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Sarcopenia and Age-Related Changes in Body Composition in Korean Older Persons

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We examined the prevalence of sarcopenia and age-related changes in body composition in Korean older persons. Community dwelling 77 men and 65 women (60~88 yr) were recruited for this study. Fat-free mass and the percent body fat were determined using bioelectrical impedance analysis. Isometric grip strength was measurement using grip strength dynamometer. Serum levels of fasting glucose, total cholesterol, HDL-cholesterol, and triglyceride were assayed. The prevalence of sarcopenia was found to increase with aging (men in their sixties 82.6%, seventies 96.6% and eighties 100%, and women in their sixties 47.4%, seventies 63%). In both gender groups, handgrip strength was inversely correlated with age and positively correlated with height, lean mass, and fat free mass. Better handgrip strength was related with higher weight in the men and with lower heart rate in the women. Fat free mass, age, and gender were found to be independent factors significantly associated with handgrip strength in the multivariate analysis. In summary, results of the present study suggest that handgrip strength is well associated with age, gender, and fat free mass and the prevalence of sarcopenia is increased with age and is exceeded by 40% among Korean persons older than 60 years.

Key Words: Sarcopenia, Aging, Body Composition

INTRODUCTION

As human beings grow older, their muscle mass decreases and fat mass increases (Baumgartner et al., 1998). Sarcopenia, defined as the progressive loss of muscle mass and strength that occur with advancing age, is an important cause of functional impairment, physical disability, and loss of independence (Morley et al., 2001; Janssen et al., 2002; Villareal et al., 2004), leading to significant social and economic public health problems. The decrease in muscle mass is the main reason for the decline in muscle strength during aging (Frontera et al., 1991). Handgrip strength correlates with elbow flexion strength, knee extension strength, and trunk extension strength and thus gives an approximation of total body muscle strength (Rantanen et al., 1994). It has been shown that handgrip strength is a robust predictor of mortality and disability (Rantanen et al., 1999). The age-related muscle mass and strength is mainly caused by atrophy of muscle fibers, especially the type IIa fibers (Morley et al., 2001).

Many factors are thought to contribute to sarcopenia. These include loss of α-motor neurons (Brown, 1972), lower levels of steroid hormones (Morley et al., 1997; Labrie et al., 1998), a reduction in dietary protein (Young, 1990), and a decreased level of physical activity (Westerterp, 2000). There is also evidence that catabolic stimuli to muscle increase with advancing age. In particular, increased production of catabolic cytokines such as interleukin-6 is thought to play a role in sarcopenia (Roubenoff et al., 1998).

Several studies have reported that sarcopenia occurs more than 40% of the elderly over the age of 80 years and 10~25% under the age of 70 years (Roubenoff, 2000; Marcell, 2003), depending on the definition and measurement of muscle mass. Although several studies have repor-

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ted associations of age-related muscle mass and strength, leading to functional impairment as well as physical disability in the older U.S. populations (Baumgartner et al., 1998; Janssen et al., 2002), little is available in the older Korean populations.

Because of the limited information available on the changes in body composition, including age-related loss of muscle mass in Korean older persons, the purpose of the present study was to examine the prevalence of sarcopenia and age-related changes in body composition in Korean older persons.

MATERIALS AND METHODS

Community dwelling 77 men and 65 women (60~88 yr) were recruited for this study. We took anthropometric measurements of each subject wearing light clothing and no shoes. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, using an automatic height-weight scale. Body mass index (BMI) (kg/m^2) was calculated as weight divided by height squared. Waist circumference was measured at the midpoint between the lower border of the rib cage and the iliac crest. Hip circumference was measured at the widest part of the hip region. Fat-free mass and the percent body fat were determined using bioelectrical impedance analysis (InBody 520, Biospace Co., Seoul, Korea). Isometric handgrip strength was measurement using grip strength dynamometer (T.K.K. 5401, Takei Scientific Instrument Co., Japan). Each test was done duplicate for each hand, and the average was used in the analysis.

The cut-off values for sarcopenia, handgrip strength values below two standard deviations of the sex-specific young adults, were 35 for men, and 19.6 for women (Gallagher et al., 1997).

Serum levels of fasting glucose, total cholesterol, HDL-cholesterol, and triglyceride were assayed using an ADVIA 1650 Chemistry system (Bayer, Tarrytown, NY, USA). LDL-cholesterol was calculated by the Friedewald's formula (Friedewald et al., 1972).

