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Research Article

Comparison of Protein Supplementation and Resistance Training Exercise on Lower Limbs Muscles Strength and Range of Motion of Elderly

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Abstract

Background and introduction: Advancing age is associated with reduced muscle protein synthesis, altered expression of and chemical modifications to muscle proteins, reduced muscle strength, and muscle power. These age-related impairments in the quantity and quality of contractile proteins contribute to physical disability and frailty, loss of independent function, the risk of falling and fractures and escalating health care costs. The aim of the study was to find out whether the combined effect of essential amino acid supplementation and resistance training in lower limbs musculoskeletal system of elderly people can strengthen the muscles activity and to improve their quality of lifestyle.

Methods: Sixty male elderly subjects at the age between sixty-five to eighty years were screened for the study randomly from Geriatrics clinics. The study design was clinical trial Experimental Research design. Elderly people having no history of recent trauma to lower extremity were selected from the population. Individuals having hypertension, diabetes mellitus, neuromuscular disease, uncooperative and psychologically ill patients were excluded from the study. The subjects were divided into two groups: Group I received essential amino acids in the form of capsules for thirty days twice per day. Group II had the same but they were also trained for lower limb strengthening exercises. These exercises included mainly the strengthening of extensor group of muscles- glutei, quadriceps and planter flexors by bridging, quadriceps isometrics and toe standing respectively. The range of motion of hip, knee and ankle joints and hip extensors, knee extensors and ankle planter flexors muscles strength were measured by manual muscle testing. This measurement was done for dominant lower extremity before and after giving the supplementation to observe its effect on musculoskeletal system of the elderly. Diet and activity were not otherwise modified. Before starting, subjects were counselled to maintain their usual dietary intake and physical activity.

Results: No significant increase was observed in range of motion of hip, knee and ankle joints after amino acid supplementation along with resistance exercise (p.0.05). But resistance training raised the muscle power significantly in group II who received amino acid supplementation too. We found that muscle power in Hip extensors, knee extensors and planter flexors were increased significantly at $p<0.001$, $p<0.01$ and $p<0.05$ respectively.

Discussion and conclusion: Resistance training raised the muscle power of lower limbs significantly when essential amino acids were administered along with them. Non-exercise group who received only amino acid supplementation did not show significant rise in muscle power. But no significant differences were found in hip, knee and ankle range of motions in both the groups. We concluded that the resistance strengthening exercises for lower extremities should be recommended for weak muscles in elderly population along with essential amino acids supplementation to maintain their active lifestyle by reducing the chances of falls or injuries.

Keywords: Essential amino acids; Musculoskeletal system; Range of motion; Resistance training exercise; elderly

Introduction

In recent years, considerable scientific interest has been devoted to amino acid supplementation and its role in regulating skeletal muscle metabolism in health, ageing and disease. It is well established that ageing diminishes muscle strength and size, contributing to a number of serious health problems such as an increased risk of falls and fractures. Falls and unsteadiness are very common in older people. Muscle weakness is a risk factor for falls in community-dwelling elderly individuals, for evidence that strength training reduces falls, and for pathophysiological evidence from patients with neuromuscular disease that supports the link between muscle weakness and falls concluded that supplementation of the diet with essential amino acids+arginine improves lean body mass, strength and physical function compared to the base line values in glucose in tolerant elderly individuals [1]. It was observed that an oral amino acids supplementation improved ambulatory capacity, maximal isometric muscle strength and myocardial ability to match an acute overload in elderly subjects without affecting the main metabolic parameters. These functional gains may translate into increased perceived walking capacity [2]. Authors found that the protein supplement resulted in greater increases in total body mass, fat-free mass, thigh mass, muscle strength, serum IGF-1, IGF-1 mRNA, MHC I and IIa expression, and myofibrillar protein. Ten-weeks of resistance training with 20 g protein and amino acids ingested 1 h before and after exercise were more effective than carbohydrate placebo in up- regulating markers of muscle protein synthesis and anabolism along with subsequent improvements in muscle performance [3]. It was stated that 90 days of beta arginine supplementation increased physical working capacity in elderly men and women. These findings are clinically significant, as a decrease in functional capacity to perform daily living tasks has been associated with an increase in mortality, primarily due to increased risk of falls [4]. Authors concluded that high-intensity resistance exercise training was a feasible and effective means of counteracting muscle weakness and physical frailty in very elderly people. In contrast, multinutrient supplementation without concomitant exercise does not reduce muscle weakness or physical frailty [5].

