Relationship between cognitive function and body composition in elderly care facilities users and residents

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《Original Articles》

Relationship between cognitive function and body composition in elderly care facilities users and residents

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Abstract

Purpose: We previously found that nutritional status drops, for example decreased body mass index (BMI) or serum albumin level, with decreasing cognitive function, but dietary intake is sufficient in many of those cases, and we could not determine the cause of poor nutritional status. We therefore performed a similar type of study to measure body composition in detail and examined how physical activity level and type of physical activity relate to dementia.

Methods: A cross-sectional study was conducted on 80 residents of an elderly care facility (nine men and 71 women, mean age of 84.4 ± 7.5 years) and 50 users of daycare services (17 men and 33 women, mean age of 85.3 ± 5.4 years). Hasegawa's Dementia Scale-Revised (HDS-R) was used to assess cognitive function and Inbody S10 to measure body composition. Associations among HDS-R, BMI, skeletal muscle index (SMI), and body fat mass were tested.

Results: HDS-R was significantly positively correlated with BMI (r = 0.32) and SMI (r = 0.49) and significantly negatively correlated with body fat mass (r = –0.24). Even with the same cognitive function, skeletal muscle mass tended to be better maintained by daycare service users with a higher physical activity level.

Conclusion: The findings of the present study suggested that skeletal muscle mass and body fat mass are associated with cognitive function, and the relationship between these characteristics is affected by physical activity level.

Keywords: dementia, BMI, Skeletal muscle index (SMI)

1. Introduction

According to the FY2016 White Paper on Aging Society published by the Japanese abinet Office[1)], the population aging rate in Japan was 26.7% in October 2015; Japan's super aging society is thus progressing. This rate is expected to continue increasing, and the accompanying issues and countermeasures for those issues are being debated. In particular, there are many concerns about dementia. Dementia is accompanied by the emergence of behavioral and psychological symptoms of dementia (BPSD) in which mealtime problem behaviors are also exhibited, such as food refusal, playing with food, and eating nonfood substances. These eating-related problem behaviors can affect dietary intake and may increase the risk of malnutrition[2)]. Izawa *et al.*[3)] performed a survey using the Mini Nutritional Assessment-Short Form (MNA-SF) in 281 daycare users who were certified

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as requiring long term care (LTC) and reported that 8.9% suffered malnutrition and 51.2% were at risk of malnutrition, with an increasing prevalence of malnutrition with increasing care level. At a long-term residence-type care facility in Italy as well, it was reported that 89.5% of residents had moderate to more severe dementia with 30% being malnourished and 56% at risk of malnutrition[4]. In addition, Mitchell *et al.*[5] reported that elderly individuals with severe dementia have the characteristic of developing and dying from various complications resulting from infection and mealtime problems.

In our previous research, we conducted cross-sectional and prospective studies on the relationship between cognitive function and nutritional status in residents of facilities for the elderly. We found that a lower cognitive function was associated with decreased physical function, motivation, and nutritional status, and mealtime problem behaviors were observed with a high frequency when Hasegawa's Dementia Scale-Revised (HDS-R) score was 11 points or less. In particular, we reported that the mealtime problem behavior of difficulty maintaining posture was associated with a high risk of poor dietary intake and nutritional status. With other mealtime problem behaviors, however, despite worse nutritional status with lower HDS-R score as seen from body mass index (BMI), MNA-SF and serum albumin (Alb) level, dietary intake was sufficient and we could not determine the cause of poor nutritional status. We therefore performed a similar type of study to measure body composition in detail and examined how physical activity level and type of physical activity relate to dementia.

