

## Increased body fat and decreased fat-free mass may not be seen in women of day care home

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In general, reduced fat-free mass (FFM) and increased percentage of body fat (%BF) are considered to be closely associated with physical frailty in the elderly. On the contrary, a reduction in body weight is a serious problem for elderly people in nursing homes because it is closely associated with frailty and mortality. However, there is little information on the body composition of institutionalized elderly, who are generally frail and require help in the activities of daily living (ADL). A cross-sectional survey was conducted to compare anthropometric characteristics of 24 women ( $84.8 \pm 4.8$  [SD] years) who commute to a day care home and 26 free-living women ( $79.3 \pm 4.2$  years) without any ADL disability. The %BF was measured with a dual energy X-ray absorptiometry scanner. Due to the higher age of the day care participants, covariance analyses were used to determine body mass index (BMI), %BF, and FFM adjusted for age. There were no significant differences in mean and/or median of any variables between groups even after adjusting for age. However, the variance in BMI and %BF of the day care group were greater than those of the control. This result may imply that the anthropometrics of women in day care homes are quite varied and that the replacement of muscle with fat alone does not fully explain ADL disabilities.

Keywords: body composition, elderly, activities of daily living, day care home

### Introduction

A positive association between increased fat mass (FM) and physical deterioration with age is widely recognized<sup>(1-3)</sup>. The changes in body composition, *i.e.*, increased body fat and decreased muscle mass, are considered a direct cause of the reduction in muscle strength with age<sup>(4)</sup>. Sarcopenia, an age-related loss of skeletal muscle mass, has been suggested as the major cause of frailty in the elderly<sup>(4)</sup>.

On the other hand, many people older than 70 years of age reduce their energy intake below their energy expenditure, which naturally results in a loss of weight<sup>(5)</sup>. A reduction in body weight is a serious problem for elderly people in nursing homes because it is closely associated with frailty and mortality<sup>(6, 7)</sup>.

Even though the number of elderly people 80 years of age or older has been increasing in developed countries, there is scant information on the body composition of institutionalized elderly, who are generally frail and require help in the activities of daily living (ADL), such as bathing, dressing,

and toileting. If increasing %BF with age could fully explain the cause of ADL-disability in elderly people, their %BF would naturally be higher than that of their relatively healthy counterparts. In the present study, we compared the physical characteristics of ADL-disabled women in a day care home and free-living ambulatory elderly women to verify that increased %BF is actually seen in the former group.

### Methods

This study was approved by the Research Ethics Committee of Nagoya University, and informed consent was obtained from all participants and/or their family. Twenty-four institutionalized subjects with a mean age of  $84.8 \pm 4.8$  years, who once or twice a week commute to a day care center affiliated with a private hospital, were included in this study. Their frailty was identified according to the criteria defined by the Nagoya City Office. The main cause of disability was muscle weakness resulting from old age and/or gonarthrosis. Two had a history of a femoral fracture. All the participants

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**Table 1** Anthropometric characteristics of the participants

	Free-living	Day-care home	<i>P</i> -value	<i>F</i> -value
Age, years	79.3 ± 4.2	84.8 ± 4.8	<0.001	1.34
Height, cm	148.8 ± 7.1	147.5 ± 5.7	0.46	1.54
Body weight, kg	50.0 ± 6.1	48.7 ± 8.5	0.65	1.92
BMI, kg/m <sup>2</sup>	22.6 ± 2.0	22.4 ± 3.8	0.67	3.57
%BF	32.5 ± 5.8	28.3 ± 9.9	0.13	2.91
FFM, kg	33.6 ± 3.5	34.2 ± 3.5	0.53	1.02
Steps/day	4722 ± 1298	832 ± 516	<0.001	6.31
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Adjusting for age (covariance analyses)				
BMI, kg/m <sup>2</sup>	22.4 (22.1-22.5)	22.6 (22.3-22.7)	0.81	
%BF	31.3 (30.3-31.5)	29.5 (28.5-29.7)	0.48	
FFM, kg	33.2 (32.8-33.3)	34.6 (34.2-34.5)	0.22	

Data are expressed as mean ± SD or mean (95% confidence interval).

BMI indicates body mass index; BF, body fat; FFM, fat-free mass.

Non-paired *t* test was used to compare between groups.

Only when the *F*-value is greater than the significant *F*-value, Mann-Whitney *U* test was adopted.

