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RESEARCH ARTICLE
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Appraising of Upper Body Blood Flow Restriction Training on Maximal Strength And Arm Circumference

ABSTRACT

The blood flow restriction training was applied in low-load resistance training to ensure the continuity of oxygen transport in the blood flow and to the muscular strength and hypertrophy. The aim of the study is to determine the effect of blood flow restriction method on hypertrophy and muscle strength changes. Total 8 strength trained men participated low-load blood flow restriction 30% of 1RM training and 8 physical men participated 80% of 1RM traditional resistance training over 6 weeks 2 times per week. To upper body maximal strength characteristics provided arm circumference ES= 0.99, biceps brachi kg ES= 1.51 and triceps push down ES= 0.78 in this study. Cocluded that blood flow restriction training promote on arm hypertrophy and strength changes on biceps and triceps brachii muscules. Indeed, resistance load traditional loading only was support absolute strength efficiency, however, blood flow restriction training method provides upper body coordination, hypertrophy, strength development to strength trained men.

Keywords: Blood flow restriction, hypertrophy, muscular strength, arm circumference, bodybuilding

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INTRODUCTION

Traditional resistance intensities consist of low-load 40-50% of 1RM, modarate-load 60-70% of 1RM and high-load 80-90% of 1RM for general resistance training prensiple. Furthermore, continuum repetition for muscle hypertrophy and muscle adaptation modarate-load 70% of 1RM conducted on sufficient effects (ACSM, 2009). The blood flow restriction as one method combined to other resistance training is provided correct hypertrophy and muscle strength gain (Pearson and Hussain, 2015; Lovery et al, 2014; Davids et al, 2021). Indeed, heavy and low load resistance training with and without blood flow restriction optionally has similar hypertrophic responses to compartment muscle (Rolnick and Schoenfeld, 2020). However, for the practical use of muscle fatigue at the desired level, it is recommended to use the 40-80% of 1RM blood flow restriction method in order to create the variation of the strength output of the training (Fatela et al, 2016). For example, for the muscle strength-endurance bench press exercise, the optimal muscle adaptations are at the same level of 80% of 1RM, and there is no additional increase in muscular endurance that occurs at high-loading resistance training intensity (Gepfert et al, 2021).

Implementation of blood flow restriction in a resistance training program requires some basic programming considerations for physical athletes. The best evidence-based approach seems to be to schedule the training periodically in sessions of multiple sets (2-4 sets) and to plan the training adaptation period as 2-4 weeks (Rolnick and Schoenfeld, 2020). Unlimited studies on the chronic effects of blood flow restriction have reported muscle hypertrophy and strength gains (Davids et al, 2021; Schwiete et al, 2021). The chronic blood flow restriction method was applied 3 times a week for 9 weeks to monitor positive maximized performance improvements, with high-load traditional resistance 75%- 80% of 1RM and low-load blood flow restriction 30%- 40% of 1RM (Davids et al, 2021). High-load resistance training was more effective for 1RM performance, although there was a 7.4% increase in both blood flow restriction and 4.6% increase in high-loading. In conclusion, the blood flow restriction method is an alternative method to traditional high-load resistance training for hypertrophy increases. For sports performance examinations, 80% of 1RM resistance and 30% of 1RM blood flow restriction training were applied for 6 weeks, especially in the muscle strength of the football players. Muscle gain was similar in both groups, and it was clear that blood flow restriction resulted in more hypertrophy increase. For this reason, when muscle building development is aimed, it is recommended to establish training periods in a way to support the performance development of athletes using the blood flow restriction method (Korkmaz et al, 2022). As can be understood from these results, it can be recommended to use blood flow restriction method as a general training method for chronic resistance training

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periodizations, often in macro cycles where strength and hypertrophy are aimed. However, the general recommendation is to choose a blood flow restriction resistance training method instead of modarate-loading 60-75% of 1RM training, and to include it as a short-term resistance method in chronic effects for muscle adaptation and neuromuscular changes during macro periods will yield high-level performance results (Teixeira et al, 2022).

