

The effects of combined exercise intervention on body composition and physical fitness in elderly females at a nursing home

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The purpose of this study was to analyze the effects of practicable combined exercise program in daily lives on body composition and physical fitness in elderly females. A total of 34, old female adults and all over 75 yr of age participated in this study. Collected data were statistically analyzed by SPSS PC win 12.0/pc for by paired simple T-test. Alpha was set at .05. The results of the study showed statistical significance in weight ($P < 0.001$), body fat mass ($P < 0.001$), waist-hip ratio ($P < 0.001$), basal metabolic rate ($P < 0.05$), body mass index ($P < 0.001$), standing-up

and down on a chair ($P < 0.001$) and showed not statistically significant in one leg standing with eyes closed, back hand holding, grip strength and emotional state. But it was found that there was significant change in a mean value between pre and post test.

Keywords: Combined exercise, Body composition, Physical fitness, Elderly females

INTRODUCTION

Due to enhancement of living standard, improvement of nutrition and environmental health and acceleration of medical technology, the average life expectancy in Korea has become extended; it was 52.4 yr in 1960, 75.9 yr in 2000 and 77.5 yr in 2003 (Park, 2003). It became 79.1 yr in 2006, which exceeded the average life expectancy of 78.9 yr in the OECD nations. This shows a rise in the proportion of aging population. Especially, that for the female is longer by 7 yr than that for the male, which trend is expected to be continued (the Ministry of Health & Welfare, 2008). Also, according to the census in 2000, the ratio of the population over 65 yr was 7.33% in comparison to the total population and so we entered the Aging Society defined by UN. The population of the aged in 2003 was 3.97 million (3,970,000), which was equivalent to 8.3% of the total population. In 2005, that was 4.38 million (4,380,000), which was 9.1%. In 2010, it reached 11% and it will be around 14.4% in 2018, which makes us expect to enter the

Aged Society. Besides, as it is expected to occupy around 20%, or around 10 million (10,000,000) in 2026, we expect to enter the Post Aged Society. It took France 155 yr to enter the Aged Society from the Aging Society (1865-1980), Sweden 85 yr (1980-1995), and Japan 25 yr (1970-1995). It is predicted to take Korea only 18 yr (2000-2018), from which we can find out easily that we experienced even faster population ageing than the other countries (Heo, 2002).

Thus, the extension of average life expectancy and rapid increase of ageing population cause to aggravate economic difficulties (44.6%) and health problems (30.1%), both of which are the biggest difficulties to old people. According to the Ministry of Health, Welfare & Family, the medical expense per capita in 2010 amounted to 810 thousand (810,000) Korean Won, increase of 11.5% over last year. That for each of the old people over 65 yr was 2,494 thousand (2,494,000) Korean Won, which was 3.1 times of that per capita. The total amount of costs of health care for old people was reported to be 12 trillion and 39.1 billion (12,039,100,000,000)

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Korean Won, increase of 14.8% over last year. Through this, we can find out that deterioration of the body strength and health problems caused by weakness of body functions and diseases for old people are very serious (Lee, 2011). Especially, the prevalence rate of chronic diseases among old people was shown to be 90.9% of the total ageing population. Among them, only 17% had just one kind of chronic disease, while about 75% were suffering from combined diseases with more than two kinds of diseases, which indicates that the medical health problem among the elderly is in serious condition).

In addition, due to the extension of average life expectancy and rapid increase of ageing population, quality of life in good health is recognized as important as longevity. Even though elderly people's independence in their social and family lives is recognized very important at the level of the policy for national and social health and welfare, in reality, their independent life and functional activities in daily lives are increasingly deteriorated. Under these circumstances, it is required to keep basic and basal body strength in order to live a healthy and independent life without relying on others (Lee et al., 1999). Keeping healthy body strength in order for elderly people to live their daily lives is very meaningful in the discussion of quality of life, that is, how to live meaningful lives (Lee, 2003b). Also, health and body strength of elderly people are very important elements in deciding their quality of life in connection with their performance of body activities in daily lives (Stewart and King, 1991) and certain levels of body strength are required to live their own daily lives (Borchelt et al., 1992; Williams, 1986; Young, 2007). Eventually, about exercises, as the most fundamental means for elderly people to keep quality of life, it is reported by western countries that consistent participation in exercises results in huge effectiveness in terms of social and medical expenses (Kim, 2005b), including reduction in the health and social expenses used by the government, growth of production, and reformation of negative attitude (WHO, 2007). But many elderly people tend not to move much due to weakness of their body functions (Lee, 1996). It is also reported that more than 40% of the females over 65 yr didn't participate in leisure activities and then old people's energy consumption related to exercises was remarkably lower than that for younger people (Kim, 2004). Therefore, this study aims to provide basic data to develop a practicable exercise program for elderly people by examining changes in the body composition and physical strength through 12 weeks' practice of a combined exercise program targeted to elderly females.

