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Influence of Planned Exercise Programme on Muscle Mass of Elderly Aged Male

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Abstract

Muscle mass loss or Sarcopenia is an important clinical problem that impacts every older population. The aim of this study was to observe the influence of planned exercise program on muscle mass and related selected variables. Total 40 elderly aged males (Experimental = 20, Control = 20) with the age ranging between 60-70 years were taken as subject. Age, height and weight were taken as personal data. Strength, flexibility, endurance and agility considered as physical functional fitness, BMI, chest, biceps (Relaxed and flexed), gluteus, thigh and calf circumference considered as anthropometric variable and percentage of muscle mass and myoglobin concentration considered as muscle mass component. Subjects were involved in 12 weeks, 65 minutes session (Warm up = 10 min, Training session = 45 min, cooling down = 10 min), 4 days/week planned multicomponent training protocol to fulfil the purpose of research work. The analysis and interpretation of the data was done by calculating mean, SD and paired sample t test. Result revealed significant improvement in physical functioning variables while anthropometric and muscle mass component variables remained unchanged. From this study it was understood that only 12 weeks training programme was not sufficient to develop quantitative parameters like selected circumference, muscle mass and myoglobin concentration but it was sufficient to develop physical functioning parameters which may influence muscle health and healthy lifestyle.

Key words: Muscle mass, physical functioning, anthropometry, exercise.

INTRODUCTION

Sarcopenia or loss of muscle mass is an important clinical problem that more or less every individual has to go through during their old age. Till the age of 30 the muscles are in peak condition and grow larger and stronger, and then there is a gradual loss begins. From 30 to 80 years of age, there is a predicted 30% reduction in muscle mass and an approximately 20% reduce in the muscle circumference. This is due to a decline in number of muscle fibers and muscle size. This can input to mobility issues, osteoporosis, frailty, loss of physical function and independence. Muscle loss and others signs associated with aging which is inevitable. A person can lose as much as 3% to 5% of their muscle mass each decade after 30 years of age. Since muscle mass accounts for up to 60% of the body mass, loss of muscle reflects in an uneven balance, gait and overall ability to perform daily tasks. Sarcopenia is mostly seen in the physically inactive or sick people, but it is also evident in individuals who remain physically active throughout their lives. People who lead a sedentary lifestyle are most likely to experience pronounced sarcopenia as they age [1]. Being a couch potato is a sure way to suffer serious loss of muscle mass late in life. There is a lot of global interest in research for ways to slow down the aging process, especially in relation to loss of muscle mass and strength. Studies have shown that muscle function, rather than mass, is associated with a high mortality risk. Fortunately, sarcopenia is partly reversible with appropriate exercise and diet interventions [1]. The aim of this study was to observe the influence of planned exercise program on muscle mass and related selected anthropometric and physical functional fitness variables.

METHODOLOGY

A total number of 40 old aged Volunteered males (Experimental group n= 20, Control group n= 20) age ranging from 60-70 years from Cooch Behar district, West Bengal,India,in the year of 2018 were taken as subject. The subjects were assigned to the experimental & control group as per their desire. Before

the intervention a thorough medical check-up was held to ensure the subjects' health and fitness. All the subjects were informed in written the benefits and risk of the particular exercise programme. The written consent was obtained from each subject before the intervention programme. The study was duly approved and supervised by Departmental Research Committee and University Research committee. Age, height and weight were taken as Personal data. Strength, flexibility, endurance and agility were considered as Physical functional fitness. BMI, chest, biceps (Relaxed and flexed), gluteus, thigh and calf circumference were considered as Anthropometric variable and percentage of muscle mass and myoglobin concentration were considered as Muscle mass component. Standardized procedure of the tests was followed for collection of data which are as follows.

Personal data

Age, height, weight were measured as personal data. Age was calculated through the date of birth from any validated certificate, ID card or AADHAR card, height was measured with measuring tape with minimal dress, and calibrated weighing machine was used for recording weight respectively.

Physical functional fitness parameter

The tests which were used for collection of physical functional fitness parameters are as follows

Strength [Upper extremities]: Arm curl test

Subject sits on the chair, holding 8-pound dumbbell with their strong hand with the arm in a vertically down position beside the chair and curl the arm up through a full range of motion and returned to the starting position with fully bent and straightened the elbow. The total number of repetition between 30 seconds was the final score [2].