Data were expressed as means ± S.D. Clinical and metabolic characteristics between men and women, and between non-sarcopenia and sarcopenia groups were compared using the t-test for continuous variables and the chi-square (χ^2) test or Fisher's exact test for the categorical variables. Pearson's correlation analyses were used to assess the relationship of handgrip strength to clinical variables according to gender. A multiple linear regression analysis was perform to determine the association between handgrip and age, gender and fat free mass after adjust for BMI, waist-hip ratio, and triglyceride. Statistical significance of

Table 1. Baseline characteristics

Variables	Men (N=77)	Women (N=65)	*P*-value
Age (Years)	72.0±5.7	71.9±4.7	0.224
Disease			
Hypertension[a]	52 (67.5)	48 (73.9)	0.412
Diabetes[b]	15 (19.5)	11 (16.9)	0.695
Life style			
Smoking[c]	7 (7.4)	3[d] (3.7)	<0.05
Drinking[e]	34 (36.2)	8 (9.4)	<0.01
Metabolic variables			
Systolic BP[f] (mmHg)	136.1±17.3	136.6±17.4	0.862
Diastolic BP (mmHg)	79.5±9.7	78.3±10.0	0.477
Heart rate (bpm)	69.8±12.8	70.6±9.0	0.679
Anthropometrics			
Height (cm)	162.6±6.2	151.0±5.1	<0.001
Weight (kg)	62.8±8.7	56.8±8.2	<0.001
BMI[g] (kg/m^2)	23.8±3.0	24.9±3.1	<0.05
Waist (cm)	81.7±7.9	81.7±8.8	0.995
Hip (cm)	92.4±5.4	95.2±6.7	<0.01
WHR[h]	0.88±0.05	0.86±0.06	<0.01
Body composition			
Percent body fat (%)	27.3±6.8	34.9±8.3	<0.001
Lean mass (kg)	42.8±4.8	34.4±3.6	<0.001
Fat free mass (kg)	45.0±5.1	35.1±3.7	<0.001
Mean handgrip (kg)	27.9±5.2	18.4±3.9	<0.001
Biochemical marker			
Fasting glucose (mg/dl)	92.5±23.1	96.9±28.5	0.37
Total cholesterol (mg/dl)	176.8±29.9	190.1±35.1	<0.05
Triglyceride (mg/dl)	106.3±69.1	140.0±71.2	<0.05
HDL-cholesterol (mg/dl)	47.5±10.6	48.7±9.7	0.56
LDL-cholesterol (mg/dl)	108.0±25.2	113.4±29.5	0.31

Data are shown as mean ± standard deviation. [a]Hypertension was defined as having a history of taking associated medication or a rise in checked blood pressure above 140/90 mmHg, [b]diabetes was defined as having a history of taking associated medication or a rise in checked fasting serum glucose above 126 mg/dl, [c]smoking habit was defined as active smoking at the present, [d]in cells with an expected count less than 5, *P*-value was calculated by Fisher's exact test, [e]alcohol ingestion ≥ 1 time a week, [f]systolic blood pressure, [g]body mass index, [h]waist-to-hip ratio.

