Underweight Mobility-Type Pre-Frailty/Frailty Was Associated with Complex Care Needs of Long-Term Care Facilities Residents: Results Using MDS RAP Triggers

Ming-Yueh Chou, MD1,2,3, Hsiu-Chu Shen, MD1,4, Li-Ning Peng, MD, MSc2,3,5, Ying-Hsin Hsu, MD1, *Chih-Kuang Liang, MD1,2,3,4, Mei-Chen Liao, MD1, Yu-Te Lin, MD, PhD1,4, *Liang-Kung Chen, MD, PhD2,3,5

1Center for Geriatrics and Gerontology, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan
2Aging and Health Research Center, National Yang Ming University, Taipei, Taiwan
3Department of Geriatrics, National Yang Ming University School of Medicine, Taipei, Taiwan
4Division of Neurology, Department of Medicine, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan
5Center for Geriatrics and Gerontology, Taipei Veterans General Hospital, Taipei, Taiwan

ABSTRACT

Background/Purpose: To evaluate the association of body mass index (BMI) and complex care needs among oldest old male with and without mobility-type pre-frailty/frailty.

Methods: This cross-sectional study recruited subjects aged 80 years and over from two veterans homes in Taiwan. Complexity of care was evaluated by the Resident Assessment Protocol (RAP) triggers derived from Minimum Data Set (MDS). High complexity of care needs was defined as ≥4 RAP triggers. Mobility-type pre-frailty/frailty was defined as low handgrip or slow gait speed (cutoff point defined by Asian Working Group for Sarcopenia).

Results: Overall, 344 participants (mean age 84.6±3.9 years, all male) were enrolled for study and 79.4% of them were classified with mobility-type pre-frailty/frailty. Lower BMI is significantly associated with higher mean of MDS-based triggers (residents with BMI <18.5: 5.4±2.4; with 18.5: BMI <25.0: 4.8±2.3; with 25.0: 4.1±2.1; P=0.022). Multivariate logistic regression analysis showed that after adjusting the covariates for age, education and Charlson comorbidity index (CCI), among residents with mobility-type pre-frailty/frailty, the groups classified as BMI <18.5 and 18.5-24.9 levels were strongly associated with higher complexity of care needs compared with the group with BMI ≥25 [adjusted odds ratio (aOR) 4.182, 95% confidence interval (CI) 1.291-13.543, p=0.017 and aOR 1.793, 95%CI 1.041-3.091, p=0.035, respectively]. But however, the difference was not found among residents without mobility-type pre-frailty/frailty.

Conclusion: Low BMI was associated with high complex care needs among oldest old long-term care facilities male residents with mobility-type pre-frailty/frailty. Further intervention study is needed to reverse the low BMI and mobility-type pre-frailty/frailty.
**1. INTRODUCTION**

Changes of body composition is one of the key features of aging, especially the progressive increase of adiposity and the loss of skeletal muscle mass. Evidence supporting the adverse impact of obesity was mainly from the young and the middle-aged population, and the “obesity paradox” suggested the different prognostic roles of obesity in older people. The J-shaped curve of relationship between BMI, health consequences and mortality in older people clearly demonstrated that higher mortality risk existed on extremes of BMI only. Higher BMI in older adults usually suggested higher fat-free mass together with fat mass, which has been considered to play favorable roles for health of older people. Several previous studies have shown that higher BMI was associated with lower mortality rate among long-term care facility (LTCF) residents, overweight and obesity may be of survival benefits in LTCF settings.

Frailty is a geriatric syndrome characterized by loss of function and physiologic reserve in older people, and is associated with higher risk for adverse health outcomes, e.g. mortality, institutionalization, falls, and hospitalization. Fried, et al. proposed using weakness, slowness, low level of physical activity, weight loss and exhaustion as the operational criteria for physical frailty, and the adverse impact of physical frailty has been identified from the Cardiovascular Health Study. Based on Fried’s criteria, subtypes of physical frailty have been proposed, i.e. non-mobility-type (weight loss and exhaustion), mobility-type frailty (slowness and weakness) and low physical activity, that each subtype of frailty was of different clinical characteristics and mortality risk. Due to the potential reversibility of frailty, frailty intervention programs are of critical importance for at-risk older people. Studies have suggested that older people with concomitant obesity and low muscle strength (dynapenic-obesity or sarcopenic-obesity) were of greater health risk than those with obesity or low muscle strength alone. Eventually, overweight and obesity in older people did not increase mortality risk of older people, and may be of survival benefits in LTCFs and community settings. However, to identify and fulfill overall complexity of care needs of residents living in LTCFs may be more important than the estimation of mortality risk. Therefore, the main aim of this study was to explore how weight status and subtypes of frailty were associated with their overall care needs among LTCF residents.