Strength [Lower extremities]: Chair Stand Test

The subject were asked to sit on the middle of the chair, with their feet shoulder width apart flat on the floor. The arms are to be crossed at the wrist and held close to the chest. From the sitting position with the command “start” the subject began completely up and back down for 30 seconds. The total number of chair stand repetition between 30 seconds was the final score [2].

Flexibility [Lower body]: Chair sit and reach test

The subject came and sat on the edge of the chair. Then they extended their one leg forward and heel placed on the floor with 90^0 angle of ankle. The other foot remained on the floor. With this position the subject was instructed to reached forward toward the toe by bending the hip, keep the knee and back straight, head up, extending their fingers as far as possible and holding this position for 2 seconds. The score was recorded nearest 1 cm as distance reached [2].

Aerobic Endurance: Two Minute Step in Place Test

At first a wall was marked at the level of midway between top of the hip bone. Then subjects were instructed to march in place for two minutes, lifting their knees to the marked level. Total number of right knee reached to the marked level was the score and finally recorded to the score sheet [2].

Agility: 8 Feet Up and Go Test

At first 8 feet path was marked on the natural grass surface and a back straight chair was placed just behind the starting line of that path. Then the subjects were instructed to move forward and sit back as fast as possible around the cone which was placed 8 feet distance from starting line. The subject had taken start fully seated position with hand resting on the knees feet flat on the floor. The time taken to cover the course was recorded nearest $1/100^{th}$ of a second. Best of two trials were recorded as final score [2].

Anthropometric variables

BMI was calculated by weight in kg/ Height in m^2. All the circumferences were measured through the anthropometric tape and followed the guidelines of ISAK and measured by ISAK level I course holder.

Muscle Mass Component

Muscle mass percentage

Percentage of muscle mass was detected through HBF-701 Karada scan body composition monitor.

Myoglobin concentration

Myoglobin concentration of the subject was measured in an eminent pathology centre with the help of expert pathologist by collecting blood sample.

Exercise protocol

The 20 subjects of experiment group (Ex. Gr) were engaged for 12 weeks of 65 minutes’ session (Warm up = 10 min, Training session = 45 min, cooling down = 10 min), 4 days/week in a planned multicomponent training protocol to fulfil the purpose of research work. These were continuous dynamic and interval training mode exercises which involving large muscle activities with an increasing level of difficulty and intensity. Subjects began with a short walk, alternated with various step exercises (e.g. both side and forward-backward step-up and down on the platform, upper limb lifts, wall push up, lower limb flexion and extension, knee both side and forward and backward direction, leg curls, bridge exercises), as a sort of brief and easy sequence to be repeated for a short time. To reach the goal the intensity, duration and number of exercises was progressively increased by the investigators. The subjects of control group (Con. Gr) followed their normal daily activity.

The analysis and interpretation of the data was done by calculated mean, SD and paired sample t test conducted on SPSS 21.

RESULT AND DISCUSSION

Table-1: data of Baseline characteristics of control and experimental group

Variables	Group	
	Control	Experimental
Personal Data		
Age (years)	63.05±2.31	62.60±2.56
Height (cm)	164.53±3.39	162.15±3.73
Weight (kg)	63.40±7.22	61.65±8.90
Functional fitness variables		
Strength [Upper extremities] (no.)	17.15±3.88	17.30±3.39
Strength [Lower extremities] (no.)	18.05±3.47	16.45±3.38
Flexibility [Upper Body] (cm)	1.34±5.19	0.48±7.73
Flexibility [Lower Body] (cm)	5.95±4.97	8.55±5.73
Aerobic Endurance (no.)	101.37±9.87	97.40±12.47
Agility (sec.)	6.03±0.82	6.20±0.76
Anthropometric variables		
BMI (kg/m^2)	23.42 ±2.48	23.47±3.36
Chest Circumference (cm)	92.21±5.38	91.55±5.99
Biceps Circumference (R) (cm)	26±1.63	25.85±2.38
Biceps Circumference (F) (cm)	28.33±1.54	28.03±2.19
Gluteus Circumference (cm)	89.75±5.47	89.70±5.41
Thigh Circumference (cm)	47.13±3.35	47.53±3.70
Calf Circumference (cm)	34.08±2.58	33.17±3.07
Muscle mass component		
Muscle mass percentage (%)	26.57±1.77	27.69±2.05
Myoglobin concentration (ng/ml)	73.04±15.11	67.79±14.09

Table-2: Paired sample t test between Pre and Post-test mean of all variables of control and experimental group

