

A LITERATURE REVIEW ON THE EFFECT OF ENDURANCE AND MIXED TRAINING ON SELECTED PHYSIOLOGICAL VARIABLES AND BODY COMPOSITION.

Ajinkya Avadhut Kudtarkar

College Director of Physical Education & Sports, Shree Damodar College, Margao, Goa.
PhD. Scholar- Physical Education at Nanded University, Maharashtra, India

Dr.Suresh Nivartirao Jondhale

College Director of Physical Education and Sports,
Saraswati Sangeet Kala Mahavidyalaya, Latur, Maharashtra- India.

Abstract

This paper is a literature review of research articles on a topic that has been rarely studied in India. The following review aims at understanding how exercise can have an effect on body composition and physiological variables. In this study, attempts have been made to analyse the effect of different kinds of training, such as Endurance Training, High Intensity Interval Training, Resistance Training etc. on various components such as Body Mass, Fat Percentage, Basal Metabolic Index (BMI), Waist to Hip Ratio, Low Density Lipoprotein (LDL) & High Density Lipoprotein (HDL) Cholesterol etc. After reviewing the literature in this area the conclusion drawn is that Endurance Training, High Intensity Interval Training, Resistance Training has significant effect in reducing body mass, fat percentage, BMI, LDL Cholesterol and elevating HDL cholesterol. It was also seen that exercise helped in lowering resting Blood Pressure. This literature may be effective if applied to the Indian population as India is being recognized for its fast growth as a capital for lifestyle illnesses as per the World Health organization.

Key words: Endurance Training, Mixed training, Body mass, Fat Percentage, LDL-Cholesterol, HDL Cholesterol and Resting Blood Pressure.

Introduction

The World Health Organization has recognized obesity as the most visible and at the same time, the world's most underestimated public health problem. Research suggests that obesity epidemic affects 500 million adults. A BMI reaching 35 kg / m² at age 20 has been shown to reduce life expectancy by 13 years. People with BMI in the 40–49.9 kg / m² range had almost twice as high an annual risk of death as people with BMI in the 22.5–24.9 kg / m² range. It is estimated that obesity is the cause of more than 300,000 deaths per annum in the United States alone. In the US, the overall annual medical costs of obesity care surpass USD 140 billion, which is 9.1 % of annual medical costs (Skrypnik et al., 2015)

The American Heart Association recommends weight loss in obese patients to minimize the severity of risk factors for cardiometabolism, such as metabolic syndrome, insulin resistance, DM2, hypertension, dyslipidemia, Cardio Vascular Disease, and inflammation. Clinically, meaningful weight loss (about 5% of the average body weight) is believed to be an efficient way to minimize risk factors for Cardio Vascular Disease (CVD) and DM2 risk factors and must be made compulsory for every treatment. In obesity therapy guidelines, physical exercise should be incorporated irrespective of the reference body weight or weight loss objectives. Physical exercise is known to be associated with loss of body weight and reductions in cardiovascular, diabetic and all-cause mortality, resulting in improved life expectancy and counteracting the negative health effects of obesity. (Skrypnik et al., 2015)

It has been shown that aerobic resistance exercise contributes to various health benefits, and there is substantial evidence of its beneficial effect on weight, glucose control, endothelial function, glomerular filtration rate (GFR), lipoprotein particle size, and concentration of high-density lipoproteins as well as overall improvement in quality of life. The most popular form of exercise for the treatment of obesity is aerobic endurance training. According to the European Clinical Practice Guidelines of the European Association for the Study of Obesity (EASO), for most days of the week, aerobic endurance training of a moderate to high intensity should be performed, tailored to the patient's health and capacity. It must be carried out on as many days of the week, for 30 to 60 minutes, irrespective of age. (Skrypnik et al., 2015)

Alternatively, recent research findings suggest various possible benefits of strength training in obesity therapy including improved muscle strength, prevention of ageing sarcopenia, preservation of bone mineral density, and reduction of body fat. In its 2013 recommendations for the treatment of arterial hypertension, the European Hypertension Society and the European Cardiology Society suggest vigorous resistance exercise, but not isometric exercise, performed 2–3 days a week as a way of lowering blood pressure and enhancing metabolic parameters. Strength training tend to be a overlooked component of guidelines related to exercise treatment of obesity. (Skrypnik et al., 2015)

The purpose of this paper is to understand the literature which depicts the influence of endurance training and mixed training on body mass, fat percentage, cholesterol and blood pressure etc. on individuals and draw some links between this.