2. Methods

Subjects

Subjects were 80 residents of a nursing home for the elderly and 50 users of a daycare service center in Aichi Prefecture for whom consent to participate in the study was obtained from the individual or their guarantor. The 80 facility residents (9 men and 71 women) were 84.4 ± 7.5 years old and had a BMI of 19.8 ± 3.1 kg/m^2 and body fat percentage of 32.2 ± 11.3%. The 50 daycare users (17 men and 33 women) were 85.3 ± 5.4 years old and had a BMI of 21.7 ± 3.2 kg/m^2 and body fat percentage of 26.1 ± 9.0% (Table 1). This facility residents included 11 cerebral hemorrhages, 25 cerebral infarctions, 5 Parkinson's diseases, 3 depression, 1 alcoholism and 5 schizophrenia. Ten residents were treated with antidepressant drugs and five residents were treated with sleeping pills. We did not exclude these residents in this study.

Assessment of body composition and cognitive function

A survey was carried out at the facilities from August to December 2016. Sex, age, height, and weight were determined as basic information, and InBody S10 (InBody Japan Inc., Tokyo, Japan) was used to measure body composition in either a su-

Table 1 Characteristics of the study participants.

	Daycare users (*n*=50)	Facility residents (*n*=80)	*P*
Sex (M/F), *n*	17 / 33	9 / 71	0.002*
Age, years	85.3 ± 5.4	84.4 ± 7.5	0.455
BMI, kg/m^2	21.7 ± 3.2	19.8 ± 3.1	0.001
Body fat parcentage, %	26.1 ± 9.0	32.2 ± 11.3	0.002
SMI, kg/m^2	6.02 ± 0.96	4.60 ± 1.27	<0.001
HDS-R score (0–30), points	23.6 ± 5.8	5.6 ± 7.0	<0.001
MMSE score (0–30), points	25.4 ± 4.1	7.2 ± 7.5	<0.001

Values are presented as means ± SD.
*Data were analyzed by x^2 test, and other date were analyzed Student's t-test.

pine or sitting position. Skeletal muscle mass was assessed using body fat mass, lean body mass, and the Skeletal Muscle Mass Index (SMI)[6], which is calculated by dividing appendicular muscle mass by the height squared. Cognitive function was assessed with the HDS-R and Mini Mental State Examination (MMSE).

Ethical considerations

The study protocol was approved by the research ethics committee of Nagoya University of Arts and Sciences. The individuals or their guarantors were given written and oral explanations of the study objectives and survey methods. We also explained that personal information obtained during the survey would be handled appropriately. Those who consented and submitted a consent form were taken as study subjects.

Statistical analysis

For statistical analysis, R ver.3.3.3 was used to perform Student's *t*-tests and Spearman's correlation coefficients. P <0.05 was considered significant difference.

3. Results

Cognitive function of subjects

Facility residents had an HDS-R score of 5.6 ± 7.0 points and an MMSE score of 7.2 ± 7.5 points. Daycare service users had an HDS-R score of 23.6 ± 5.8 points and an MMSE score of 25.4 ± 4.1 points (Table 1). There was a clear difference between the two groups.

Association between physique and HDS-R

Compared to a BMI of 19.8 ± 3.1 kg/m^2 among facility residents, the BMI of daycare service users was 21.7 ± 3.2 kg/m^2, which was significantly higher. The BMI of the users of both facilities combined was significantly and positively correlated with HDS-R (r = 0.32; p<0.001) (Fig. 1–1).

Compared to a body fat percentage of 32.2 ± 11.3% among facility residents, the body fat percentage of daycare service users was 26.1 ± 9.0%, which was significantly lower. The body fat percentage of the users of both facilities combined was significantly and negatively correlated with HDS-R (r = –0.24; p = 0.006) (Fig. 1–2).