Variables	Group (df = 19)			
	Control		Experiment	
	Mean Diff	t	Mean Diff	t
Functional fitness variables				
Strength [Upper extremities] (no.)	0.15	0.58^{NS}	1.40	2.83*
Strength [Lower extremities] (no.)	0.73	1.90^{NS}	2.45	3.17**
Flexibility [Upper Body] (cm)	0.39	0.82^{NS}	0.86	1.90^{NS}
Flexibility [Lower Body] (cm)	0.74	1.53^{NS}	1.53	2.09*
Aerobic Endurance (no.)	1.01	1.48^{NS}	8.35	4.51 **
Agility (sec.)	0.11	1.85^{NS}	0.44	1.38^{NS}
Anthropometric variables				
BMI (kg/m^2)	0.01	0.33^{NS}	0.10	0.12^{NS}
Chest Circumference (cm)	0.05	0.80^{NS}	0.20	0.16^{NS}
Biceps Circumference (R) (cm)	0.03	0.36^{NS}	0.22	1.07^{NS}
Biceps Circumference (F) (cm)	0.10	0.16^{NS}	0.25	0.24^{NS}
Gluteus Circumference (cm)	0.02	0.58^{NS}	0.20	0.10^{NS}
Thigh Circumference (cm)	0.10	0.61^{NS}	0.33	0.48^{NS}
Calf Circumference (cm)	0.37	1.59^{NS}	0.13	0.39^{NS}
Muscle mass component				
Muscle mass percentage (%)	0.01	1.32^{NS}	0.11	0.81^{NS}
Myoglobin concentration (ng/ml)	0.28	0.02^{NS}	1.78	0.23^{NS}

Discussion on Functional fitness variable

Muscle strength is defined as the contraction force of muscle. The components of functional fitness depend on some degree of strength, since they all depend on some degree of muscle action. The higher contraction of muscle, higher force exerted and greater the strength. It is best measured by tests which require maximum effort on a given movement or position. Upper and lower body strength is the ability to exert maximum force against an object. Upper body strength is important to meet the everyday demands that are placed on the arms, shoulders and back. Lower body strength is important to fulfil the everyday demands which are placed on the trunk, hip and legs. Muscle strength changes with aging. From the middle of the 5^{th} decade of the life annual rates of loss of strength approximately 3% [3, 4]. In the present study the investigators found a significant increase in upper body and lower body strength among the subjects of experimental group following 12 weeks of planned exercise program. This was occurred due to activities selected for planned exercise programme which was beneficial to improve the upper body strength level. Izquierdo et al. reported that 16 weeks training program would lead to large gains in strength and power of the upper and lower extremity muscles [5]. Significant increment in strength of the old aged people was observed with intervention of exercise by Marques et al., though the intervention of exercise was different [6]. Carvalho et al., observed that 8 weeks of training program consisted of 2 sessions per week was significantly improved lower body strength in older women [7]. Significant improvement in strength of aged experimental subjects was observed by Blumenthal et al., Frontera et al., and Bandyopadhyay reported that physical activity could prevent or preserve the losses of strength in older adults [8-10]. Bandyopadhyay found 10 weeks multi-component exercise programme improved the grip strength of middle-aged women [10].

Flexibility depends partly on energy liberation processes and partly on the co-coordinative processes of the CNS [11]. Flexibility can be defined as the ability to execute movements with greater amplitude or range [12]. Upper body flexibility is maximum stretch ability around the shoulder joint and lower body flexibility is maximum stretch ability around the hip joint. In the present study only lower body flexibility was measured and significant improvement was observed among the subjects of experimental group following 12 of weeks of planned exercise program. Bandyopadhyay found significant improvement in flexibility among elderly population following 10 weeks of multi-component exercise programme [10].

Endurance activity needs aerobic work capacity of a person. Physiologists do agree that main limitation in most endurance performance is supply of oxygen to the working muscles. Good endurance capability requires other elements to develop up to an intended level and those elements are strength, coordination, speed of movements, reaction time and alertness [13]. In the present study the investigators found a significant increase in endurance among the subjects of experimental group following 12 weeks of planned exercise program. Finding have clearly indicated that the specific exercises were positively influenced the endurance ability of elderly adult men. Similar finding by other leading researcher such as Pillae, et al., Toraman et al., having with different frequency, intensity and duration of exercise are supporting the findings of the present study [14, 15]. Foster et al., conducted a moderate and a low intensity exercise program on 67-89 years old women for 10-week (five sessions/week) [13]. At the end of the training both the groups of low and high intensity had improved their endurance ability. Steinhaus et al., Blumenthal et al., were observed significant improvement in endurance ability even after 12-weeks endurance type exercise program performed by the elderly subjects volunteered in their studies. So even with low intensity aerobic exercise can improve the aerobic capacity of elderly population [16, 8].