In the comparison of acute blood flow restriction applications, 15-40% of 1RM and 15-80% of 1RM, and traditional 70% of 1RM modarate-load resistance training, while providing great muscle fatigue, the overall torque increase was realized in the traditional resistance protocol. This suggests that blood flow restriction contributes more to the chronic effects of 20-30% of 1RM at optimized low loads. In contrast, low load blood flow restriction and low load resistance training show similar muscle size and strength adaptation (Buckner et al, 2019). Moreover, a study reported that the blood flow restriction method in the bench press 80% of 1RM acute effect did not reduce the strength-endurance repetitions compared to traditional resistance (Gepfert et al, 2021). However, great peripheral fatigue was observed at 30% of 1RM resistors, in which maximal voluntary contractions were evaluated in acute blood flow restriction (Copithorne and Rice, 2019). In the training unit where acute blood flow restriction is generally applied for 20%, 40%, 60% and 80% of 1RM torque increases, only 40% and 80% of the torque change protocols are the main training in the preliminary recognition phases in the detection of muscle fatigue before starting the intended exercises. It was determined that it should be detected beforehand (Fatela et al, 2016). Therefore, as reported by ACSM, blood flow restriction 20-50% of 1RM applications and ≥65% of 1RM traditional resistance training creates muscle mass gain, strength and fatigue resistant effects similar to 1RM resistance training (ACSM, 2009). Current blood flow restriction studies reported 6.4% and 6.8% in cross-sectional area and 1RM 9.5% and 10% increases, respectively, as examined the control group and blood flow restriction protocol (Teixeira et al, 2022). Thus, the short-term (3 weeks) blood flow restriction method validated muscle strength and hypertrophy gains compared to traditional training. However, blood flow restriction has little to do with interruption in training other than being an exercise stimulus. In this study, we aimed to determine the effect of blood flow restriction method on the development of muscle strength and arm circumference in upper body muscle groups.

MATERIAL AND METHOD

Participants

A total of 8 strength trained men and 8 physical mean voluntary participated in this study. All Blood flow restriction (BFR) and Control (CONT) groups involved in upper body muscular strength test session and arm circumference were measured pre and posttest analysis. The exclusion criteria were serious humerus, forearm, and wrist injuries within one week before training. Population creating were obtained detect calculation effect size= 1.00, α error probability = 0.5 and power (1-β) error probability = 0.96 transferred in analysis statistic.

Table 1: Properties of strength trained men

Properties	Min	Max	Pre-Ptot Sum	Mean
BFR-Group				
Height	172	183	1433	179.12
Age	22	25	189	23.62
Training experience	5	7	44	5.50
Weight	75	95	661	82.65
BMI	23.70	28.70	206	25.75
CON-Group				
Height	168	185	1408	176
Age	23	25	192	24
Training experience	5	5	40	5
Weight	68	90	616	77
BMI	22.20	29.10	203.70	25.46

Table 2: Maximal relative strength characteristics

Strength characteristics	BFR-Group	CON-Group
BCD mean load (kg)	25.25	22
Biceps curl dumbbell ($kg{\cdot}kg^{-1}$)	0.40	0.43
TPD mean load (kg)	108.75	94.37
Triceps push down ($kg{\cdot}kg^{-1}$)	0.09	0.09

1RM= One repetition maximum

Experimental approach to the problem

To determine upper body blood flow restriction resistance training was planned on training loading by 30% of 1RM low-volume resistance training (Davids et al, 2021). Upper body absolute and relative strength were obtained to maximal dynamic strength activations at 85-100% of 1RM load repetitions providing on pre and post intervention. The muscle strength actualized high frequency 2 times per week. Muscular adaptation tested by arm circumference and 1RM muscular strength was applied one day pre intervention after blood flow restriction training post interventation.