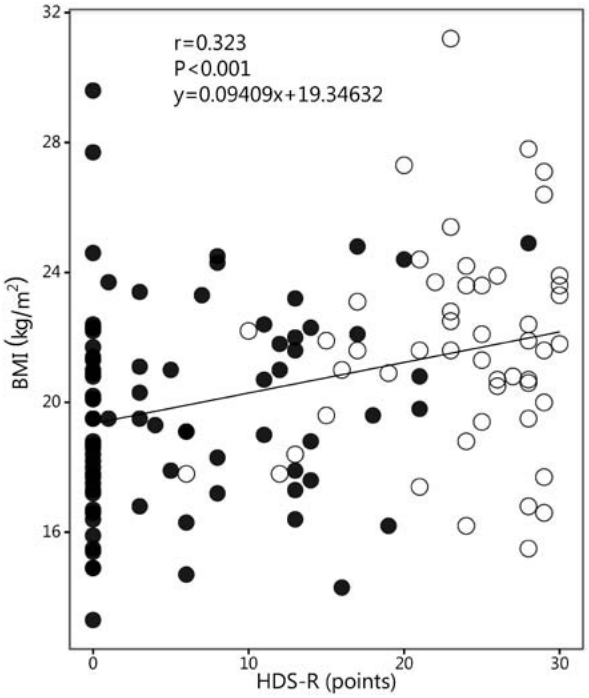

Figure 1–1. Correlation between BMI and HDS-R score

○ and ● represent the users of daycare service and the residents of a nursing home, respectively.

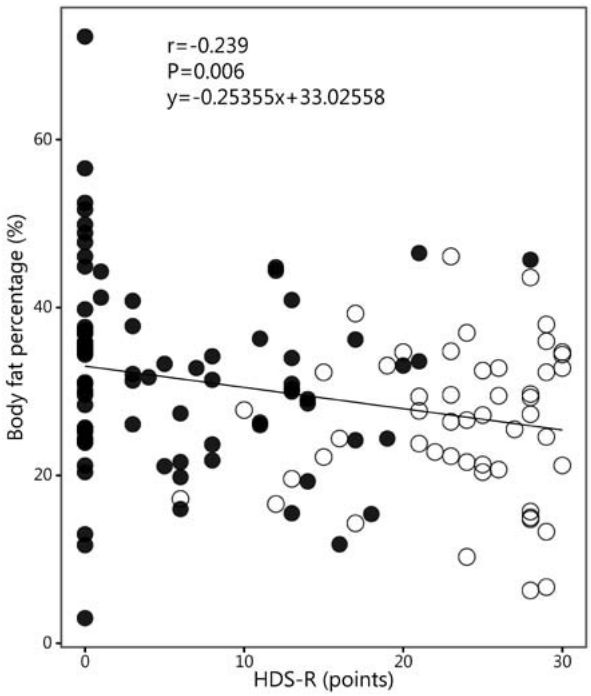

Figure 1–2. Correlation between body fat percentage and HDS-R score

○ and ● represent the users of daycare service and the residents of a nursing home, respectively.

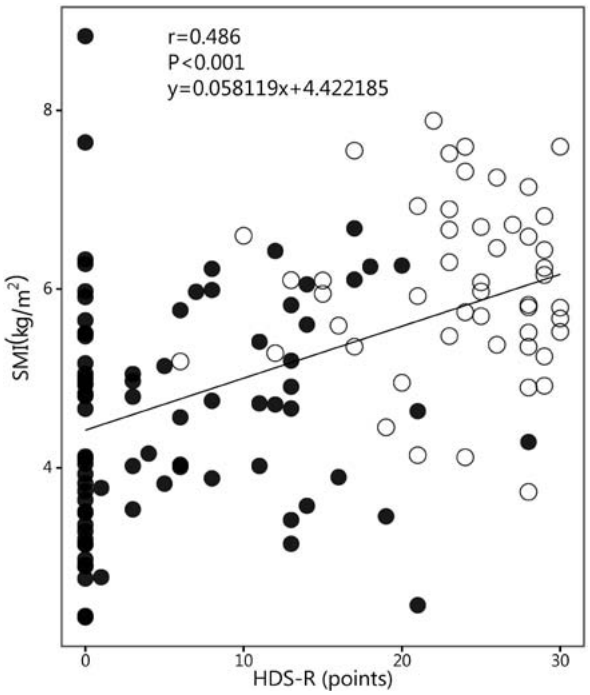

Figure 1–3. Correlation between SMI and HDS-R score

○ and ● represent the users of daycare service and the residents of a nursing home, respectively.

