

## Musculoskeletal Hypertrophy Training for Overweight and Obesity

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### Abstract

*The present research is an exploratory, descriptive, and documentary study that aimed to analyze the impact of musculoskeletal hypertrophy training on the improvement of overweight and obesity. Different sources of information were reviewed: Google Scholar, Science Direct, PubMed, Springer, among others. A total of 19 articles related to training for hypertrophy, musculoskeletal, overweight and obesity were reviewed. The most salient findings were that training for skeletal muscle hypertrophy and muscle mass development is beneficial to health in overweight and obese populations. The problems faced by overweight and obese individuals when attempting to improve their current health status were broadly identified, with one of the main causes being cultural ignorance of the benefits of hypertrophy-focused strength training.*

**Keywords:** training; musculoskeletal; hypertrophy; overweight; obesity.

### Introduction

Human beings have adapted to the environment around them, that is, to the surroundings and conditions that have required them to change their habits by acquiring new skills. Nowadays, being a daily active or sedentary person is a determining factor to guarantee the general wellbeing of a person and to reduce the risk of death due to pathological causes. Currently, the main problem facing the health area is overweight and obesity.

According to Shailendra et al. (2022) point out that another factor associated with increased risk of mortality and all its pathological causes is the absence of strength training and low muscle mass.

Strength training is essential for optimal health status, with a wide range of benefits, such as (Pesta et al., 2017; Lopes dos Santos et al., 2018), as the development of muscle mass

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improves glucose transport and increases mitochondrial oxidative capacity, so it controls and decreases the risk of type II diabetes. In addition to significantly decreasing glycosylated hemoglobin levels in people with type II diabetes (Jansson et al., 2022).

It is important to note that strength training improves insulin sensitivity in overweight people even without seeing a reduction in body weight (Shaibi et al., 2006).

Although the main cause of overweight and obesity is an incorrect diet together with the lack of physical activity in a systematic way, being these the causes to which the investigations are mainly attributed, another fundamental factor is the poor development of the skeletal muscle tissue, for which the following research question has been determined. What is the impact of training focused on skeletal muscle hypertrophy in overweight and obese population?

According to sources consulted (Nedergaard et al., 2013; Maestroni et al., 2020; Hokken et al., 2021) express that an increase in protein synthesis constitutes an essential factor for the production of insulin aimed at increasing muscle mass, which results in better insulin action, as well as greater sensitivity to insulin. Furthermore, increasing the contents in the mitochondria, which also improves the oxidative capacity of fatty acids, leads to greater glucose homeostasis, thanks to the increase in glycogen synthesis rates, which makes it relevant that glycogen represents par excellence the energy reserves of our organism, playing an essential role in strength training and sports practice.

Muscle has been shown to act as an endocrine organ, producing cytokines and myokines with application in various metabolic diseases (Schnyder & Handschin, 2015). Therefore, strength training and muscle mass development has anticancer and antitumor effects by suppressing cancer cell growth and regulating systemic inflammatory responses (Kyrgiou et al., 2017).

On the other hand, studies by (Ströhle, 2009; Yang et al., 2012), state that weight training has been shown to combat depression and anxiety. Because weight training improves sleep quality, which is an important point since sleep disturbance is one of the symptoms of depressive illness.

The objective was to analyze the impact of musculoskeletal hypertrophy training on the improvement of overweight and obesity.

## **Methodology**

The present research is an exploratory, descriptive, documentary type study. We reviewed several sources that provided us with relevant information on the subject: Google Scholar, Science Direct, PubMed, Elsevier Clinical Key, American College of Sport Medicine, National Strength, and Conditioning Association, American Physiological Society, Biomed Central, Springer and Apeks Performance Institute. Among the sources reviewed, a detailed analysis could be obtained on 19 articles related to skeletal muscle hypertrophy training in the improvement of overweight and obesity.

It is evident that strength training causes a great increase in musculature. Likewise, that the intensities of the efforts allow new very specific scopes in the impact of skeletal muscle hypertrophy training. Now, what is not so clear are the mechanisms that can produce it, although more and more scientific indications appear of the importance of hypertrophy strength, as an essential ingredient of training to obtain a development of musculoskeletal hypertrophy, that is, for the well-being of obesity and sedentary lifestyle. (Roig, 2017).