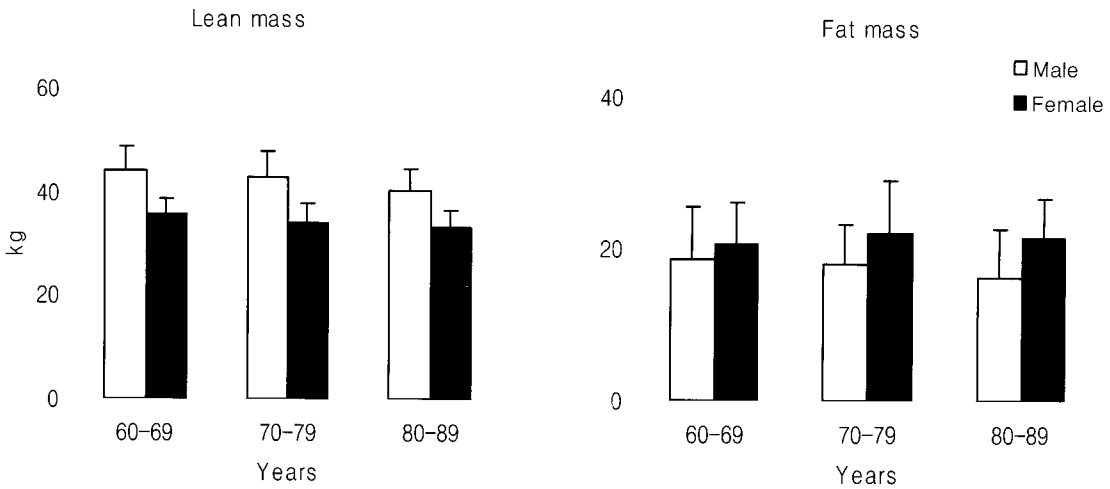

Fig. 1. The differences in lean and fat mass in men and women with aging

Table 2. The prevalence of sarcopenia

Age group (years)	Men (N=77) (%)	Women (N=65) (%)
60~69	82.6	47.4
70~79	96.6	63.0
80~89	100	-
Total	93.1	55.2

mean differences was set at α=0.05.

RESULTS

Gender differences in the outcome parameters were assessed. As can be seen in Table 1, men were heavier, taller and stronger, and had higher waist-hip ratio, lean mass, fat free mass, and health behaviors, such as smoking habits and alcohol ingestion, compared to women. On the other hand, women had higher BMI, hip circumference, percent body fat, total cholesterol, and triglyceride levels.

The prevalence of sarcopenia was found to increase with aging [men in their sixties 82.6%, seventies 96.6% and eighties 100%, and women in their sixties 47.4%, seventies 63% (Table 2)].

Fig. 1 showed that the differences of in lean mass and fat mass according age in men and women, greater loss of lean mass in men, and fat mass was higher in women.

The clinical characteristics of the non-sarcopenia and sarcopenia groups were shown in Table 3. Sarcopenia group was older and had lower hip circumference than non-sarcopenia group.

The relationships between handgrip and the other parameters were primarily analyzed for the men and women participants separately. In both gender groups, handgrip strength was inversely correlated with age and positively correlated with height, lean mass, and fat free mass. Better handgrip strength was related with higher weight in the men and with lower heart rate in the women (Table 4).

Fat free mass, age, and gender were found to be independent factors significantly associated with handgrip strength, in the multivariate analysis, as shown in Table 5. Other clinical variables, such as BMI, waist-hip ratio, and triglyceride levels, which were included in a multiple regression model, were not significantly associated with handgrip strength.

DISCUSSION

We found that the prevalence of sarcopenia increased with aging and exceeded 40% among persons old than 60 years. The prevalence of sarcopenia in the present study is higher than that of other studies, 6~24% (Melton et al., 2000; Tanko et al., 2002), 50% after the age of 80 years (Baumgartner et al., 1998). The differences might be explained by different definitions of sarcopenia, differences in populations being studied, or reference populations, suggesting that further refinement in the definition of a sarcopenia index is necessary.

Handgrip strength was associated with age, gender, and

Table 3. The differences in variables between sarcopenia groups

Variables	Non-sarcopenia (N=56) M: >35.1 W: >19.7	Sarcopenia (N=86) M: <35.0 W: <19.6	*P*-value
Age (Years)	71.0±4.7	73.5±5.4	<0.01
Sex (men)	18 (32.1)	59 (68.6)	<0.001
Disease			
Hypertension[a]	28 (50.0)	45 (52.9)	0.732
Diabetes[b]	8 (14.3)	18 (20.9)	0.317
Metabolic variables			
Systolic BP[c] (mmHg)	136.8±15.5	136.1±18.5	0.820
Diastolic BP (mmHg)	80.2±9.2	78.2±10.2	0.243
Heart rate (bpm)	71.0±10.7	69.6±11.5	0.472
Anthropometrics			
Height (cm)	157.0±8.4	157.5±8.0	0.72
Weight (kg)	61.1±8.0	59.4±9.5	0.28
BMI[d] (kg/m^2)	24.8±2.8	23.9±3.2	0.09
Waist (cm)	82.5±7.4	81.3±8.8	0.39
Hip (cm)	95.4±6.0	92.6±6.1	<0.01
WHR[e]	0.86±0.05	0.88±0.06	0.23
Body composition			
Percent body fat (%)	31.9±8.9	30.1±8.1	0.21
Lean mass (kg)	39.1±5.8	38.8±6.2	0.73
Fat free mass (kg)	41.4±6.9	41.5±6.6	0.95
Fat mass (kg)	20.6±6.1	18.7±5.9	0.07
Mean handgrip (kg)	25.4±7.0	22.3±6.2	<0.01
Biochemical marker			
Fasting glucose (mg/dl)	97.1±32.1	92.7±21.1	0.44
Total cholesterol (mg/dl)	177.7±30.2	184.0±33.6	0.34
Triglyceride (mg/dl)	112.2±62.8	122.6±75.7	0.47
HDL-cholesterol (mg/dl)	49.4±9.9	47.2±10.4	0.29
LDL-cholesterol (mg/dl)	105.9±24.9	112.2±27.8	0.24