**2. METHODS**

**2.1. Study Design and Study Subjects**

This study was supported by the Taiwanese Veterans Affairs Commission and was part of the Longitudinal Older Veterans (LOVE) Study. Residents of Veterans Care Homes (VCHs) were invited for the LOVE study. All participants were enrolled when they provided signed informed consent.

VCHs are veterans retirement communities and are similar to the assisted living in the United States. MDS is a federally mandated process and assesses LTCF residents’ functional status comprehensively and the LOVE study was designed to evaluate the impact of implementing the Minimum Data Set (MDS Nursing Home 2.1, Chinese version) on the quality of care.

In this study, data of two VCHs were retrieved for analysis, i.e. Banciao VCH in 2006 and Gansan VCH in 2011. All participants were aged 80 years and over and all males. Subjects with the following conditions would be excluded: 1) not able to walk with or without assistance, 2) not able to communicate with research nurses, 3) not able or unwilling to provide informed consent, and 4) having the diagnosis of moderate or advanced dementia. All participants were interviewed by well-trained research nurses to collect demographic characteristics, including age, educational level, BMI, and to assess the MDS Resident Assessment Protocol (RAP). The Charlson’s Comorbidity Index (CCI) was used to assess multimorbidity. The study protocol was reviewed and approved by the Institutional Review Boards of National Yang-Ming University and Kaohsiung Veterans General Hospital. All the methods described were performed in accordance with the approved guidelines.

**2.2. Anthropometric Measurements**

Body height and weight were measured using a digital floor scale to the 0.1 cm and 0.1 kg respectively. The BMI was calculated as body weight (in kg) divided by the square of body height (in meter). According to the WHO Asian criteria of obesity, BMI was classified into three categories: underweight (BMI less than 18.5 kg/m²), normal weight (BMI between 18.5-24.9 kg/m²), and overweight and obesity (BMI ≥25.0 kg/m²).

Muscle strength was measured by handgrip strength using a digital dynamometer (TTM-YD, Tokyo, Japan). Participants were tested for three trials by the dominant hand, and the best measurement was recorded. Usual gait speed was measured by using a timed 6-meter walking test (with or without walking aids) with a static start throughout the hallway without deceleration. A chronometer (HS-70 W, Casio Computer, Tokyo, Japan) was used by research nurses to record time for the 6-meter walk (seconds). Following the test, the usual gait speed was calculated by the 6-meter distance divided by walking time (meters/second).

**2.3. Definition of Mobility-Type Pre-Fraility/Frailty**

Mobility-type pre-fraility/frailty was defined when
weakness or/and slowness were present. In this study, weakness was defined by low handgrip strength and slowness was defined by slow gait speed. The cut-off point for handgrip strength was <26 kg and gait speed was <0.8 m/s based on the Asian Working Group for Sarcopenia (AWGS) definition.

### 2.4. Complexity of Care

In this study, the complexity of care of each participant was estimated by using the MDS resident assessment protocol (RAP) triggers. The MDS RAP triggers were specific items defined by the MDS to evaluate the residents’ functional capabilities comprehensively and were measured individually and totally (sum of RAP triggers). RAP triggers from residents’ responses helped to identify their care needs for specific problems and were linked to the intervention care plans individualized provided by on-site healthcare staffs. In the present study, the RAP trigger of tube feeding was excluded for analysis because none of the participants was fed by tubes. Subjects with ≥4 RAP triggers were defined as having high complex care needs, and those with <4 RAP triggers were classified as having low complex care needs as described before.

### 2.5. Statistical Analysis

In this study, all continuous variables are presented as mean±standard deviation (SD), and categorical data are presented as numbers (percentage). Student’s t-test was used for comparisons of continuous variables between groups. Associations between BMI and the sum of RAP triggers among residents with and without mobility-type pre-frailty/frailty were evaluated by using one-way ANOVA. Multiple logistic regression models were used to adjust for other covariates, including age, education and CCI. For all tests, a two-tailed P-value of <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS version 21 (SPSS Inc., Chicago, IL).

### 3. RESULTS

Overall, this study obtained data of 344 older male residents (mean age 84.6±3.9 years) from two VCHs in Taiwan for analysis. Table 1 summarized participants’ demographic and anthropometric characteristics. Among all participants, 273 (79.4%) were classified into residents with mobility-type pre-frailty/frailty. Table 2 showed results of univariate analysis that residents with the triggers of delirium, cognitive loss, poor communication ability, poor psychosocial well-being, low mood states and psychotropic drug use had lower BMI level than subjects without those triggers (21.8±3.2 versus 23.3±3.3 kg/m², p=0.042; 22.5±3.1 versus 23.4±3.4 kg/m², p=0.032; 22.5±3.6 versus 23.7±3.1 kg/m², p=0.002; 22.9±3.3 versus 23.9±3.4 kg/m², p=0.007; 22.4±3.7 versus 23.4±3.2 kg/m², p=0.017, respectively) (Table 2).

