Comparative Study Of Effects Of Resistance Training Of Lower Limb Limb Versus Blood Flow Restriction Training Of Quadriceps On Muscle Mass And Blood Lipids In Over-Weight Adults: A Randomized Clinical Trial.

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Abstract : This study has been undertaken to investigate the Effects of resistance training of lower limb limb versus blood flow restriction training of quadriceps on muscle mass and blood lipids in over-weight adults. A clinical trial where subjects were divided into 2 groups, one group was given resistence training and another blood flow restriction training.This study demonstrated that quadriceps BFR training is more effective than traditional lower limb resistance training in improving muscle mass and blood lipid profiles in overweight adults**.**

Key words – Resistence training, blood flow restriction training, blood lipid, quadriceps.

INTRODUCTION:

In recent years, the prevalence of overweight/obesity has been on the rise in both developed and developing countries and has become a global public health problem.[1]

A study revealed alarming obesity rates in India, with 70% of urban population overweight. India ranks third globally in obesity, following the US and China. Approximately 8 crore Indians are obese, with 1 crore aged 5-19.[2]

The report, conducted by the NCD Risk Factor Collaboration, revealed that approximately eight crore individuals in India are classified as obese, with a striking one crore falling within the age group of 5 to 19 years. The Lancet study also revealed that 30 million adults in India are either overweight or obese, and 62 million diabetic Indians exhibit obesity-related characteristics such as excess body fat, abdominal adiposity, and fat deposition in ectopic sites.

The World Health Organization considers overweight/obesity to be one of the world's most serious public health problems. The European Commission regards overweight/obesity as a chronic disease, and its occurrence is often accompanied by an increase in the incidence of chronic diseases such as hyperlipidemia, type 2 diabetes, atherosclerosis, liver disease, cancer and neurodegenerative diseases. The impact is wide ranging affecting 6.7 billion people worldwide and is growing at a threefold rate.[3]

The American College of Sports Medicine (ACSM) recommends moderate to high-intensity aerobic exercise (46–90% VO_2 max) for 3–7 days per week to enhance cardiopulmonary function, improve metabolism, and reduce the risk of obesity and cardiovascular disease (CVD).[4]

In the management of adult overweight/obesity, moderate-intensity aerobic exercise can reduce body weight, total fat, visceral fat, intrahepatic fat, and control blood pressure, whereas moderate-intensity resistance exercise can maintain lean body mass during weight loss.[5]

However, it may pose the risk of high mechanical stress and injury, limiting its applicability to certain populations, including older adults. To address this concern, blood flow restriction exercise (BFRE), also known as "KAATSU" exercise, has emerged as an effective intervention for individuals who may find high-intensity exercise challenging. BFRE involves applying pressure to the limbs during exercise using air cuffs, which restricts blood flow to the exercising muscles and induces a hypoxic environment within the muscle tissue.[6]

Blood flow restriction training (BFRT) involves applying external pressure to the limb during exercise. This is done using special devices such as inflatable cuffs or elastic bandages, or using compression wraps such as a blood pressure cuff or other specially designed restraint bands. BFRT is a method to achieve the effect of intensive training by partially blocking arterial blood flow and occlusion of venous blood flow of the pressured limbs.[7]

BFRT combined with low intensity resistance or endurance training can lead to an increase in muscle strength and mass. As well, blood flow restriction combined with endurance training has also been shown to improve cardiopulmonary health.[8]

Furthermore, BFRT can effectively improve muscle mass and strength in different populations and improve muscle fitness.[9]

2.NEED OF THE STUDY.

To assess the comparative effect of resistance training and blood flow restriction training on muscle mass and lipid profile in overweight adults.

3.1Population and Sample

Sample size: 50

Sampling method: Random sampling

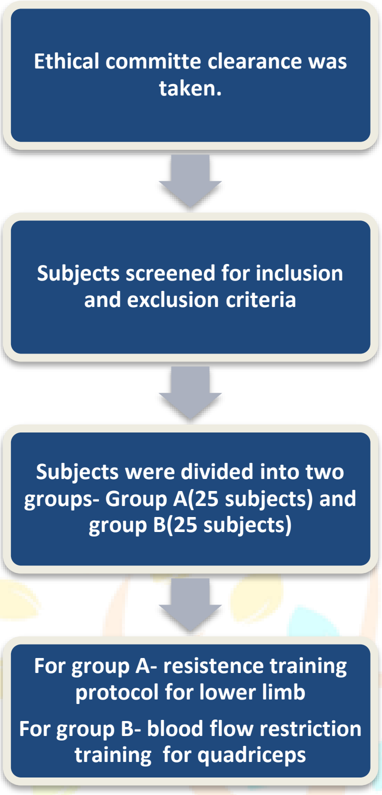
Inclusion criteria:

1. Overweight adults with age group from 25 years to 40 years.
2. Individuals with BMI more than 25-29.

Exclusion criteria:

1. Any previous musculoskeletal injuries.
2. Any cardio respiratory complications such as High BP.
3. Uncontrolled Type 2 DM or subjects who are on medications for type 2 diabetes mellitus.
4. Any neurological deficits.
5. Any arterial dysfunction or subjects on medications like aspirin or blood thinners

RESEARCH METHODOLOGY



Blood flow training protocol:
Frequency 2-3 times/week for 4 weeks
Intensity: 1-2 times/day
Repetitions:75 reps
Set: 2-4 sets
Set pressure: 40-80% AOP
Restriction time: 5-10 minutes/exercise
Rest between sets: 30-60 seconds.