Review of Literature

Damian Skrypnik, Paweł Bogdański et.al.(2015), in their study titled, 'Effects of Endurance and Endurance Strength Training on Body Composition and Physical Capacity in Women with Abdominal Obesity' have found out that endurance and endurance strength training causes a significant decrease in body mass, BMI, total body fat, total body fat mass, and waist and hip circumference which were observed after both types of intervention and also stated that significant increases in total body lean and total body fat-free mass were documented in group B. In both groups, significant increases in peak oxygen uptake, time to exhaustion, maximal work rate, and work rate at ventilatory threshold were accompanied by noticeably decreased resting heart rate, resting systolic blood pressure, and resting and exercise diastolic blood pressure. No significant differences were noticed between groups for the investigated parameters.

This intervention was conducted on 44 females who were classified into group A and B, Group A was asked to perform Endurance training and Group B was asked to perform Endurance Strength training for 3 months, 3 times a week for a 60 minutes in a day. It was conclude that positive health benefits can be seen after performing endurance and endurance strength training for the period 3 months on anthropometric parameters, body composition, physical capacity, and circulatory system in women with abdominal obesity.

Tina Oddli Sundli,(2016), in her study titled, 'The effect of endurance training on body composition and blood lipids in older adults: A randomized controlled trial', found out that there was slight reduction of body weight after 3 years of endurance training. High intensity Training group showed a more weight loss as compared to a Moderate Intensity training Group.

Visceral fat showed a rise in the control group and in the group which received Moderate intensity Training. However this was not seen in the case of the High intensity Training Group, after 3 years of intervention. It was seen that Endurance training did not have significant difference in blood lipids.

Gender differences were also found to be significant in the body composition and blood lipid value before the intervention (baseline). There was a gender difference which was observed in various other components like waist, LDL cholesterol, BMI, visceral fat in response to endurance training.

Women were seen to have a greater effect where BMI was concerned with High Intensity training as compared to men. Men, however showed a reduction in LDL cholesterol and visceral fat with Moderate Intensity Training while this was also seen in the control group.

There was a difference in the muscle mass as well as in the triglycerides of males and females where males had lesser muscle mass as compared to the females.

This study was conducted with 400 participants which had 204 females and 194 males. The mean age was 71.9 years. Body composition was measured by using bio electrical impedance in a fasting stage. Blood lipids were measured through a blood test also during the fasting period.

In this particular study, Moderate Intensity Training included 50 minutes of continuous endurance training which was equal to 70% of heart rate and this was done 2 times per week. High Intensity Interval Training included 30 to 40 minutes of high intensity interval training with 90% equal to the heart rate, twice a week.

The final finding of this study showed that 3 years of endurance training had a moderate effect on body composition, however had no effect on blood lipids. It was also seen that men and women had different changes that occurred where men showed more reduction in muscle mass and triglycerides as compared to women.

In the high intensity group, women showed greater reduction in BMI and waist. But in the moderate intensity group it was the men who showed greater reduction in LDL and visceral fat. This suggests that males and females perhaps need different intensity training depending upon their blood lipid count and body composition.

Nailton José Brandão de Albuquerque Filho, Gleidson Mendes Rebouças et al, (2014) in their study titled 'Effect of Concurrent Training on Body Composition and Lipid Profile in Overweight Adolescents' has come to the conclusion that before intervention sum of skin-fold thickness and body fat percentage when compared between Intervention and Control group showed there is significant difference in the intervention group. There was significant difference were shown in triglycerides, LDL cholesterol and total cholesterol after 8 weeks of intervention and after 16 weeks of intervention significant difference were found among Sum of skin-fold thickness, body fat percentage, fasting glucose, triglycerides, LDL-Cholesterol, HDL Cholesterol and total Cholesterol.

After 8 weeks of intervention there was significant reduction in case of skin-fold thickness, body fat percentage, triglycerides and total cholesterol in the intervention group. However control group showed significant rise in the body mass, skin fold thickness, body fat percentage, triglycerides, LDL-cholesterol and total cholesterol.

After 16 weeks of training, intervention group showed a significant gain in the body mass, BMI waist circumference, sum of skin fold thickness, body fat percentage, triglycerides, LDL-C HDL-C and total cholesterol, but in case of control group significant increase were seen in the body mass, BMI, waist circumference, sum of skin fold thickness, body fat percentage, triglycerides, LDL-C and total cholesterol, added with significant reduction in the HDL-C.

In case of fasting glucose there was no significant difference noticed at the baseline, after 8 weeks and after 16 weeks values in either group. Further it is noticed that fasting glucose lowered in the intervention group and rise in the control group after both 8 and 16 weeks when compared to baseline.