Researcher observed that the regular performance of resistance exercises and the habitual ingestion of adequate amounts of dietary protein from high-quality sources were two important ways for older persons to slow the progression of and treat sarcopenia, the age-related loss of skeletal muscle mass and function. Resistance training can help older people gain muscle strength, hypertrophy muscle, and increase whole body fat-free mass. It can also help frail elderly people improve balance and physical functioning capabilities. In adequate protein

intake will cause adverse metabolic and physiological accommodation responses that include the loss of fat-free mass and muscle strength and size. Findings from controlled feeding studies showed that older persons retain the capacity to metabolically adjust to lower protein intakes by increasing the efficiency of nitrogen retention and amino acid utilization [6]. Resistance training in older men significantly increased muscular strength and added muscle mass with no additional benefits from creatine and/or protein supplementation [7]. They concluded in their studies that the effects of the incorporation of exercise [endurance and resistive] to nutritional interventions and the nutritional timing relative to the exercise bout, the combination of hormonal and nutritional interventions, and the optimal interactions therein, in order to better understand and positively impact muscle mass and strength in older adults [8].

Williams and Jones found that Regular glucose/amino acid supplementation immediately after resistance exercise is unlikely to enhance the gain in muscle strength brought about by resistance training [9]. The advancement of age is associated with reduced skeletal muscle protein synthesis, altered expression of and chemical modifications to muscle proteins, reduced muscle strength, muscle strength per unit muscle mass and muscle power. These age-associated impairments in the quantity and quality of contractile protein contribute to physical disability and frailty, a loss of independent function, the risk of falling and fractures, and escalating health-care costs. Dietary amino acid supplementation may also improve muscle protein balance in the elderly. Several potential cellular mechanisms for the loss of muscle protein and resistance exercise-induced improvement in muscle quantity and quality in elderly adults are reviewed [10]. The aim of the study was to find out could the combined effect of essential amino acid supplementation and resistance training in lower limbs musculoskeletal system of elderly people strengthen the muscles activity and to improve their quality of lifestyle.

Materials and Methods

Subjects

Sixty male elderly subjects at the age between sixty-five to eight were screened for the study randomly from Geriatrics clinics. The study design was clinical trial Experimental Research design. Elderly people aged 65 -80 years and having no history of recent trauma to lower extremity was selected from the population. Individuals having hypertension, diabetes mellitus, neuromuscular disease, uncooperative and psychologically ill patients were excluded from the study.

Procedure

The subjects were divided into two groups: Group I had received essential amino acids in the form of capsules for thirty days twice per day. Group II had the same but the individuals were also trained for lower limb strengthening exercises. These exercises included mainly the strengthening of extensor group of muscles- glutei, quadriceps and planter flexors by bridging, quadriceps isometrics and toe standing respectively. The range of motion of hip, knee and ankle joints and hip extensors, knee extensors and ankle planter flexors muscles strength were measured by manual muscle testing. These measurements were done for dominant lower extremity before and after giving the amino acids supplementation to observe its effect on musculoskeletal system of the elderly. Diet and activity were not otherwise modified. Before starting, subjects were counselled to maintain their usual dietary intake and physical activity.

Results

The Table 1 showed that no significant increase was observed in range of motion of hip, knee and ankle joints after amino acid supplementation along with resistance exercise. The Table 2 depicted that resistance training raised the muscle power significantly in group II who received amino acid supplementation too. We found that muscle power in Hip extensors, knee extensors and planter flexors were increased significantly at $p<0.001$, $p<0.01$ and $p<0.05$ respectively.