Resistance training protocol:
The group underwent strength training sessions composed of muscle-strengthening exercises conducted on machines (Abdominal curl, sit-ups, leg extension, leg flexion, lateral pulldown).
After measuring the dynamic force using the one repetition maximum tests, strength exercises were performed at 40–50% of the personal recorded values for 2–3 sets of 8–12 repetitions each one with 1-min rest between sets and 3-min rest between exercises. The intensity of the exercises was increased by 2% each week for total 4 weeks.

3.3 Results

Cardiorespiratory Markers	Group A	Group B	P value
Heart rate(HR)	86±2.5	79±1.5	<0.0001
Respiratory rate(RR)	32±1.2	28±2.1	<0.0001
Blood pressure(BP)	142/93±1.5	125/89±1.2	<0.0001

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3.4 Discussion

The study compared the effect of resistance training for lower limb and blood flow restriction technique on quadriceps muscle to assess the cardiovascular parameters, lipid profile and the effect on muscle mass. The result has shown improvement in cardio markers, lipid profile and quadriceps girth measurement.

Previous studies have shown that the, Resistance training and Blood Flow Restriction Training (BFRT) in overweight adults, particularly with lower limb exercises, can improve muscle mass by increasing lean mass and size. Muscle growth following RE can result from the accumulation of contractile proteins.[10]

Both interventions i.e resistance exercise and blood flow restriction technique improved cardiovascular markers & lipid profile, but the improvement was seen more in the blood flow restriction technique group. Blood flow restriction technique (BFRT) offers a valuable alternative to high-load resistance training, allowing for muscle and strength gains with lower mechanical stress, beneficial for those unable to tolerate high loads.

The current study it has been shown that blood flow restricted training improved cardiovascular markers, the possible explaination can be due, muscle hypertrophy and increased muscle strength with low to moderate intensity training through improved anabolic processes mediated by BFR.[11]

The present randomized clinical trial compared the effects of lower limb resistance training and quadriceps blood flow restriction (BFR) training on muscle mass and blood lipid profiles in overweight adults. The main finding was that **BFR training induced significantly greater improvements in both quadriceps muscle mass and blood lipid parameters compared to traditional resistance training**, despite the use of lower external loads.

These findings are consistent with previous studies demonstrating that **low-load BFR training can produce comparable or even superior hypertrophic and metabolic adaptations to high-load resistance training** [12,13]. The superior increase in muscle mass observed in the BFR group may be attributed to the **unique physiological environment created by vascular occlusion**, which leads to metabolite accumulation, increased motor unit recruitment, and stimulation of anabolic signaling pathways such as mTOR [14,15].

Additionally, hypoxic conditions during BFR promote type II fiber activation even at low loads [16], thereby enhancing hypertrophy.

Beyond muscle adaptations, this study also demonstrated that **BFR training resulted in more favorable changes in blood lipid profiles**, including significant reductions in total cholesterol, LDL, and triglycerides, as well as an increase in HDL levels. These results are in line with previous evidence suggesting that BFR training can positively influence cardiovascular and metabolic health[17,18]. The mechanisms underlying these lipid changes may involve **increased shear stress, enhanced nitric oxide bioavailability, and improved peripheral circulation** during the repeated ischemia–reperfusion cycles inherent in BFR training [19]. These vascular adaptations can enhance lipid metabolism and endothelial function, contributing to improved lipid profiles [20].

In contrast, traditional resistance training also produced positive changes in both muscle mass and blood lipids, but the magnitude of improvement was lower. This may be due to the relatively lower metabolic stress associated with conventional training at moderate intensities when compared with the **intense metabolic and hormonal stimulus elicited by BFR**, even at lower loads [21].

The clinical implications of these findings are noteworthy. Overweight adults often experience **joint discomfort, lower exercise tolerance, and increased risk of injury**, which may limit their ability to perform high-load resistance exercises. BFR training provides an effective, low-load alternative that can stimulate muscular and metabolic adaptations while minimizing joint stress [22,23]. This makes BFR particularly useful for populations with orthopedic or metabolic limitations, as well as for clinical rehabilitation settings.

However, a few considerations should be noted. The intervention was limited to quadriceps training over a relatively short duration. Future studies should explore the **long-term effects of BFR training**, the optimal frequency and pressure parameters, and the impact of training multiple muscle groups simultaneously on systemic lipid metabolism. Additionally, while no adverse events were reported, BFR training requires **appropriate supervision and individualized cuff pressures** to ensure safety [24].

Overall, this study demonstrates that **quadriceps BFR training is more effective than traditional lower limb resistance training in improving muscle mass and blood lipid profiles in overweight adults**. These results support the inclusion of BFR training as a complementary or alternative strategy for exercise prescription in overweight populations, with potential implications for both **body composition enhancement and cardiovascular risk reduction**.

3.4.1 Conclusion

This study demonstrates that **quadriceps BFR training is more effective than traditional lower limb resistance training in improving muscle mass and blood lipid profiles in overweight adults**.

3.4.2 References

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