MATERIALS AND METHODS

Target

This research was conducted targeted the following: firstly, the elderly females over 75 yr at the nursing home in B-city were selected, who voluntarily accepted to participate, didn't have any mental diseases, and could communicate without any visual and hearing impairments. Secondly, all of the 60 ladies who met those requirements participated in 12 weeks' combined exercise program with sincerity. Thirdly, the final 34 old ladies among those were selected as the targeted for analysis who completed the tests for both of body composition and body strength. But the control group wasn't able to be set at the beginning because all of the old ladies there wanted to participate in this program. The old ladies, who participated in it but couldn't take before and after tests for it because of their personal reasons like hospitalization, were excluded from the analysis. Refer to Table 1 for physical traits for the targeted.

Measured items and their methods

In order to identify the elderly people's body composition, body fat (kg), waist-hip ratio (%), basal metabolic rate (kcal), body mass index (BMI) (kg/m²) and skeletal muscle rate were measured using InBody 230 (Biospace, Seoul, Korea). For their body strength, squat to stand (number), stand on one leg with eyes closed (sec), hold hands at the back and gripping power test were performed. Based on the performance by the arm and leg which are mainly used, one time's measurement was used. Combined exercises with more than two exercises mean the exercises performed in parallel by resistance training as an anaerobic exercise and an aerobic exercise. For the low intense combined exercise program in this study, the goals for exercise and functional improvement were set divided into the each month of the first, second and third month. And the composition of the whole program was set based on each step. Among the program, the stretching exercise was performed by part of the body. Sitting dance was performed to move or shake all of the body by listening to the favorite pop music. Weight exercise using their own weight was performed by sustaining the

Table 1. Physical trait for the targeted

N=34	Age	Height (cm)	Weight (kg)	Skeletal muscle mass (kg)	Body fat (kg)	BMR (kcal)	BMI (kg/m ²)
M	81.74	146.03	50.09	16.70	17.87	1,057.26	23.48
SD	5.96	7.05	8.48	2.73	6.24	92.90	3.56

body with hands on the floor and lifting each leg in turn by maintaining it in a stationary position for a certain period of time. Also, the exercise using a towel was performed by holding the ends of the towel with two hands, putting it underneath one leg and pushing the leg toward it and at the same time pulling the arms up. It was performed also to lift a water bottle, an alternative to a dumbbell, up and down repeatedly. Refer to Table 2 below for the whole program.

Data analysis

In this study, mean value and standard deviation were calculated by using Statistical Package for the Social Sciences (SPSS) for Windows (SPSS Inc., Chicago, IL, USA) 12.0 version. Paired simple T-test was performed to verify the difference between before and after performing the combined exercise program. The statistic level of significance was set to be $P < 0.05$.

RESULTS

Changes in body composition

Changes in body composition are as follows: Weight was changed from the average of 50.09 ± 8.48 kg to 49.01 ± 8.30 kg, which showed significant reduction of ($P < 0.001$). Body fat rate was changed from the average of 17.87 ± 6.24 kg to 17.19 ± 6.17 kg, which proved significant reduction of ($P < 0.01$) as well. Waist-hip ratio decreased significantly from the average of $0.89 \pm 0.05\%$ to $0.87 \pm 0.05\%$ ($P < 0.001$). Basal metabolic rate increased significantly from the average of $1,057.26 \pm 92.90$ kcal to $1,066.18 \pm 98.61$ kcal ($P < 0.05$). Body mass index decreased significantly from the average of 23.49 ± 3.56 kg/m² to 22.95 ± 3.50 kg/m² ($P < 0.001$). Skeletal muscle rate showed significant difference from 16.70 ± 2.73 kg to 16.42 ± 2.60 kg ($P < 0.05$). Refer to Table 3 for more details.