**Results**

The following tables 1,2,3 show some of the main findings of this research regarding the effects of musculoskeletal hypertrophy training for the improvement of overweight and obesity, according to the sources consulted.

Table 1 Results of meta-analyses on resistance training and mortality, (Shailendra et al., 2022).

Meta-analysis	Mortality from all causes			Mortality due to CVD			Mortality from cancer		
	n	I <sup>2</sup> , %	Summary, RR (IC.95%)	n	I <sup>2</sup> , %	Summary, RR (IC.95%)	n	I <sup>2</sup> , %	Summary, RR (IC.95%)
	EF								
Some vs. none	6	79.9	0.85 (0.77,0.94)	4	64.7	0.81 (0.61,1.00)	5	62.8	0.86 (0.78,0.95)
Highest vs. lowest	7	57.6	0.92 (0.83,1.01)	6	35.2	0.90 (0.79,1.02)	6	46.8	0.87 (0.77,0.99)
	Asociación conjunta de EF y AFMV								
With out EF and AFMV	3	-	1.00 (ref.)	3	-	1.00 (ref.)	3	-	1.00 (ref.)
EF only	3	73.4	0.82 (0.72, 0.93)	3	0	0.82 (0.74,0.91)	3	11.1	0.84 (0.75,0.94)
AFMV only	3	88.0	0.75 (0.67,0.84)	3	65.2	0.71 (0.61,0.81)	3	90.3	0.89 (0.72,1.10)
EF and AFMV	3	57.5	0.60 (0.54,0.66)	3	61.0	0.54 (0.41,0.70)	3	84.8	0.72 (0.53,0.98)

Legend: CVD: cardiovascular disease; I<sup>2</sup>: degree of heterogeneity; MVPA: moderate physical activity; EF: strength training.

Table 2 Changes in measures of insulin dynamics from FSIIVGTT. (Shaibi et al., 2006).

Units of measure	Strength Training (n=11)			Control (n=10)		
	Pre-Post	Exchange		Pre-Post	Exchange	
Fasting Insulin (µU-mL <sup>-1</sup> )	12.8 ± 2.1	11.5 ± 2.5	-1.3 ± 1.2	17.4 ± 2.1	19.1 ± 2.7	1.7 ± 1.9
Fasting Glucose (mg. dL <sup>-1</sup> )	91.3 ± 1.8	93.8 ± 1.9	2.5 ± 1.9	90.6 ± 1.9	91.7 ± 2.0	1.1 ± 2.6
Insulin sensitivity (x10 <sup>-4</sup> . µU-mL <sup>-1</sup> )	2.3 ± 0.3	3.2 ± 0.3*	0.9 ± 0.1	1.7 ± 0.4	1.8 ± 0.6	0.1 ± 0.3
Air (µU-mL <sup>-1</sup> x 10 m)	936.2 ± 213.9	762.1 ± 127.8	-174.1 ± 132.0	1153.8 ± 213.1	1339.1 ± 196.1	185.4 ± 184.6
Disposition Index	1881.4 ± 287.4	2246.3 ± 338.5	365.0 ± 283.7	1542.8 ± 205.3	1741.0 ± 313.6	198.2 ± 393.0

Note: Data are means ±SEM. \*p<0.05 vs. corresponding previous value p<0.05 vs. group change vs. Air, acute insulin response.

Table 3 Meta-analysis of the effect of strength training on HbA1c. (Jansson et al., 2022).

Results	Studies	n	Effect size and accuracy				Heterogeneity			
			Estimation	95%CI	Value p	Value q	Dif. (q)	Value p	I <sup>2</sup>	fail-safe n
HbA1c (EF vs CON)	20	1172	-0.390	-0.600 a -0.180	<0.001	61.684	19	<0.001	69.198	177
HbA1c (EF vs EA)	13	640	0.077	-0.110 a 0.264	0.419					

AE, aerobic exercise; CON, control; HbA1c, glycosylated hemoglobin; EF, strength training.