Table 3 compared the mean number of RAP triggers among those with different BMI status between residents with and without mobility-type pre-frailty/frailty. By using One-way ANOVA, among the residents with mobility-type pre-frailty/frailty, those with lower BMI levels were associated with higher number of RAP triggers (5.4±2.4, 4.8±2.3 and 4.1±2.1 among three groups with BMI <18.5, BMI 18.5-24.9 and BMI ≥25.0, respectively, p=0.022). However, there’s no significant association between those groups with different BMI status and the number of RAP triggers among residents without mobility-type pre-frailty/frailty (p=0.944) (Table 3). Figure 1 illustrated that the group with lower BMI was associated with higher number of RAP triggers among the residents with mobility-type pre-frailty/frailty, but
among residents without mobility-type pre-frailty/frailty, there was no significant association between the complexity of care needs and body weight status (Table 4).

4. DISCUSSION

In the present study, we evaluated the impact of BMI on the complex care needs among LTCF male residents with mobility-type pre-frailty/frailty, and results showed that mobility-type pre-frailty/frailty with underweight to normal weight status was strongly associated with higher complexity of care needs, but not overweight and obese group. Nevertheless, the associations between BMI and complex care needs were insignificant among residents without mobility-type pre-frailty/frailty. Therefore, mobility status may be more important than body weight status to health and care burden of LTCF residents.

Results of this study also revealed that underweight group was associated with RAP triggers of delirium, cognitive loss, problem of communication, poor psychosocial well-being, low mood and psychotropic drug use compared to those with normal weight and above. Several studies also reported the associations between lower BMI and delirium in LTCF residents. Low BMI in LTC settings may imply risk of malnutrition and low serum protein may reduce protein-binding capacity of individuals and increase free drug levels, as well as the risk of delirium. In addition, micronutrient deficiencies, such as vitamin B\textsubscript{12}, may also contribute to the development of delirium. Although obesity has been reported to be the risk factor for dementia in the middle age, the risk of obesity on dementia in the old age remained controversial. Some studies showed that higher BMI was associated with less cognitive declines and better cognitive performance; testosterone in the body fat of older men also played an important role to prevent cognitive impairment (possibly via conversion to oestrogen). Psychosocial well-being, measured by general attitude, adaptation to surroundings, and changes in relationship patterns, may be used to assess LTCF residents coping to the environment and care. Crogan, et al., reported that lower BMI was associated with poor psychosocial well-being and quality of life, which may be a subsequence of depressive mood, poor appetite and decreased oral intake related to poor adjustment to LTCFs of individuals. Evidence suggested that obese older people were less likely to have depressive symptoms and the “jolly fat” hypothesis may be applied in this observation.

In the present study, subjects with mobility-type pre-frailty/frailty represented substantially higher complexity of care needs. Advancing age is often mingled with disability, multimorbidity and geriatric

### Table 2. Comparisons of BMI between residents with MDS-based triggers or not.

<table>
<thead>
<tr>
<th>Body Mass Index</th>
<th>Trigger: Yes</th>
<th>Trigger: No</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Mean±SD</td>
<td>n</td>
<td>Mean±SD</td>
</tr>
<tr>
<td>1. Delirium</td>
<td>23</td>
<td>21.8±3.2</td>
<td>320</td>
</tr>
<tr>
<td>2. Cognitive loss</td>
<td>80</td>
<td>22.5±3.1</td>
<td>264</td>
</tr>
<tr>
<td>3. Functional behavior</td>
<td>130</td>
<td>22.9±3.2</td>
<td>214</td>
</tr>
<tr>
<td>4. Communication</td>
<td>146</td>
<td>22.5±3.6</td>
<td>198</td>
</tr>
<tr>
<td>5. Rehabilitation needs</td>
<td>102</td>
<td>23.5±3.0</td>
<td>242</td>
</tr>
<tr>
<td>6. Urinary incontinence</td>
<td>32</td>
<td>22.4±3.2</td>
<td>312</td>
</tr>
<tr>
<td>7. Psychosocial well-being</td>
<td>244</td>
<td>22.9±3.3</td>
<td>100</td>
</tr>
<tr>
<td>8. Mood states</td>
<td>82</td>
<td>22.4±3.7</td>
<td>262</td>
</tr>
<tr>
<td>9. Behavioral symptoms</td>
<td>1</td>
<td>21.6±0.0</td>
<td>343</td>
</tr>
<tr>
<td>10. Activities</td>
<td>132</td>
<td>23.5±3.3</td>
<td>212</td>
</tr>
<tr>
<td>11. Falls</td>
<td>54</td>
<td>23.1±3.3</td>
<td>290</td>
</tr>
<tr>
<td>12. Nutritional status</td>
<td>10</td>
<td>22.4±1.9</td>
<td>324</td>
</tr>
<tr>
<td>13. Tube Feeding</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>14. Dehydration</td>
<td>6</td>
<td>24.5±3.2</td>
<td>338</td>
</tr>
<tr>
<td>15. Dental care</td>
<td>295</td>
<td>23.1±3.4</td>
<td>49</td>
</tr>
<tr>
<td>16. Pressure ulcers</td>
<td>17</td>
<td>23.4±3.1</td>
<td>327</td>
</tr>
<tr>
<td>17. Psychotropic drug use</td>
<td>143</td>
<td>22.6±3.7</td>
<td>201</td>
</tr>
<tr>
<td>18. Physical Restraints</td>
<td>1</td>
<td>20.0±0.0</td>
<td>343</td>
</tr>
</tbody>
</table>