This study was conducted on 26 overweight (BMI>85th percentile) pubertal adolescents which consists of 14 males and 12 females, aged between 12 to 15 years. The subject were classified into 2 groups intervention group and control group, intervention group participated in a 30-min combination of strength training on weight machines and free weights addition 33 min of aerobic exercise on a cycle ergo meter 3 times a week. Also dietary guidelines were provided and the Control Group didn't participate in any exercise programme.

It is concluded that body composition and lipid profile were observed lowered in the IG at 8 and 16 wks of intervention while no changes were found in CG. The results showed that concurrent training and dietary intervention has positive effect on body composition, central adiposity, and lipid profile.

Joshua R.Smith, Ariel M.Johnson et al.(March 2016) in their study titled 'The Effect of Low Volume Interval Training on Resting Blood Pressure in Pre-hypertensive Subjects: A Preliminary Study' have found out that endurance training group and high intensity interval training group lowered mean arterial pressure after following 8 weeks of training, it also showed that C-reactive protein decreased significantly and VO2 max rise by 25% in both the group.

This study was conducted on twelve pre hypertensive subject with mean age of 33.3 years, this participants undergone 8 weeks of cycle ergo meter exercise training. Where Endurance training group exercised for 30 continuous minutes a day,4 times a week at 40% of VO2 reserve where as High intensity interval training exercised for 20 minutes a day,3 times a week with 1:1 work to rest ratio at 60% of peak power. From the study it is concluded that both type of training helped in lowering resting blood pressure,CRP and raising VO2 max.

Cris A.slentz, Brian D.Duscha et al.(2004) in their study titled 'Effects of the Amount of Exercise on Body Weight, Body Composition, and Measures of Central Obesity: Stride—A Randomized Controlled Study' have found out that there is sufficiently great, exposure relationship between extent of exercise and extent of weight and fat mass loss. When a comparison between four groups were made (High amount/vigorous intensity group, low amount/moderate intensity group, low amount/vigorous intensity group and control group) significant difference was seen, where there was decrease in body mass and fat mass of individuals in the high amount/high intensity group. Low amount/moderate intensity and low amount/vigorous intensity group showed significantly good improvement than the control group however there was not much difference between the two. Abdominal, minimal waist,and hip circumference lowered significantly in all the groups however there no much changes were found in control group.

In this study out of 302 participants, 182 successfully cleared inclusion criteria, however study was completed by 120 participants. Inclusion criteria decided for this study were, Age -40to65 years, who was sedentary (doing exercise less than one time a week), BMI between 25 to 35 with slight lipid abnormalities and also participants should not be diabetic and having hypertension. Subject were categorized into 3 groups who followed eight months of exercise routine. (1) high amount/vigorous intensity [32.0 km] of jogging per week at 65%-80% peak oxygen consumption (2) low amount/vigorous intensity [19.2 km] of jogging per week at 65%-80% peak oxygen consumption (3) low amount/moderate intensity [19.2 km] of walking per week at 40%-55% peak oxygen consumption. Participants were guided to follow same diet and maintain body weight.

From the study it can be concluded that when one does not follow calorie deficient diet, control group increase weight, both low amount exercise group lost weight and fat, however high amount exercise group lost more weight and fat compared to both low amount exercise group. This study suggests that when you don't follow calorie deficit diet. A larger amount of exercise is required for maintaining weight.

Dr. C.Sugumar, & Ms. G. Redempta Nishanthi in their study titled 'Effect Of Endurance Training On Body Fat And BMR Among College Women Players' has observed that after 8 weeks of endurance training, mean score of body fat of post test is 25.53 where as pre test mean score was 26.57 which shows endurance training has significantly lowered body fat. In case of BMR pre test mean score was 1183.7 and post test mean score is 1163.93 which also says that after eight weeks of endurance training significant decrease was seen in BMR, whereas if you also compared pre and post score of body fat (26.57 & 25.53) we can say that there is also significant reduction in body fat.

This study was conducted on randomly selected 10 college women players between the age group of 18 to 25 years. The participants were trained on endurance for eight weeks where first 4 weeks intensity were 65 % of VO₂ Max and a Rest 4 weeks intensity were 70% of VO₂ Max performed for 30 Minutes in a day, 6 times a week. Weight machine was used to measure body weight, BMI was measured by using BMI Formula, BMI = weight in kilograms/height in meter Square, Bioelectrical Impedance machine were used to find out body fat.

From the study it is concluded that significant decrease was seen in BMI, BMR, Body weight and Body fat after eight weeks of endurance training. The reduction in BMR was seen because there was decrease in body fat and BMI

Fredrick C. Hagerman, Seamus J. Walsh et.al (2000) in their study titled 'Effects of High-Intensity Resistance Training on Untrained Older Men. I. Strength, Cardiovascular, and Metabolic Responses' found out that strength training has shown significant improvements in the following components, 3 % reduction was seen in body fat %, strength improvement were seen in following limbs, leg extension increased by 50.4%, leg press gained by 72.3%, and half squat rise by 83.5%.