Discussion and Conclusion

The results indicated that the only amino acid supplementation have little effect on lower limbs muscle power of the elderly people in Group I but when amino acids supplementation was given in combination with strengthening exercises of lower limb muscles in elderly people in Group II showed more beneficial effects in Figure 1. Advancing age is associated with reduced muscle protein synthesis, altered expression of and chemical modifications to muscle proteins, reduced muscle strength, and muscle power. These age-related impairments in the quantity and quality of contractile proteins contribute to physical disability and frailty, loss of independent function, the risk of falling and fractures and escalating healthcare costs. Our results found that strengthening exercise may have a great impact in reducing the muscle illness when administered with amino acids mixture in elderly population. Exercise and amino acid intake have additive effects on muscle protein synthesis. We proposed that over a more prolonged time, exercise will amplify the beneficial effects of amino acids supplementation on lean body mass, strength and muscle function in elderly population.

Physical work capacity, a measure of muscular endurance and aerobic power was tested at the beginning and end of the trial after consumption of beta-alanine, 800 mg three times per day, or placebo for 90 days. Most (67%) of the people in the beta-alanine group experienced improvements in their physical working capacity between the beginning and end of the study and muscle test measurements increased by an average of 28.6% in this group but there was no change in the placebo group, as stated by authors [11]. Evans studied that resistance exercise can result in a substantial increase in muscle size and strength in elderly people. However, it was clear that when the intensity of the exercise was low, only modest increase in strength were achieved

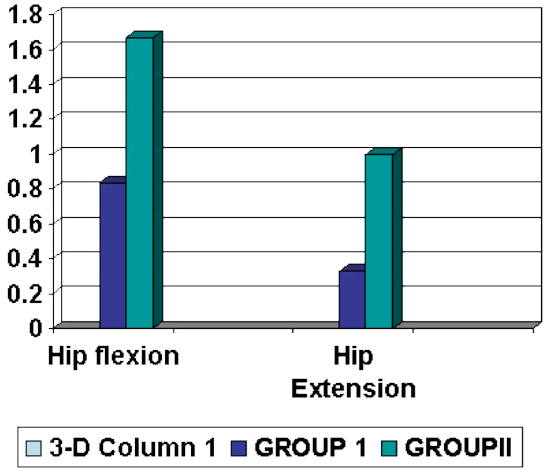

Figure 1: Comparison of hip flexion and hip extension in degree between Gr I and Gr II of elderly individuals.

S No	Variables	Gr I	Gr II	S.E Value	t Value	p-Value
1	Hip flexion	0.83	1.67	1.34	0.62	p>0.05 NS
2	Hip extension	0.33	1.0	0.55	1.10	p>0.05 NS
3	Knee flexion	0.50	0.90	0.50	1.0	p>0.05 NS
4	Knee extension	0.50	0.70	0.50	1.0	p>0.05 NS
5	Dorsi flexion of Ankle	1.33	1.80	1.56	1.81	p>0.05 NS
6	Planter flexion of Ankle	11.0	11.50	1.55	1.88	p>0.05 NS

NS: Not significant

Table 1: Range of Motion of Hip joint, Knee Joint and Ankle joint of Gr I and Gr II after amino acid supplementation.

S No	Variables	Gr I	Gr II	S.E	t- Value	p-Value
1	Hip extensors	0.58	0.83	1.6	5.0	p<0.001**
2	Knee extensors	0.41	0.67	0.21	3.16	p<0.01*
3	Ankle planter flexors	1.00	1.50	1.22	12.2	p<0.05*

*: Significant; **: Highly significant

Table 2: Muscle power Grade Hip extensors, Knee extensors and Ankle planter flexors of Gr I and Gr II after amino acid supplementation.

by elderly subjects. A number of studies had demonstrated that, given an adequate training stimulus, older men and women showed similar or greater strength gains compared to young individuals as a result of resistance training [12].

Resistance training raised the muscle power of lower limbs significantly when essential amino acids were administered along with them. Non-exercise group who received only amino acid supplementation did not show significant rise in muscle power. But no significant differences were found in hip, knee and ankle range of motions in this group. We concluded that the resistance strengthening exercises for lower extremities should be recommended for weak muscles in elderly population along with essential amino acids supplementation to maintain their active lifestyle by reducing the chances of falls or injuries.

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