to measurement the muscle hypertrophy when are applied low loads. The study that selected cadets (men and women) to a high-load group (10RM) or a low-load group (30RM), obtained 13,687 kg volume load to HL group and ~25,119 kg to LL group. A difference in volume load is noted for the low load group. Perhaps, this could be the important point for muscle hypertrophy, since the group LL increased the mean total lean mass 60.2 kg to 62.8 kg (+2.6 kg) and the HL group increased 57.7 to 59.7 (+2 kg) [9]. Another study divided participants between low load (30% 1RM) and high load (80% 1RM) and finding that the resistance training to failure at low (30% 1RM) and high (80% 1RM) loads are effective for increasing 1RM strength [6]. The author of this work systematically gathered the main data from the analyzed articles in a table (Table 1), including methodological data and conclusions [10].

Conclusion

In summary, when the individual does not want or does not have the physical capacity to train with high loads (80% 1RM), their training using low loads (20, 30% or 40% 1RM) can induce muscle hypertrophy when the volume load is programmed.

Conflicts of Interest Statement

The author declares there isn't any conflict of interest

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Table 1: Study descriptive characteristics from the documents included in this systematic review.

Study	Participants	Experimental design	Findings
4	Twenty-seven healthy men: 27.2 (±7.1) years. Height: 176 (±6.1) cm. Body mass: 80.6 (±6.5) kg.	3 experimental groups: 16 weekly sets per muscle group (G16, n=9), 24 weekly sets per muscle group (G24, n=9), or 32 weekly sets per muscle group (G32, n=9).	This study provides evidence that a higher RT volume (32 weekly sets per muscle group) augments muscular strength and a dose-response relationship were observed for the increase in muscle hypertrophy.
5	Thirty health young men: 24.5 (±2.4) years. Height: 180 (±0.7) cm. Body mass: 77 (±16.5) kg.	Within-subject design, in which one leg and arm trained at 20% 1RM (G20; n=30) and the contralateral limb was randomly assigned to one of the three conditions: 40% (G40; n=10); 60% (G60; n=10), and 80% 1RM (G80; n=10).	These findings demonstrated that intensities ranging from 20% to 80% 1RM are effective for increasing muscle strength and hypertrophy in men with no experience in RT. However, the lowest RT intensity (20% 1RM) was suboptimal for maximizing muscular adaptations.
6	Twenty-three untrained women: 21.2 (±2.2) years. Height: 167.1 (±5.7) cm. Body mass: 62.3 (±6.2) kg.	RT to failure intervention at either 30% 1RM (n=11) "low load" or 80% 1RM (n=12) "high load". During weeks 2–7, the subjects completed 2 sets to failure for each exercise and 3 sets during weeks 8–11.	The results of this study demonstrated RT failure at low (30% 1RM) and high (80% 1RM) loads are effective for increasing 1RM strength in untrained women.
7	Eighteen men: 21 (±1) years.Height: 176 (±0.04) cm.Body mass: 73.3 (±1.4) kg.	One set of knee extension performed to voluntary failure at 80% of 1RM (80%-1); three sets of knee extension performed to the point of fatigue at 80% of 1RM (80%-3); or three sets performed to the point of fatigue with 30% of 1RM (30%-3).	After the analysis, the researchers report that similar resistance training induced muscle hypertrophy can result from lifting loads to failure with higher (80% of 1RM) and lower (30% of 1RM) loads than are currently recommended for novice lifters
8	24 male volunteers (age = 23.3 years; age range: 18–33 years, body mass = 82.5 kg; height = 175 cm.	Low-load RT routine (LL; N=12) in which 25–35 repetitions (approximately 30–50% 1RM) were performed to failure per exercise or a high-load RT routine (HL; N=12) where 8–12 repetitions (approximately 70–80% 1RM) were performed per exercise. On this study each group performed 3 sets of 7 exercises per session.	The researchers concluded that low-load training can be an effective method to increase muscle hypertrophy of the extremities in well-trained men. The gains in muscle size from low-load training were equal to that achieved with training in a repetition range normally recommended for maximizing muscle hypertrophy.
9	Twenty-seven cadets:20 (±1) year.Height: 182 (±9) cm.Weight: 75.5 (±12.9) kg, from the second year of the Norwegian Defense Cyber Academy.	High-load group (HL; n=14, 10RM) or a low-load group (LL; n=13, 30RM). The training protocol consisted of 3 sets of 7 exercises per session, performed 2 days a week during the first 10 weeks and 3 days a week during the last 9 weeks.	No significant differences were found between groups for CSA (cross-sectional rea) of the vastus lateralis. The mean total lean mass among men increased from 60.2 kg to 62.8 kg (difference of 2.6 kg) in the LL group, while in the HL group it was from 57.7 to 59.7 (difference of 2 kg).

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