Table 2. Exercise programming

Goals of exercise		Adaptation and learning correct exercise posture					
Exercise prescription	Stage	Warming up	Flexibility	Aerobic	Weight training	Cooling down	Meditation
Mode	Beginner's	Tapping and massaging the whole body	Stretching (8-10 sec per stretching motion)	Sitting dance (with lively songs on)	Exercise using own weight	Tapping the whole body and stretching	Breathing with correct posture
Intensity		RPE 10-11	RPE 10-11	RPE 10-11	PRE 10-11	RPE 10-11	Deep breath
Frequency		3 times per week					
Duration		15 min	10 min	10 min	10 min	10 min	5 min
Period		For 4 weeks of the first month					
Goals of exercise		Adaptation and learning correct exercise posture					
Exercise prescription	Stage	Warming up	Flexibility	Aerobic	Weight training	Cooling down	Meditation
Mode	Basic	Tapping and massaging the whole body	Stretching(10-12 sec per stretching)	Sitting dance (with lively songs on)	Exercise using own weigh (5 sec per one posture)	Tapping the whole body and stretching	Breathing with correct posture
Intensity		RPE 10-11	RPE 10-11	RPE 10-11	RPE 10-11	RPE 10-11	RPE 10-11
Frequency		3 times per week					
Duration		10 min	10 min	15 min	10 min	10 min	5 min
Period		For 4 weeks of the second month					
Goals of exercise		Adaptation and learning correct exercise posture					
Exercise prescription	Stage	Warming up	Flexibility	Aerobic	Weight training	Cooling down	Meditation
Mode	Basic	Tapping and massaging the whole body	Stretching (15 sec per stretching)	Sitting dance (with lively songs on)	Exercise using apparatus (water bottle or towel)	Tapping the whole body and stretching	Breathing with correct posture
Intensity		RPE 10-11	RPE 10-11	RPE 10-11	RPE 10-11	RPE 10-11	RPE 10-11
Frequency		3 times per week					
Duration		10 min	10 min	15 min	10 min	10 min	5 min
Period		For 4 weeks of the third month					

Table 3. Changes in body composition before and after exercise program

Classification (n=34)	M±SD	t	P
Weight (kg)-before	50.09±8.48	4.213	0.000
Weight (kg)-after	49.01±8.30		
Body fat (kg)-before	17.87±6.24	2.896	0.007
Body fat (kg)-after	17.19±6.17		
Waist-hip ratio (%) -before	0.89±0.05	4.399	0.000
Waist-hip ratio (%) -after	0.87±0.05		
BMR (kcal)-before	1,057.26±92.90	2.294	0.028
BMR (kcal)-after	1,066.18±98.61		
BMI (kg/m ²)-before	23.49±3.56	4.414	0.000
BMI (kg/m ²)-after	22.95±3.50		
Skeletal muscle rate (kg)-before	16.70±2.73	2.635	0.013
Skeletal muscle rate (kg)-after	16.42±2.60		

Changes in body strength

Changes in body strength of the targeted ladies before and after the combined exercise program are as follows: For squat to stand, they performed 10.53 ± 3.60 times instead of the average of 7.94 ± 3.40 times, which showed a statistically significant increase of ($P < 0.001$). For the exercise to stand on one leg with eyes closed, they sustained for 2.45 ± 2.28 sec instead of the average of 1.65 ± 1.30 sec, which didn't show any statistically significant difference. For the holding hands at the back, they performed -23.00 ± 15.47 cm from the average of -25.01 ± 17.03 cm, which didn't either show any statistically significant difference. For the gripping power test, they performed 13.80 ± 5.15 kg instead of the average of 13.67 ± 5.78 kg, which didn't either show any statistically significant difference. Refer to Table 4 for more details.

DISCUSSION

It is aging that all of the people share and experience from birth to death, which is connected to quality of life. And it has been rising as one of the most important issues in our current circumstances where life expectancy is extended and population of elderly people is rapidly increasing. The following two points are reported (Kim and Park, 2005; Lee, 2003b): As we are getting older, our body strength becomes weaker and eventually at the age of 75 as a kind of base point, it is deteriorated so rapidly. On the other hand, some exercise can help prevent weakening of physical strength due to aging to a considerable degree (Kim and Park, 2005; Lee, 2003b). Also, it is reported when we are doing exercises or participating in body activities regularly in our daily lives, life satisfaction could be improved and, at the same time, body strength would be increased (Lee, 2003a; Morgan et al., 1991). It

Table 4. Changes in physical strength pre and post exercise program

Elements	Exercise (n=34)	M±SD	t	P
Strength of lower extremity	Squat to stand-pre	7.94±3.40	-5.003	0.000
	Squat to stand-post	10.53±3.60		
Balance	Stand on one leg with eyes closed-pre	1.65±1.30	-1.900	0.066
	Stand on one leg with eyes closed-post	2.45±2.28		
Flexibility	Holding hands at the back (cm)-pre	-25.01±17.03	-1.018	0.316
	Holding hands at the back (cm)-post	-23.00±15.47		
Strength of upper extremity	Grip strength (kg)-pre	13.67±5.78	-0.284	0.778
	Grip strength (kg)-post	13.80±5.15		