Muscular strength

Muscular dynamic strength test achieved on biceps curl barbell, triceps push down were used for perform maximum attempts with option 2-10RM progression baseline loading warm-up. First trial 1RM set of 3 repetitions at 85% of 1RM within 1 min recovery was provided. Maximum eforts at 90% of 1RM with 2-4 repetitions was followed by 2 min recovery. After 2 repetitions was increased up to 5-10 kg weights maximal with 1 repetitions and 1 min recovery (Haff and Triplett, 2016).

Body mass and arm circumference

Body mass and arm circumference measurement applied as standard protocols. Body mass was measured with digital scale. To evaluate arm circumference The American College of Sport Medicine protocols for measuring arm muscle girths were taken biceps brachii and triceps muscules contraction condition by standard tape measurement (Luebbers et al, 2014).

Blood flow restriction resistance training

The blood flow restriction training method by low load has been generated 4 set, 15x15x15 high repetitions and 30 second short time recovery during upper body muscular contractions in eccentric 2 second and concentric 2 second implementation changes formed large muscle stimulation (Lauver et al, 2020). In the same time period, the training load for blood flow restriction was 30% of 1RM and physical men was 80% of 1RM. External pressure was implementation of low-load blood flow restriction by using wide cuff measurement to ensure positive adaptation (Wilk et al, 2022). During exercise blood flow restriction intentional decreasing arterial blood flow for blocked venous blood, cuff was located on proximal of extremities such as deltoid muscle location (Pope et al, 2013). Upper body wide cuff located on deltoid muscules cuff 3 cm in posterior portion by beybi medical turnique, indeed most proximal location prevented from superficial damage potential (Lorenz et al, 2021). As periodic training seans composed of 4 set – 2 day to training adaptation over 6 weeks (Rolnick and Schoenfeld, 2020).

Statistical analysis

Population effect size values interaction determined by G Power analysis program. Sample size similarity effect t=2.13 and d=1.00 for actual power assumption. Therefore, this study sample size occured n=8 and actual power 0.96 in statistical analysis. Progressivelly pre nd post comparisons tested on Paired-t test for group interaction effect. Mean and standard deviation descripted descriptive analysis. Normality statistic provided on swekness and kurtosis values. Alpha significant values were explored p-value at 0.05. Difference of pre and post comparisons were determined Cohen'd effect size descriptive effect on 0.20 small, 0.50 moderate and 0.80 large.

FINDINGS

The chronic blood flow restriction method to aim of possive maximize performance development and follow exacuated at 6 weeks with high load traditional resistance at 80% of 1RM and low load at 30% of 1RM blood flow restriction. Upper body both biceps brachii and triceps muscules concluded on strength performance change and to hypertrophy change resulted on arm circumference.

Table 3: Circumference and strength measures

	PRE Mean / SD	POST Mean / SD	ES
Arm circumferance (cm)			
BFR	39.25±0.88	40.43±1.42	0.99
CON	38.25±1.66	39.06±1.45	0.51
Biceps curl (kg)			
BFR	22.25±3.70	27.25±2.86	1.51
CON	22.00±5.52	23.00±4.74	0.19
Triceps push down (kg)			
BFR	108.75±11.57	116.75±8.71	0.78
CON	94.34±24.55	100.37±22.54	0.25

$p<0.05$.