Figure 1. Mean of MDS-based triggers between 3 groups of different BMI in residents with or without mobility-type pre-frailty/frailty.
characteristics of participants were homogeneous, which might limit the extrapolation of results to the general population. Second, some residents declined to participate in this study and non-participants were usually relatively healthy or too frail to finish the tests. Third, the cross-sectional observational design limited the possibility to identify causal relationships, which needs a longitudinal study or intervention study for further clarification.

In conclusion, mobility-type pre-frailty/frailty may suggest complexity of care needs for LTCF residents and may be an indicator for MDS re-assessment and updates in care plans. Moreover, mobility-type pre-frailty/frailty were of greater health risk than underweight, but the two factors eventually synergistically jeopardize the health of LTCF residents. Further multicomponent intervention activities for LTCF with complex care needs are needed to improve the quality of care in LTCF settings.

CONFLICTS OF INTEREST

All authors have no conflicts of interest to declare.

Acknowledgements

This study was supported by the Veterans Affairs Commission of Taiwan, and the Ministry of Science and Technology (MOST 103-2633-B-400-002; and MOST 101-2314-B-010-008).

REFERENCES

2. Chen LY, Peng LN, Liu LK, Lin MH, Chen LK, Lan CF, et al. Body syndromes, and over two-thirds of older people eventually presented with geriatric syndromes before hospitalizations. Older people with multimorbidity and geriatric conditions needed more comprehensive and complex care plans to optimize the quality of care. Therefore, timely identification of complex care needs among LTCF residents is of critical importance for appropriate care planning. Results of this study may suggest that mobility-type pre-frailty/frailty, i.e. presence of slowness and/or weakness, is an effective indicator to consider complete MDS assessment and update the care plans for LTCF residents. Mobility-type pre-frailty/frailty was defined as lower muscle strength and/or physical performance, which may be suspected by observations and simple measurements. Liu, et al., reported that mobility-type frailty was significantly associated with poor health conditions, such as multimorbidity, poorer cognitive performance, poorer physical performance with higher prevalence of hypertension and diabetes. In this study, mobility-type pre-frailty/frailty and underweight synergistically increased the complexity of care needs, which was not noted among underweight LTCF residents without mobility-type pre-frailty/frailty. Underweight has been recognized as an indicator of undernutrition and was associated with mortality and hospitalizations for older adults, but the real risk of underweight may confounded by conditions of mobility. Therefore, multicomponent intervention comprising of nutrition supplement and exercise training to reverse mobility-type frailty is important for older people and may reduce subsequent disability, hospitalizations and mortality.

Despite all efforts went into this study, there were several limitations still. First, the demographic characteristics of participants were homogeneous, which my limit the extrapolation of results to the general population. Second, some residents declined to participate in this study and non-participants were usually relatively healthy or too frail to finish the tests. Third, the cross-sectional observational design limited the possibility to identify causal relationships, which needs a longitudinal study or intervention study for further clarification.

In conclusion, mobility-type pre-frailty/frailty may suggest complexity of care needs for LTCF residents and may be an indicator for MDS re-assessment and updates in care plans. Moreover, mobility-type pre-frailty/frailty were of greater health risk than underweight, but the two factors eventually synergistically jeopardize the health of LTCF residents. Further multicomponent intervention activities for LTCF with complex care needs are needed to improve the quality of care in LTCF settings.

CONFLICTS OF INTEREST

All authors have no conflicts of interest to declare.

Acknowledgements

This study was supported by the Veterans Affairs Commission of Taiwan, and the Ministry of Science and Technology (MOST 103-2633-B-400-002; and MOST 101-2314-B-010-008).

REFERENCES