is reported by many researchers that, through regular exercises with a long-term, body fat rate for old people is reduced and their skeletal muscles and basal metabolic rates are increased as well (Kim, 2005a, 2008a, 2008b; Park, 2005). Even in this study, after carrying out a light combined exercise program for 12 weeks, weight, waist-hip ratio, basal metabolic rate, BMI, etc. showed statistically significant decrease or increase, which tells us that when old ladies do exercises consistently, their body composition would be changed. But this exercise program was so targeted to the old ladies that it was required to be performed sitting on the floor (or on the chairs) for the sake of security and smooth progression. Accordingly, there wasn't any single chance to perform it with a standing position for 12 weeks. In case of the skeletal muscle rate, there was a little bit reduction after performing the muscle exercises as they were done by using only a towel and water bottle, weights of which had limitation. This should be considered to be compensated at further studies in the future. Exercises are deeply related to independency of elderly people's activities in their daily lives, and the level of body strength and social activities is reported to have great influence on subjective happiness, maintenance and promotion of health, and extension of active life (Morgan, 1991). It is also reported when body activities are increased, each element for body strength is increased as well and when they are active, they can improve weakened elements caused by aging (Han, 2002; Kang, 2007; Kim, 2008b, Seo, 2004). Also, in this study, after performing the 12 weeks' combined exercise program, the number of performing squat to stand was significantly increased in statistics. At the comparison of the mean values for standing on one leg with eyes closed, holding hands at the back, and gripping power test, all of them were increased even though they were not so significantly different from the previous ones in statistics. Still, this can be regarded as one of great study

results to emphasize once more the importance of regular body activities for old ladies. Even though this kind of importance for body activities has been well-known, the actual practice rate of intensive body activities by Korean old people in sixties is reported to be 18.2% for the males and 7.3% for the females, respectively. Also, the one for males over 70 yr was 7.9% and the one for females over 70 yr was 3.3%. Also, the actual practice rate of moderate body activities by males in sixties is reported to be 12.2% and the one for females in the same age group is 11.7% (the Ministry of Health & Welfare, 2008). In the case of males over 70 yr, that is reported to be 9.3% and that for females in the same age group to be 3.2% (the Ministry of Health & Welfare, 2008). These figures show that the level of physical activities among Korean elderly people, especially old ladies' body is too low. Above 95% of old ladies over 70 yr don't work out regularly, which seems to be very serious. The reasons for this kind of lower level of body activities are as follows: The space for elderly people to exercise in convenient facilities is not sufficient. The facilities or environments equipped with technical exercise programs are insufficient. Even though there are spaces where other comforts are provided, they are only allowed to a small number of people. Especially, the elderly people in disadvantaged group are mostly alienated from these facilities. Under this kind of circumstance, doing regular body activities is regarded to be very difficult (Bae, 2004). In that sense, this combined exercise program may be meaningful with its strong point that anyone can practice it in their daily lives without difficulties and they can do it with others or instruct each other.

Having healthy body strength is very meaningful for elderly people with relation to quality of life or how to live their lives meaningfully (Lee, 2003b). Weakening of physical functions caused by aging, or decrease in body strength can be prevented and even improved through regular and active body activities. The basic direction and aims for Health Plan 2010 by the Ministry of Health & Welfare in order to solve the problem of the aged are to extend healthy span. Its major tasks for the area of exercise are reduction of dangerous factors of chronic diseases and improvement of healthy body strength through regular exercise and body activities. By increasing the actual practice rate for exercise to more than three days per week and above 20 min of maximum exercise intensity per day, self-realization and self-recognition about health should be raised. Like this, through promotional education on proper function of body activities and also development and supply of proper exercise programs, the exercise for elderly people should be activated (the Ministry of Health & Wel-

fare, 2005; Lee, 2006). First of all, the programs which are practicable for elderly people who don't want to move or exercise should be developed to increase practice rate.

CONCLUSIONS

This study aims to provide the basic data to develop a practicable exercise program for elderly people by performing the combined exercise program and testing body composition and body strength. The result of analysis obtained through Paired simple T-test was as follows: Firstly, body composition such as body fat rate, waist-hip ratio, basal metabolic rate, and BMI showed a significant change. Secondly, body strength was significantly changed only in strength of lower extremities. Senses of balance and flexibility and body strength in strength of upper extremities didn't show any significant change, but all of them showed improvement on average.

To sum up, it is found out this combined exercise program is composed to allow old people, especially old ladies, to practice with ease in their daily lives while other existing ones are not easy for old ladies to practice due to their problems in approaches and difficulties. Also, it is found to have great effect on regular body activities. Therefore, it is judged to increase the practice rate for old people's body activities. On the other hand, given that this combined exercise program requires longer time to change body strength, the future studies should develop programs to increase body strength more and adjust time for practicing periods from the performance by sitting position to that by standing one.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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