Compared to an SMI of 4.60 ± 1.27 kg/m^2 among facility residents, the SMI of daycare service users was 6.02 ± 0.96 kg/m^2, which was significantly higher. The SMI of the users of both facilities combined was significantly and positively correlated with HDS-R (r = 0.49; p = 0.001) (Fig. 1–3).

The physique (BMI, body fat percentage and SMI) and HDS-R were significantly correlated even when analyzed by adjusting for sex and age.

Comparing the SMIs of subjects with the same HDS-R level revealed a tendency towards higher SMIs for daycare service users.

4. Discussion

We investigated the relationship between cognitive function and body composition in residents of a nursing home for the elderly and users of daycare services. We found that cognitive function was significantly correlated with muscle mass and body fat, and that daycare service users with a higher physical activity level tended to have a higher SMI, even with the same level of dementia.

In the present study, we conducted a survey on cognitive function and physique in groups using different types of long term care services. Comparison of the two groups revealed that facility residents had a significantly higher level of dementia than users of daycare services as well as a higher body fat mass and significantly lower SMI. According to the Japanese Ministry of Health, Labour and Welfare's FY2014 Survey of Institutions and Establishments for Long Term Care[7], users who are certified as requiring LTC at a care level of three or higher (incapable of performing daily activities, such as standing up, walking, toileting, bathing and dressing and undressing independently without nursing care assistance, and the presence of dementia-related problem behaviors) account for 34.1% of daycare users and 88.1% of residents of nursing homes for the elderly. The disparity in level of dementia and physique between these two types of facilities may be strongly influenced by the care level.

BMI and HDS-R were significantly correlated. In a study on 990 patients aged 65 and older receiving home care (384 men and 606 women)[8], lower independence degree of daily living for the demented elderly was significantly associated with lower BMI. Another study showed that elderly individuals who were more capable of conveying their intentions had a significantly higher BMI. Furthermore, a five-year prospective study on 169 healthy community-dwelling elderly individuals aged 68 or older in France showed[9] that those with a BMI of 23 kg/m^2 or higher has a 3.6-fold lower risk of decline in cognitive function five years later. These studies showing an association between lower BMI and higher level of dementia support the findings of the present study.

SMI was significantly positively correlated with HDS-R and body fat percentage was significantly negatively correlated with HDS-R. Motokawa *et al.*[10] examined the relationship between dementia and body composition with nutritional status in 301 people (48 men, 241 women) diagnosed with Alzheimer's disease living at facilities for the elderly. Dementia was assessed by grouping individuals using the Clinical Dementia Rating (CDR). Significant dif-

ferences were observed in various factors including BMI, SMI, the Fat-free Mass Index (FFMI), MNA-SF, calf circumference, and the Barthel Index and those with advanced dementia with CDR level three had a high rate of decline in SMI and FFMI, suggesting that body composition changes occur more readily in individuals with severe dementia. These reports suggest that dementia may affect body composition, for example through the decline of skeletal muscle mass.

In the present study, however, comparing SMI by type of nursing care service with the same HDS-R level showed a tendency for a higher SMI among users of daycare services with a higher physical activity level than facility residents[11]. Studies have shown that even elderly individuals requiring LTC can reduce various risks with exercise and training can improve physical functions even for those living in facilities for the elderly. Considering the characteristics of resident-style facilities and adult daycare centers, it is possible that physical activity level in the different types of facilities has an effect[12]. Further studies are needed to determine the relationship between physical activity level and muscle mass and dementia.