Data are shown as mean ± standard deviation. [a]Hypertension was defined as having a history of taking associated medication or a rise in checked blood pressure above 140/90 mmHg, [b]diabetes was defined as having a history of taking associated medication or a rise in checked fasting serum glucose above 126 mg/dl, [c]systolic blood pressure, [d]body mass index, [e]waist-to-hip ratio.

Table 4. Correlations between handgrip strength and various parameters

	Men (N=77)		Women (N=65)	
	r	*P*-value	*r*	*P*-value
Age	-0.26	<0.05	-0.31	<0.01
Metabolic variables				
Systolic BP[a]	-0.05	0.61	-0.01	0.95
Diastolic BP	0.12	0.25	0.08	0.45
Heart rate	0.02	0.83	-0.24	<0.05
Anthropometrics				
Height	0.52	<0.001	0.21	<0.05
Weight	0.38	<0.001	0.20	0.06
BMI[b]	0.11	0.31	0.01	0.93
Waist	0.13	0.22	0.01	0.94
Hip	0.06	0.55	0.01	0.95
WHR[c]	0.15	0.15	0.02	0.88
Body composition				
Percent body fat	-0.11	0.29	-0.19	0.07
Lean mass	0.54	<0.001	0.54	<0.001
Fat free mass	0.53	<0.001	0.48	<0.001
Biochemical marker				
Fasting glucose	0.08	0.46	-0.01	0.94
Total cholesterol	-0.08	0.49	-0.11	0.42
Triglyceride	0.02	0.86	0.05	0.70
HDL-cholesterol	-0.04	0.71	0.10	0.45
LDL-cholesterol	-0.08	0.45	-0.19	0.15

Coefficients (*r*) and *P*-values were calculated by the Pearson correlation model. [a]Systolic blood pressure, [b]body mass index, [c]waist-to-hip ratio

Table 5. Multiple regression analysis to assess independent relationships between handgrip strength and clinical variables

Variables	Parameter Estimate	SE	*P*
Fat free mass	0.81	0.06	<0.001
Age	-0.15	0.66	<0.05
Gender (men)	-4.05	1.20	<0.01

Regression coefficients were adjusted for body mass index, waist-to-hip ratio, triglyceride (R^2=0.66, F-value 44.05, *P*<0.001).

fat free mass in this study. The results are also consistent with those of others who found a strong correlation between muscle mass and muscle strength in old man (Kallman et al., 1990; Reed et al., 1991). Baumgartner and coworker (1999) found that muscle mass was an important predictor of grip strength in men.

We did not observe difference in body composition (lean mass, percent body fat) compared with those without sarcopenia. However, different study was reported that men and women with sarcopenia had both reduced fat free mass and fat mass (Castillo et al., 2003). The sample size in our survey might have been insufficient to consider some associations statistically significant.

In the present investigation, lean body mass change was greater in men than in women, in additional to progressive increases in fat mass with age, progressive reduction in fat free mass is also noted. Those are consistent with other studies (Mazariegos et al., 1994; Gallagher et al., 1997), and the relatively stable fat free mass has seen until 60y that has been reported by other (Chumlea et al., 1999). This decline

in muscle mass is associated with weakness, disability, and morbidity (Baumgartner et al., 1998; Hughes et al., 2001). These findings underscore that need for future studies effect of sarcopenia on metabolic and physiological parameter and examining the contribution of muscle properties to physical disability.

The limitations of this study are as follows. Participants in our study were relatively healthy and might not be representative of the general older population. Comparisons with other studies are difficult because body composition parameters vary with age, weight, height, physical activity level, and general health status.

In summary, results of the present study suggest that 1) handgrip strength is well associated with age, gender, and fat free mass, and 2) the prevalence of sarcopenia increases with aging and exceeds 40% among Korean older persons (>60 years).

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