Hypertrophic effects of low-load blood flow restriction training with different repetition schemes: a systematic review and meta-analysis

## OBJECTIVE

This systematic review and meta-analysis analyzed the effect of low-load resistance training (LL-RT) with blood flow restriction (BFR) versus high-load resistance training (HL-RT) on muscle hypertrophy focusing on the repetition scheme adopted.

METHODS

Studies		Effect Size	Weight	Subgroup
Biazon et al. (2019)	<u>i</u>	-0.016	3 162	Sets of 20 repetitions
Buckner et al. (2019)		-0.018	3.102	Sets of 20 repetitions
0% AOP (Site 50%)		0.266	0.522	Failure
0% AOP (Site 60%)		0.222	0.522	Failure
0% AOP (Site 70%)		0.219	0.522	Failure
0% AOP (Site 60%)		0.244	0.522	Failure
30% AOP (Site 70%)		0.066	0.522	Failure
Centner et al. (2019)		-0.097	2.480	75 repetitions
Centner et al. (2022) % muscle length		- 0.523	0.244	75 repetitions
0% muscle length		0.208	0.244	75 repetitions
20% muscle length 30% muscle length		0.162	0.244	75 repetitions
0% muscle length		0.209	0.244	75 repetitions
50% muscle length		0.214	0.244	75 repetitions
'0% muscle length		0.030	0.244	75 repetitions
00% muscle length		-0.024	0.244	75 repetitions
00% muscle length		0.000	0.244	75 repetitions
ook and Cleary (2019)				
inee extensor Inee flexor		-0.041 0.014	1.144 1.144	Failure Failure
cook et al. (2017)				
cook et al. (2018)		-0.039	2.449	Failure
Illefsen et al. (2015)		0.084	1.731	Failure
Proximal		0.081	1.369	Failure
Distal		0.051	1.369	Failure
essee et al. (2018)				
0% AOP (Site 30%) - Anterior muscle thickness		0.296	0.196	Failure
0% AOP (Site 50%) - Anterior muscle thickness		0.037	0.196	Failure
0% AOP (Site 60%) - Anterior muscle thickness		0.055	0.196	Failure
0% AOP (Site 30%) - Lateral muscle thickness		0.119	0.196	Failure
0% AOP (Site 50%) - Lateral muscle thickness		0.060	0.196	Failure
0% AOP (Site 60%) - Lateral muscle thickness		-0.067	0.196	Failure
30% AOP (Site 30%) - Anterior muscle thickness		0.073	0.196	Failure
0% AOP (Site 50%) - Anterior muscle thickness		0.055	0.196	Failure
00% AOP (Site 60%) - Anterior muscle thickness		0.091	0.196	Failure
30% AOP (Site 40%) - Lateral muscle thickness		0.199	0.196	Failure
0% AOP (Site 50%) - Lateral muscle thickness 0% AOP (Site 60%) - Lateral muscle thickness		0.159 0.110	0.196 0.196	Failure Failure
Kataoka et al. (2022)				
Posterior site .ateral site		-0.189 -0.169	1.833 1.833	Failure Failure
Kubo et al. (2006)				
Physiological CSA		-0.120	1.060	Other
aurentino et al. (2022)	Ī	0.032	1.000	Other
ihardi et al. (2015)		0.067	2.176	Sets of 15 repetitions
ivendeže etal. (2015)		0.030	2.108	75 repetitions
nanurao et al. (2015) 20/40 (load (pressure)		0.205	0.548	Sets of 15 repotitions
20/80 (load/ pressure)		0.195	0.548	Sets of 15 repetitions
0/40 (load/pressure)		0.116	0.548	Sets of 15 repetitions
		0.052	0.040	outs of 15 repetitions
viay et al. (2022)		0.400	0.606	7E repetitions
Knee flexor		0.045	0.686	75 repetitions
otal muscle CSA		-0.045	0.686	75 repetitions
Dzaki et al. (2013)	<b>_</b>	0.228	2.169	75 repetitions
Pereira et al. (2019)		-0.147	2.118	Sets of 15 repetitions
Ramis et al. (2018)				
Biceps brachii		0.210	1.318	VT equalized
		0.032	1.318	vi equalized
keece et al. (2023)		0.120	2.736	Failure
Feixeira et al. (2020)		-0.047	2.828	Sets of 15 repetitions
/echin et al. (2015)		0.010	2.000	75 repetitions
′asuda et al. (2011) Triceps brachii		0.229	1 1 1 1	75 repetitions
Pectoralis major		0.378	1.111	75 repetitions

# We searched four databases to

Forest plot demonstrating the effects of LL-RT with BFR versus HL-RT on muscle hypertrophy. AOP, arterial occlusion pressure; HL-RT, high-load resistance training; LL-RT-BFR, low-load resistance training with blood flow restriction.

retrieve studies involving trained or untrained participants (18 years or older) that have reported on muscle hypertrophy following low-load blood flow restriction exercise (≤50%) 1RM) compared to high-load (≥70% 1RM). We performed a meta-analysis on 23 studies with a total of 495 participants and showed that regardless of the repetition scheme adopted in the training protocol, the resultant muscle growth following low-intensity resistance exercise with blood flow restriction is similar to high-load strength training. However, there does appear to be a small beneficial effect of high-load exercise on upper-body exercise.

# RESULTS

## Study ID

Biazon et al. (2019) Buckner et al. (2019) Centner et al. (2019) Centner et al. (2022) Cook and Cleary (2019) Cook et al. (2017) Cook et al. (2018) Ellefsen et al. (2015) Jessee et al. (2018) Kataoka et al. (2022) Kim et al. (2017) Kubo et al. (2006) Laurentino et al. (2022) Libardi et al. (2015) Lixandrão et al. (2015) May et al. (2022) Ozaki et al. (2013) Pereira et al. (2019) Ramis et al. (2018) Reece et al. (2023) Teixeira et al. (2020) Vechin et al. (2015) Yasuda et al. (2011)



- Lowrisk
  Some concerns
  Highrisk
- D1 Randomisation process
- D2 Deviations from the intended interventions
- D3 Missing outcome data
- D4 Measurement of the outcome
- D5 Selection of the reported result

Graph of risk of bias for the studies included in the in the review.

Our results support that contrary to the current recommendations of a 4 set routine of 30-15-15-15 or sets to volitional failure, low-intensity BFR resistance exercise can induce similar magnitudes of muscle hypertrophy as high-load exercise using 3-4 sets of 15 repetitions between 20-30% 1RM. As perceptual demands increase with proximity to failure during resistance exercise with or without the addition of blood flow restriction, reducing the total number of repetitions in the prescription of BFR may have the added benefit of reducing the overall perceptual demands of the exercise session, enhancing long-term compliance to the training modality.

LL-RT with BFR elicits muscle hypertrophy similar to HL-RT regardless of the employed repetition scheme, although there appears to be a small beneficial effect in favor of HL-RT in upper-limb exercise.





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