Many previous studies have found a relationship between SMI and nutritional status[13]. Kuzuya *et al.*[14] examined the relationship between nutritional status and sarcopenia as defined by Sanada *et al.*[15] in 281 community-dwelling elderly individuals and found a significant correlation between SMI and MNA-SF. In addition, a significant correlation was observed between predicted SMI value (the Sanada *et al.* method) and MNA-SF, and malnutrition was reported to be one relevant factor for sarcopenia and pre-sarcopenia. It can be surmised from this that decline in nutritional status may be one major factor affecting decrease in muscle mass. There is also an association with BMI. Studies have shown mean lower limb circumference to decrease significantly with decreasing BMI[8]. Michael *et al.*[16] found that a BMI of 21 kg/m^2 or less for men and 19 kg/m^2 or less for women aged 65 and older had a 90% or higher chance of lower muscle mass. These findings suggest that various factors are linked to decline in muscle mass for elderly individuals.

Rosenberg proposed the term 'sarcopenia' to describe a decrease in muscle mass with age or a decrease in muscle mass due to aging[17]. Generally, skeletal muscle area decreases by 25–30% from the 20s to 70s, and muscle mass decreases by approximately 1–2% annually from the age of 50[18]. The loss of muscle mass is caused by atrophy of mostly type IIa muscle fibers and fiber loss, and the muscle lost is generally said to be replaced with fat. In 2010, however, the European Working Group on Sarcopenia in Older People proposed the concepts of primary sarcopenia with no clear cause other than age and secondary sarcopenia caused by factors such as disuse, inflammation, and malnutrition, suggesting that decreased activity level, diseases such as dementia, malnutrition, and other factors may affect loss of muscle mass. Concerning dementia and body composition, physical activity and nutritional status may be mutually correlated[19].

In the present study, we could not determine the daily nutritional intake or physical activity level of daycare service users, and were therefore limited to a cross-sectional study on only dementia and body composition. Further studies are needed to objectively assess nutritional intake and physical activity level of daycare service users and compare these two factors as well. By determining these factors, we can investigate whether or not dementia is independently involved in skeletal muscle mass loss. That said, the findings of the present study are important from the perspective of care aimed at maintenance of skeletal muscle mass in dementia patients. A prospective follow-up study is needed to examine the changes that occur with declining cognitive function.

5. Conclusion

A lower cognitive function is associated with a lower skeletal muscle mass and greater body fat percentage. Even with the same cognitive function, skeletal muscle mass is maintained differently according

to differences in long term care services used, and this difference was surmised to be the result of differences in physical activity level.

6. Acknowledgments

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《原著》

高齢者施設利用者の認知症レベルと体組成の関連

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要旨

【目的】我々は認知症レベルが低下するとBMI及び血清アルブミン値が低下するなど、栄養状態が悪くなることを報告した。しかしながら、その多くは十分な食事摂取量が確保できており、栄養状態の低下の原因を明らかにすることはできなかった。そこで、同様の研究系において、詳しく体組成を測定し、身体活動量やその内容と認知症の関連について検討した。
【方法】高齢者福祉施設入居者80名（男性9名、女性71名、平均年齢84.4±7.5歳）と通所介護サービス利用者50名（男性17名、女性33名、平均年齢85.3±5.4歳）を対象に調査を行った。認知症レベルの評価としてHDS-Rを用い、体組成はInbody S10を用いた。HDS-R、BMI、SMIおよび体脂肪量との関連について検討した。
【結果】HDS-RはBMI（r=0.32）およびSMI（r=0.49）と有意な正の相関を認め、体脂肪量と有意な負の相関（r=－0.24）が認められた。また、同じ認知症レベルの場合、骨格筋量は身体活動量が多い通所介護サービス利用者のほうが維持されている傾向があった。
【結論】骨格筋量および体脂肪量は認知症レベルと関連があり、それは身体活動量に影響を受けることが示唆された。

キーワード：認知症、BMI、骨格筋指数（SMI）

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