The most outstanding results obtained regarding musculoskeletal hypertrophy training were the following. According to various authors (Burd et al., 2010; Terzis et al., 2010; Galluzzi et al., 2012; Hanssen et al., 2013; Ogasawara et al., 2017; Damas et al., 2019; Hammarström et al., 2020; Baz et al., 2021), the sets of maximum hypertrophic potential are groupings of repetitions (determined by the practitioner; 6±20≥30) performed continuously close to volitional failure. That is, 0-5 Repetitions in Reserve (RER) or RIR for its acronym 3 "Repetitions in Reserve". More specifically 0-2 RIR for light loads and 3-5 RIR with moderate to high loads, as can be seen in Table 4.

Table 4 Relationship of means with workload and requirement of need for proximity to muscle failure.

Medios	Charges	Range of repetitions	Requirements for proximity to failure
Multi/mono-joints	Heavy	5 – 10	3 – 5 RIR
Multi/monoarticular	Moderate	10 – 15	3 – 4 RIR
Monoarticular	Light	15 – 20	0 – 2 RIR

Relationship of means with workload and requirement of need for proximity to muscle failure.

It is important to emphasize that training to muscle failure is not more beneficial for skeletal muscle hypertrophy, the need or absence of approaching muscle failure should be considered considering: technique, subsequent intra and inter session fatigue, the risk of injury or safety of the exercise.

The series of work should not have extended pauses or significant recovery periods during the execution of the series and, on the contrary, look for an appropriate recovery at the end of each series of work. In other words, rests of less than 2 minutes are not enough to reduce the accumulated fatigue in an ideal way to continue with series highly capable of stimulating hypertrophy. Therefore, we will opt for sufficient rests of approximately 2 minutes since these will better maintain the hypertrophic potential of the work series. In this way each set is more stimulating due to the reduction of fatigue from previous work.

The training decisions to be taken should ensure that the conditions are optimal to achieve the greatest possible growth of each group. These sets should have all the characteristics shown in Table 5.

Table 5 Characteristics of a series of maximum hypertrophic potential. Ehrenstein (2022)

Series of maximum hypertrophic potential	Ranges
Range of repetitions	5 – 20 $\geq$ 30
Proximity to muscle failure	0 – 5 RIR
Breaks between series (minutes)	2 – 3

Series that do not meet the above guidelines represent suboptimal training strategies.

Similarly, the meta-analysis stated +20 repetitions; but we have data stating that after 30 repetitions the potential per set decreases (figure 1).

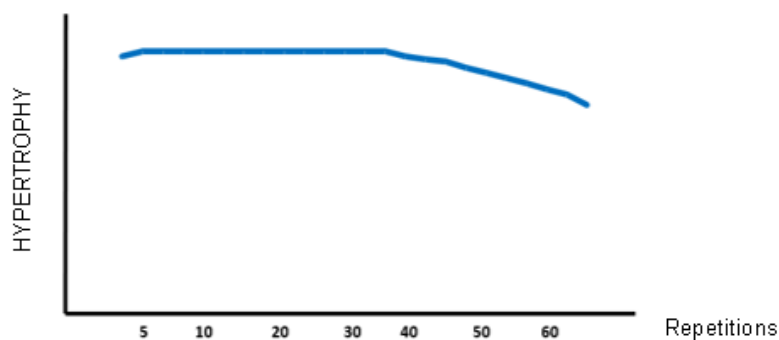


Figure 1. Hypertrophic potential hormetic curve of repetition range. (Ehrenstein, 2022).

The further you move away from the recommended repetition range, the lower the hypertrophic potential, i.e., 50 repetitions are lower for hypertrophy than 40 repetitions, and so on.

According to Ehrenstein (2022) updated meta-analytical data show a logarithmic relationship between training volume and hypertrophy in a single session. Gains increase rapidly at small volumes and there are diminishing returns as session volume increases.

Thus, sessions with too high volumes should be avoided as they present less benefit, as well as greater muscle damage, loss of neural drive and motor unit firing capacity, time investment, and fatigue that can manifest itself in later sessions. To increase the weekly volume, it will be necessary to increase the frequency and not pass the limit per session, in order to maintain optimal conditions for growth (Schoenfeld, 2010).