DISCUSSION

The low-load blood flow restriction training method increases muscle size and strength in the upper body (Farup et al, 2015). However, the applied pressure sites have variable applications in the proximal regions (Pope et al, 2013). For example, the creation of biceps and triceps muscle size sessions for the upper extremity is similar for both elbow flexion and elbow extension, as average increases can create strength differences in the proximal regions (Weatherholt et al, 2013). Blood flow restriction supported the development of muscle strength and hypertrophy in this study as a periodic training adaptation in upper body exercise combinations in the elimination of chronic muscle fatigue during periods of reduced blood flow. Indeed, blood flow restriction training can be used in place of traditional resistance training in reductions in exercise (Pope et al, 2013; Farup et al, 2015). In particular, low-loading exercises and lifting weights provided more alternative muscle adaptation processes in bodybuilders than in other resistance training populations (Pignanelli et al, 2021; May et al, 2022). Moreover, increased muscle strength and hypertrophy gains resulted in significant increases in potential for altered adaptations of muscle activation where the use of high loads was not necessary (Fatela et al, 2016). Low-load blood restriction training to upper body may be advantage as traditional resistance training. Low-load arm curl blood flow restriction training at 40% of 1RM is produce as low-load traditional training equal muscular hypertrophy and greater develop 1RM dynamic muscular strength into 2-4 weeks as well as isometric voluntary contraction greater than traditional training (Farup et al, 2015). Strength production an adequate stimules such as unilateral elbow flexion at 50% of 1RM causes increased maximal voluntary dynamic strength 22% and isometric voluntary contraction 8.3% in indices of neuromuscular function over 8 weeks (Moore et al, 2004). Furthermore, low-load blood flow restriction training to upper body needed for arm circumference improvement (Weatherholt et al, 2013). Low-load blood flow restriction upper body protocols to represent the strength of elbow flexors and extensors, unilateral biceps curl and triceps extension training were founded arm girths become significant larger compared to baseline at 6 weeks and support to blood flow restriction increased strength. Similarly, low-load arm curl and triceps down exercises over 12 weeks were applied arm cross-sectional area for elbow flexors 17.6% and extensors 17.4% increased and maximum voluntary isometric contraction for elbow flexion 7.8% and elbow extension 16.1% improved in blood flow restriction training (Yasuda et al, 2015). The application of blood flow restriction to the upper body resistance training program seems to be limited for physical athletes, but it is indeed popular as no additional resistance is required considering that short-term adaptations will be seen between 2-4 weeks (Rolnick and Schoenfeld, 2020). Blood flow restriction also supports absolute muscle hypertrophy and strength gains in the chronic effect (Davids et al, 2021; Schwiete et al, 2021). Positive and maximize strength performance compared to traditional resistance may be loading 20-50% of 1RM represent generally increased 5-10% muscular strength development (ACSM, 2009; Davids et al, 2021). Therefore, blood flow restriction for hypertrophy increases is alternative training method, because fatigue thresholds were show mostly late (Gepfert et al, 2021). In the general training method, one can recommend the use of blood flow restriction method in macro cycles where strength and hypertrophy are often aimed, but the general recommendation is to prefer blood flow restriction resistance training method instead of modarate load 60-75% 1RM training, its use for muscle adaptation and neuromuscular changes during macro periods, in chronic effects. Its inclusion as a short-term resistance method will yield superior performance results (Teixeira et al, 2022).

CONCLUSION

Can realize biochemical and physical adaptation in the organism with appropriate quality and quantity of training (Çetinkaya et al, 2017). It is clear that the blood flow restriction method, which is an alternative resistance training method in muscle performance studies, provides high hypertrophy and muscle strength increases in low-load resistance applications compared to traditional high-load resistance training. For this reason, it is thought that its frequent use in achieving chronic adaptations and acute strength gains will benefit both athletes and physical individuals. The American College of Sports Medicine has recommended approximately 60–100% of 1RM as the required resistive load for muscle strength-endurance training based on the characteristics of muscle strength, hypertrophy, and to some extent induced muscle adaptation within the absolute muscle strength zone (ACSM, 2009; Teixeira et al, 2022). However, resistance training in combination can induce similar adaptive conditions, such as blood flow restriction and high-intensity resistance training characteristics. The result is that significantly lower intensities 20-50% of 1RM would be more accurate for populations to be used during high-intensity resistance training, where we cannot tolerate large mechanical loads applied.

REFERENCES

American College of Sports Medicine (2009). American College of Sports Medicine position stand. Progression models in resistance training for healthy adults. *Medicine and science in sports and exercise*, *41*(3), 687–708. https://doi.org/10.1249/MSS.0b013e3181915670.

Buckner, S. L., Jessee, M. B., Dankel, S. J., Mattocks, K. T., Mouser, J. G., Bell, Z. W., Abe, T., & Loenneke, J. P. (2019). Acute skeletal muscle responses to very low-load resistance exercise with and without the application of blood flow restriction in the upper body. *Clinical physiology and functional imaging*, *39*(3), 201–208. https://doi.org/10.1111/cpf.12557.