Sheppard and young defined agility as a “rapid whole body movement with change of velocity or direction in response to a stimulus” [17]. Reports on effect of exercises on agility of elderly persons are limited in literature. However, in an exercise-training program on aged men (mean age = 50.33 yrs.), Mondal observed significant improvement in post-test. But in the present study no significant improvement in agility was found among the subjects of experimental group following 12 weeks of planned exercise programme [18]. The control group of the present study showed no significant change in any fitness variable during post-test.

Discussion on Anthropometric variables

BMI can be used to screen for weight categories that may lead to health problems but it is not diagnostic of the body fatness or health of an individual. BMI has been increased with lower quality of life as well as lower exercise tolerance. In the present study no significant improvement in BMI was observed in experimental group following 12 weeks of planned exercise program but their BMI was within the normal to overweight range. Result indicates that BMI slightly decreased in experimental group. Decrement in BMI of the old aged people were observed with intervention of exercise by Kulhe [19].

In the present study the researcher noticed that there was no significant change occurred in biceps circumference (Relaxed and Flexed condition), chest circumference for both experimental and control group following 12 weeks of planned exercise programme, though the repercussion was positive.

Gluteus circumference consists with three major muscles which are gluteus maximus, gluteus Medias and gluteus minimus in the buttock region. This circumference has both positive and negative influence for the movement-oriented activity along with the performance [20]. The present study showed that the gluteus circumference was slightly decrease in 12 weeks following planned exercise program for experimental group but the result was not statistically significant. In case of control group, no change was found in gluteus circumference before and after the interventional duration. Similar result has been mentioned by Siparsky, et al. considering the result of decreasing in gluteus circumference it is opined that excessive fat accumulation in the buttock region which was slightly reduced with that particular training period. [20]

Thigh circumference is an important and responsible component for movement-oriented activities with largely depends on hamstring and quadriceps muscles. In the present study it also clearly indicated that the thigh circumference is slightly decreased in experimental group, though the result was statistically not significant. This decrease in that particular region it is opined that excess fat accumulated which was slightly burned [21]. Though this result statistically not approved.

In daily life activity, physical activity and sports performances calf muscle plays a great role. Calf muscle pulls the heel up to allow forward movement when the people are walking, running and jumping [22]. In the present study the investigator found no significant changed occur among the subjects of experimental group following 12 weeks planned exercise program. In the present study it also clearly indicated that the calf circumference is slightly increase in experimental group whereas slightly decrease in control group, though the result was statistically not significant. So the researcher selected the training program and exercises protocol, but it is suggested by the researcher that the significant change may occur with higher intensity, volume and duration of training program.

The present study showed that no significant change was occurred in Muscle Mass percent in experimental group and control group following 12 weeks of planned exercise program, though both groups were below the normal level [3]. The result also clearly indicated that the Muscle Mass percent slightly increased in experimental group but no change found in control group. Though the change was not statistically significant. It was observed by the researchers that due to the intervention of exercise, fat mass of the subjects slightly reduced. With this reduction of fat mass, muscle mass % increased accordingly. The investigators selected the particular training program and exercises protocol which was very much relevant with the parameter but it is suggested that the significant change may occur with higher intensity, volume and duration of training program. So, comprehensive studies are required with a multidimensional approach to find out the appropriate result in this concern which will help to develop in that particular field.

Myoglobin was an iron containing protein in muscle, similar to haemoglobin which receives oxygen from the red blood cells and transport it to the mitochondria of muscles cells, where the oxygen is used in cellular respiration to produce energy [20]. The present study showed that no significant change was occurred in Myoglobin Concentration in experimental group and in control group following 12 weeks of planned exercise program, though both groups were within the normal level. The result also clearly indicated that the Myoglobin Concentration slightly increased in experimental group but no change was found in control group. Though there was no significant change occurred in anthropometric variable but significant improvement was noticed in more or less all selected physical fitness various which involve the selected anthropometric variable to perform.

CONCLUSION

From this study it was understood that only 12 weeks training programme was not sufficient to develop quantitative parameters like selected circumference, muscle mass and myoglobin concentration but it was sufficient to develop physical functioning parameters which may influence the muscle health and healthy lifestyle.

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