There is an interaction between set volume and rest intervals. Since short rest intervals can affect hypertrophy for a given volume, more sets must be done to compensate. Therefore, volume requirements may be approximately double compared to longer rest intervals, which manifests no benefit.

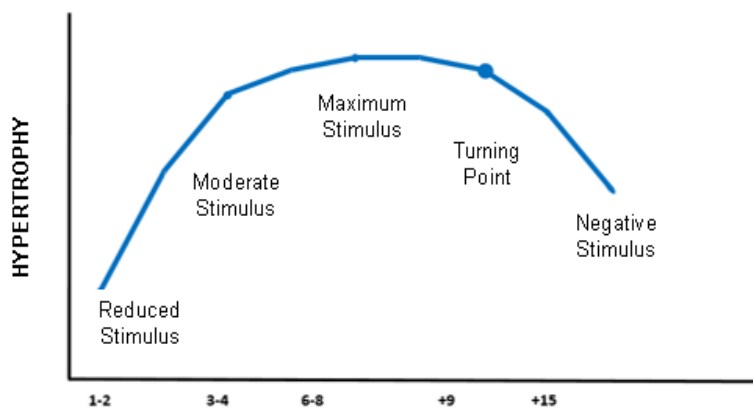


Figure 2. Hormetic curve of training volume per session. (Ehrenstein, 2022).

## Discussion

From these inquiries it can be established that training aimed at skeletal muscle hypertrophy is extremely beneficial for people with overweight and obesity, as it promotes a development of their body mass, which causes them to accentuate, a planned work to produce a positive effect on the health of people with this condition.

Unlike what is culturally thought that cardiovascular training is inferior to the reduction of the percentage of fat, which is the goal of people with overweight or obesity, should work strength to improve the quality of life. According to Achten et al., (2002) and Broskey et al., (2021), the rate of fat utilization during cardiovascular training turns out to be minimal. Therefore, it can be concluded that the prescription of exclusively cardiovascular exercise to increase fat oxidation is not optimal, and the real purpose should be to maintain a healthy cardiorespiratory system. The theory is presented and contrasts that musculoskeletal hypertrophy training improves overweight and obesity, as well as the advantages for health and quality.

Fat oxidation and reduction of body fat percentage should be addressed by a nutritional strategy and not by a specific training, which is an important fact to consider, since it is extremely common the bad practice and belief, to prohibit strength training to overweight and obese people, prescribing only cardiovascular exercise with the intention of lowering the fat percentage.

Meanwhile cardiovascular training interferes with hypertrophy training and thus causes an attenuation in muscle mass development (Hickson, 1980; Morton et al., 2019; Krzysztofik et al., 2019).

The misinterpretation of this aforementioned article is the origin of some of the biggest myths in the fitness industry. Which has led for decades to coaches prescribing only one type of training.

Murach & Bagley (2016) argue that this does not occur, that the possible detrimental effects on adaptations caused by interference from such training do not outweigh the benefits obtained and even claim that cardiovascular exercise can increase skeletal muscle hypertrophy in healthy people.

In turn, it emphasizes that the magnitude of the interference effect will be directly related to the intensity, frequency, and volume of both training systems. The inadequate practice found in the implementation of strength training in gyms is the use of insufficient rests in order to seek higher feelings of fatigue, erroneously linking them with more growth potential, it is the opposite (Ehrenstein, 2022).

## Conclusions

According to the results achieved in this research, it was proved that training for skeletal muscle hypertrophy is beneficial in overweight and obese people, thanks to the increase of their muscle mass, which is fundamental for health; in addition, the optimal guidelines for training were established, which guarantee the effectiveness for the prevention of inadequate training. While these processes provide a specific contribution to elucidate the possible ways that are described for a better training process for skeletal muscle hypertrophy, which may have an impact on the responses to physical exercise of strength. This review provides information for the development of possible interventions to improve physical performance and mitigate the effects of metabolic disorders such as overweight and obesity.

## Conflict of Interest

There is no conflict of interest between the authors.

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