Copithorne, D. B., & Rice, C. L. (2019). The effect of blood flow occlusion during acute low-intensity isometric elbow flexion exercise. *European journal of applied physiology*, *119*(3), 587–595. https://doi.org/10.1007/s00421-019-04088-8.

Çetinkaya, E., Tanır, H., Atay, E., Bulut, Ç., & Engin, H. (2017). Investigation of musculoskeletal system injuries in athletes doing bodybuilding and fitness sports Vücut geliştirme ve fitness sporu yapanlarda, kas, iskelet sistemi sakatlıklarının belirlenmesi. *Journal of Human Sciences*, 14(4), 4023-4031.

Davids, C. J., Næss, T. C., Moen, M., Cumming, K. T., Horwath, O., Psilander, N., Ekblom, B., Coombes, J. S., Peake, J., Raastad, T., & Roberts, L. A. (2021). Acute cellular and molecular responses and chronic adaptations to low-load blood flow restriction and high-load resistance exercise in trained individuals. *Journal of applied physiology (Bethesda, Md.: 1985)*, *131*(6), 1731–1749. https://doi.org/10.1152/japplphysiol.00464.2021.

Farup, J., de Paoli, F., Bjerg, K., Riis, S., Ringgard, S., & Vissing, K. (2015). Blood flow restricted and traditional resistance training performed to fatigue produce equal muscle hypertrophy. *Scandinavian journal of medicine & science in sports*, *25*(6), 754–763. https://doi.org/10.1111/sms.12396

Fatela, P., Reis, J. F., Mendonca, G. V., Avela, J., & Mil-Homens, P. (2016). Acute effects of exercise under different levels of blood-flow restriction on muscle activation and fatigue. *European journal of applied physiology*, *116*(5), 985–995. https://doi.org/10.1007/s00421-016-3359-1.

Gepfert, M., Jarosz, J., Wojdala, G., Krzysztofik, M., Campos, Y., Filip-Stachnik, A., Kostrzewa, M., Gawel, D., Szkudlarek, A., Godlewski, P., Stastny, P., & Wilk, M. (2021). Acute impact of blood flow restriction on strength-endurance performance during the bench press exercise. *Biology of sport*, *38*(4), 653–658. https://doi.org/10.5114/biolsport.2021.103726.

Haff, G. G and Triplett, N. T. (2016). Essentials of Strength Training and Conditioning. Champaign, IL: Human Kinetics.

Korkmaz, E., Dönmez, G., Uzuner, K., Babayeva, N., Torgutalp, Ş. Ş., Özçakar, L. (2022). Effects of Blood Flow Restriction Training on Muscle Strength and Architecture. *J Strength Cond Res*. *36*(5): 1396-1403. https://doi:10.1519/JSC.0000000000003612.

Lauver, J. D., Cayot, T. E., Rotarius, T. R., & Scheuermann, B. W. (2020). Acute Neuromuscular and Microvascular Responses to Concentric and Eccentric Exercises With Blood Flow Restriction. *Journal of strength and conditioning research*, *34*(10), 2725–2733. https://doi.org/10.1519/JSC.0000000000003372.

Lorenz, D. S., Bailey, L., Wilk, K. E., Mangine, R. E., Head, P., Grindstaff, T. L., & Morrison, S. (2021). Blood Flow Restriction Training. *Journal of athletic training*, *56*(9), 937–944. https://doi.org/10.4085/418-20.

Lowery, R. P., Joy, J. M., Loenneke, J. P., de Souza, E. O., Machado, M., Dudeck, J. E., & Wilson, J. M. (2014). Practical blood flow restriction training increases muscle hypertrophy during a periodized resistance training programme. *Clinical physiology and functional imaging*, *34*(4), 317–321. https://doi.org/10.1111/cpf.12099.