*F* (25, 23, 0.05) = 2.29; *F* (25, 23, 0.01) = 3.00.

were non-smokers and were free from the following diseases: severe heart, liver, gastrointestinal and renal diseases, stroke, cancer, and dementia. None were completely bed-ridden, but one woman 92 years of age was unable to walk at all. They were able to feed themselves, and had no diet restrictions. All of them ate the lunch and snacks served by the day care center, with mean energies of 550 kcal and 150 kcal, respectively, but all of them needed assistance with the activities of daily living (ADL), such as dressing, taking a bath, and using the toilet. Twenty-six free-living local residents with a mean age of 79.3 ± 4.2 years, who exercise by playing a golf-like ball game, walking, or swimming were included as a control group. They all gathered at a gymnastic class held in this area. They were also non-smokers and did not require help from others with the ADL described above.

The %BF was measured with a dual energy X-ray absorptiometry scanner (Lunar DPX-LIQ, USA) equipped with software versions 1.2 and 1.3 and applied by a trained X-ray technician (CT). Height and body weight were recorded before measuring %BF. BMI was calculated by dividing weight in kilograms by height in meters squared. The participants had not eaten for more than 3 hours, wore a thin hospital gown, and were barefoot. The FFM was calculated from body weight minus fat mass. The coefficients of variation for %BF measurements were < 2%.

Their ambulatory level was assessed using the mean number of steps per day measured with an accelerometer (Life-

order, Suzuken, Japan)<sup>(8)</sup>. The subjects were asked to use an accelerometer for at least 3 days between waking and going to bed, except while taking a bath or showering. This apparatus automatically counts and records the number of steps.

The differences between the groups were compared using an unpaired *t*-test. Before conducting the analysis, the variance of each group was compared. If a significant *F*-value was seen, a Mann-Whitney *U* test was adopted to compare the median between groups. Due to the difficulty in matching ages for each group, covariance analyses were used to determine BMI, %BF, and FFM adjusted for age. *P* < 0.05 was considered statistically significant. All statistical analyses were done using SPSS version 12.0J for Windows.

## Results and Discussion

The age, height, body weight, BMI, and the number of daily steps of each group are shown in Table 1. The institutionalized group was older, and the number of steps/day was much lower than that of the control (*P* < 0.001 for both age and steps/day). No significant differences in mean height, weight, BMI, %BF, or FFM were seen between groups. Even after adjusting for age, no significant difference was obtained. However, the variance in BMI (*P* < 0.01) and %BF (*P* < 0.05) of the institutionalized group was greater than that of the control.

The results indicate that increased %BF and decreased FFM are associated with frailty, which is inconsistent with

the findings of previous studies<sup>(1-3)</sup>. This is probably because the ages of the women in the day care group (mid-80s) were much higher than those of the participants in previous studies (up to mid-70s). The participants of their studies were all free-living, and their functional disability, physical activities, and frailty were assessed using a self-administered questionnaire on activities such as walking 2-3 blocks, climbing 10 stairs, putting on and removing a laboratory coat, and lifting a 7-pound book onto a shelf<sup>(9, 10)</sup>. Those participants were probably able to perform ADL, *i.e.*, eating, dressing, bathing, and using the toilet, by themselves.

It is interesting that we observed no significant differences in FFM between the groups. It is known that reduced FFM is associated with frailty, such as poor strength, gait, and balance. However, FFM does not indicate muscle mass, but all portions of body tissues not containing fat. The percentage of cell mass in FFM decreases with age<sup>(4)</sup>. Cell mass occupies 59% of FFM in men 20-29 years of age, but it is only 46% in men 80-89 years old because cell mass declines faster than does intercellular connective tissue and water<sup>(11)</sup>. Their observation and our results may indicate that FFM does not reflect muscle mass accurately with advancing age.

Our observation of greater variance in BMI and %BF in the institutionalized group indicates that the anthropometrics of the women in day care homes is quite varied. The BMI and %BF of the institutionalized women ranged from 15.8 to 30.1 kg/m<sup>2</sup> and 7.0 to 44.5%, respectively. Infiltration of fat into the remaining muscle accompanies the muscle loss, and it is impossible to produce power per unit of area equivalent to that of the former muscle<sup>(4)</sup>. The lower muscle mass in women may complicate the relationship between ADL disability and the changes in body composition with age.

There are several limitations to interpreting the observations in this study. First, a cross-sectional design does not account for frailty in the individual aging process. Second, due to the difficulty in collecting women in their mid-80s who are free from ADL, the mean age of the control group was younger than that of the women in day care homes. This difference of approximately 5 years may be a confounder, so variables were adjusted using covariance analyses. Third, the scale of this study is relatively small. Therefore, a large scale survey is necessary to verify our findings. However, our

results are not inconsistent with many previous studies that indicate a close association between body weight reduction and frailty in institutionalized elderly people.

As mentioned above, increased body fat is closely associated with physical frailty and aging. On the other hand, underweight institutionalized older people have a high rate of mortality. Our finding of great variation in BMI and %BF of women in day care homes may indicate that the replacement of muscle with fat alone does not fully explain ADL disabilities.

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