When checked on muscle fibers it was seen that IIB decrease and II A fibers increased, when you see cross sectional fiber type (I, IIA ,IIB) rise significantly. However there was no change noted on ECG and echocardiography data. Treadmill performance and VO₂ max increased significantly in 1 Repetition Maximum group, however Serum Lipids Rise but not sufficiently. There was no improvements were found in control group.

This study was conducted on 18 volunteered untrained men between the age groups of 60-75 years . The 18 members were further divided into two groups, nine members in each group. One group who had undergone resistance training (RT) and other group were who were untrained. RT group had undergone 16 weeks high intensity (85% to 90%) of 1 repetition maximum resistance training workout for 2 to 3 times a week. Exercise scheduled for 1 Rm were Leg press, leg extension and Half squat performed 6 to 8 repetition (3 sets) based on their 1 Rm, with 1-2 minutes recovery time in between.

From the study it shows Skeletal muscle in old non training person will gain strength, that will be accompanied by great increase in fiber size and capillary density. From the high intensity resistance training - Maximal working capacity, VO₂ max, and Serum lipid profile showed great improvements. However, no changes were noticed in HR max and Maximal response of arterial blood pressure. From the study we can definitely say that older adults are capable of managing high intensity exercise and will show intramuscular, cardiovascular and metabolic changes as observed in young subjects.

Massimo Venturelli & Emiliano Cè et.al (2015), In their study titled 'Effects of endurance, circuit, and relaxing training on cardiovascular risk factors in hypertensive elderly patients' have found out that resting blood pressure significantly decreased in all the groups by (-11%). After 12 weeks of endurance, circuit and relaxing training interventions, It was seen that after 12 weeks of endurance training blood cholesterol level decreased by (-18%), Vo₂ peak increased by (+8%), mechanical efficiency and quality of life increased by (+ 9%) and (+36%) respectively. After 12 weeks of circuit training it was observed that blood glucose level lowered by (-11%), VO₂ increased by (+7%) and quality of life score by (+35%). In case of relaxing training performed for 12 weeks, improvement was seen in blood pressure and also it was highlighted in quality of life which rose by (+42%).

This study was conducted on forty subject out of which 20 were males and 20 were females, in the age group of 65-74 years, these subjects were identified with grade 1 hypertension, there systolic pressure was in the range of 140-159 mmHg and diastolic pressure was in the range of 90-99 mmHg, The participants were further divided into four different groups with 10 members each in ET,CT,RT and control group which consisted of 5 males and 5 females in each group.

The workout routine for endurance training lasted for 60 minutes which included 20 minutes each of treadmill, elliptical and stepper ergometer at 70% of Maximal exercise capacity, this was performed 3 times a week.

The Workout routine for Circuit training lasted 60 minutes which included short duration of dynamic exercises on knee extension, knee flexion, calf rise, and leg press ergometers. The 70% of the mechanical power was the intensity set for circuit training. 60 seconds exercise with 60 rests in between was duration of a single bout.

The Relaxing training also lasted for 60 minutes, they participated in a relaxing training programme which consists of breathing exercises of 5 to 6 cycles/min and meditation practice.

From the study it is concluded that to reduce Cardiovascular diseases risk factors endurance training and circuit training is helpful because blood pressure decrease was accompanied by lowering in blood glucose and cholesterol levels, and increase in VO₂ peak, mechanical efficiency and quality of life . However relaxing training only lowered Blood pressure and increased quality of life, but this training is greatly helpful for the people who have difficulty in carrying out dynamic exercises.

Conclusion

From the different studies reviewed on different age groups, it may be said that in most of the studies it was found that endurance training had helped in lowering body mass and body fat percentage. However results were more positive for High Intensity Endurance Training, Circuit, Concurrent and Endurance training combined with Resistance Training in loosing body mass and fat percentage.

Contrary to the popular belief, one study pointed out that all age group individuals, including the elderly, can benefit greatly with High Intensity Training. The elderly population is able to adapt to this high intensity training as per the study (2015).

The studies also show that exercise in general enables in the lowering of LDL cholesterol and helps in increasing HDL cholesterol. Exercise also helps lower blood pressure among people. This can then be adapted to the Indian population where the World Health Organisation notes that India is fast becoming the capital for Lifestyle Illnesses. Further research in related topics in India is scarce and thus more studies are needed on the Indian population.

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