Luebbers, P. E., Fry, A. C., Kriley, L. M., & Butler, M. S. (2014). The effects of a 7-week practical blood flow restriction program on well-trained collegiate athletes. *Journal of strength and conditioning research*, *28*(8), 2270–2280. https://doi.org/10.1519/JSC.0000000000000385.

May, A. K., Russell, A. P., Della Gatta, P. A., & Warmington, S. A. (2022). Muscle Adaptations to Heavy-Load and Blood Flow Restriction Resistance Training Methods. *Frontiers in physiology*, *13*, 837697. https://doi.org/10.3389/fphys.2022.837697.

Moore, D. R., Burgomaster, K. A., Schofield, L. M., Gibala, M. J., Sale, D. G., & Phillips, S. M. (2004). Neuromuscular adaptations in human muscle following low intensity resistance training with vascular occlusion. *European journal of applied physiology*, *92*(4-5), 399–406. https://doi.org/10.1007/s00421-004-1072-y.

Pearson, S. J., & Hussain, S. R. (2015). A review on the mechanisms of blood-flow restriction resistance training-induced muscle hypertrophy. *Sports medicine (Auckland, N.Z.)*, *45*(2), 187–200. https://doi.org/10.1007/s40279-014-0264-9.

Pignanelli, C., Christiansen, D., & Burr, J. F. (2021). Blood flow restriction training and the high-performance athlete: science to application. *Journal of applied physiology (Bethesda, Md. : 1985)*, *130*(4), 1163–1170. https://doi.org/10.1152/japplphysiol.00982.2020.

Pope, Z. K., Willardson, J. M., & Schoenfeld, B. J. (2013). Exercise and blood flow restriction. *Journal of strength and conditioning research*, *27*(10), 2914–2926. https://doi.org/10.1519/JSC.0b013e3182874721.

Rolnick, N and Schoenfeld, B. J. (2020). Blood flow restriction training and the physique athlete: a practical research-based guide to maximizing muscle size. *Strength and Conditioning Journal*, *42*(5): 22-36, doi: 10.1519/SSC.0000000000000553.

Schwiete, C., Franz, A., Roth, C., & Behringer, M. (2021). Effects of Resting vs. Continuous Blood-Flow Restriction-Training on Strength, Fatigue Resistance, Muscle Thickness, and Perceived Discomfort. *Frontiers in physiology*, *12*, 663665. https://doi.org/10.3389/fphys.2021.663665.

Teixeira, E. L., Painelli, V. S., Schoenfeld, B. J., Silva-Batista, C., Longo, A. R., Aihara, A. Y., Cardoso, F. N., Peres, B. A., & Tricoli, V. (2022). Perceptual and Neuromuscular Responses Adapt Similarly Between High-Load Resistance Training and Low-Load Resistance Training With Blood Flow Restriction. *Journal of strength and conditioning research*, *36*(9), 2410–2416. https://doi.org/10.1519/JSC.0000000000003879.

Yasuda, T., Fukumura, K., Uchida, Y., Koshi, H., Iida, H., Masamune, K., Yamasoba, T., Sato, Y., & Nakajima, T. (2015). Effects of Low-Load, Elastic Band Resistance Training Combined With Blood Flow Restriction on Muscle Size and Arterial Stiffness in Older Adults. *The journals of gerontology. Series A, Biological sciences and medical sciences*, *70*(8), 950–958. https://doi.org/10.1093/gerona/glu084.

Wilk, M., Krzysztofik, M., Filip, A., Zajac, A., Bogdanis, G. C., & Lockie, R. G. (2022). Short-Term Blood Flow Restriction Increases Power Output and Bar Velocity During the Bench Press. *Journal of strength and conditioning research*, *36*(8), 2082–2088. https://doi.org/10.1519/JSC.0000000000003649.

Weatherholt, A., Beekley, M., Greer, S., Urtel, M., & Mikesky, A. (2013). Modified Kaatsu training: adaptations and subject perceptions. *Medicine and science in sports and exercise*, *45*(5), 952–961. https://doi.org/10.1249/MSS.0b013e31827ddb1f.