Associations between depressive symptoms and geriatric syndromes in community-dwelling older adults in Japan: a cross-sectional study

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Abstract

Background

It is estimated that 7.2% of community-dwelling older adults in worldwide have major depression. This cross-sectional study aimed to investigate the relationship between geriatric syndromes and depressive symptoms.

Methods

Data were obtained from 363 older adults (mean age 73.6 ± 6.6 years; women = 75.8%) who participated in a community-based health check. Depressive symptoms were assessed using the 15-item Geriatric Depression Scale (GDS-15). Depression was defined as a GDS-15 score of ≥ 5. Further, geriatric syndromes in participants—such as frailty, sarcopenia, and locomotive syndrome—were assessed.

Results

There was a 28.1% prevalence of depressive symptoms. In a logistic regression analysis with depressive symptoms as the dependent variable, both pre-frailty (odds ratio [OR] 1.85, 95% confidence interval [CI] 1.09–3.01) and frailty (OR 5.45, 95% CI 2.23–13.31) were found to be significantly higher in the depressive group.

Conclusions

Our findings suggest that depressive symptoms are associated with frailty and pre-frailty in community-dwelling older adults in Japan.

Background

Depression is a common psychiatric disorder that affects approximately 322 million people worldwide [1]. It is estimated that 7.2% of community-dwelling older adults in worldwide have major depression, and 17.1% had depression throughout their lives [2]. Factors associated with depression in old age include deterioration of life functions [3] and decline in physical [4, 5] and cognitive functions [6]. Other factors related to living conditions, such as living alone and being divorced, have also been reported [7]. Depressive symptoms are associated with adverse health outcomes, including impairment [8], mortality [9], and poor quality of life [10].

Previous studies with community-dwelling older adults have reported associations between depressive symptoms and physical [11, 12] and cognitive functions [13]. In the 3-year prospective cohort study with 680 community-dwelling older adults by Yoshida et al. [12], continued physical activity in old age was the

only factor associated with a reduction in the incidence of depressive symptoms. A previous 14-year prospective study in 1,417 older adults with no chronic illness found that exercise habits were significantly associated with depression [11]. Another study identified depression as a risk factor for dementia [13]. To date, depressive symptoms have been evaluated from the perspective of exercise or cognitive function alone, but not both.

Recent geriatric syndrome studies addressed a number of complex conditions associated with aging, such as depression, frailty [14], sarcopenia [15], and locomotive syndrome [16], while several studies focused on motor functions [17–21]. One study reported that community-dwelling frail older adults are at high risk of depression [22]. A systematic review reported an independent association between depression and sarcopenia in community-dwelling older adults [23–25], and a cross-sectional study reported an association between depression and locomotive syndrome [16, 26]. Although the association between these geriatric syndromes and depression is clear, the strength of the association is not evident.

Therefore, we conducted a cross-sectional study of typical geriatric syndromes—including frailty, sarcopenia, and locomotive syndrome—to examine their association with depression. Our findings may contribute to the prioritization of the clinical evaluation of geriatric syndromes and highlight the importance of focusing on the items included in the geriatric syndromes, such as muscle strength, muscle mass, mobility, fatigue, and weight loss.

Methods

Aim, design, and setting

Study population

Data from the Kaizuka Dementia Prevention Study 2018 and 2019 were used in this cross-sectional study. The Kaizuka Study was a community-based health check conducted in collaboration with the Osaka Kawasaki Rehabilitation University (Kaizuka City Office) and Cognitive Reserve Research Center in Osaka, Japan.

The inclusion criteria for participation were being residents of Kaizuka City and aged ≥ 60 years at the time of the study. For recruitment, a leaflet was inserted in a newspaper and posted at the public hall, and interested participants applied telephonically. Exclusion criteria were having a history of depression (n = 13), being aged 60 or under (n = 25), and missing data on the survey (n = 7). Finally, data from 363 participants (mean age 73.6 [SD ± 6.6] years; women n = 275 [75.6%]) were analyzed (Fig. 1).

Ethical considerations

This study was approved by the Ethics Committee of the authors' affiliate institution. Written informed consent was obtained from all participants in accordance with the tenets of the Declaration of Helsinki.

No compensation was provided for participation. This study was approved by the Ethics Committee of the Osaka Kawasaki Rehabilitation University (Reference No. OKRU29-A016).

Measures

Depressive symptoms

We used the Japanese version of the Geriatric Depression Scale 15 (GDS-15) to determine the existence of depressive symptoms among the participants. The GDS-15 is a self-report instrument comprising 15 items that assess the individual's mood [27, 28]. A cut-off point of 4/5 was used to define depressive symptoms in this study.

Body muscle mass

We collected data on physiological parameters obtained using bioelectrical impedance analysis (InBody270; InBody, Tokyo, Japan) at 20 and 1000 kHz frequencies from participants' electronic medical records [29]. Measurements were recorded within 30 seconds by the staff. Body mass index (BMI) was calculated by dividing body weight (kg) by squared height (m^2). The appendicular skeletal muscle index (SMI) was derived from the appendicular muscle mass (kg) divided by squared height (m^2). Low muscle mass was defined as a height-adjusted skeletal muscle mass < 7.0 kg/m^2 for men and < 5.7 kg/m^2 for women.

Muscle strength

Muscle strength was measured by handgrip strength, which has been reported to be significantly associated with whole-body muscle strength [30]. The maximum voluntary isometric strength of the handgrip was measured using a Grip-D hand dynamometer (Takei; Niigata, Japan) for the dominant hand while in a standing position. Low muscle strength was defined as a handgrip strength < 26 kg in men and < 18 kg in women.

Gait speed

We instructed participants to walk 6.4 m (divided into two 2-m zones at each end and a 2.4-m zone in the middle) at a speed they found comfortable. The time needed (s) to pass the 2.4-m middle zone was measured to calculate the gait speed (m/s) [31]. Participants could use a cane or walker if they were unable to walk without help. We used the average of five gait trials.

Cognitive status

We used the Japanese version of the Mini-Mental State Examination (MMSE), which is widely used to assess cognitive function and screen for cognitive impairment [23, 32]. MMSE scores range from 0 to 30, with lower scores representing weaker cognitive function.

Locomotive syndrome

We measured locomotive syndrome using the two-step test. Participants were asked to take two steps forward as far as possible and stop after the second step [33]. Participants were retested if they lost balance during the test or if they did not stop after the second step. They were not allowed to jump. The test was carried out until two results were obtained. The maximum length (m) covered in the two tests was selected and divided by the participant's height (m). Results were categorized as robust ($\geq$ 1.3 m/m), Locomo1 (< 1.3 m/m), and Locomo2 (< 1.1 m/m), based on the Japanese Orthopedic Association criteria [16].

Sarcopenia

We determined participants' sarcopenia status using the Asian Working Group for Sarcopenia (AWGS) consensus recommendations [15] in terms of the results of the gait test, muscle strength, and muscle mass. Participants with skeletal muscle mass loss (SMI [< 7.0 kg/m^2 for men and < 5.7 kg/m^2 for women]), low physical function (low grip strength [< 26 kg for men and < 18 kg for women] and slowness, indicated by normal walking speed [< 0.8 m/sec]), and skeletal muscle mass loss without low physical function were determined as having pre-sarcopenia.

Frailty

The definition of frailty used in this study [14] has been described in detail elsewhere. The components of frailty, as defined by Fried et al. [14], are as follows: weight loss, weakness, exhaustion, low activity level, and slowness. Weight loss was determined using the question "Have you lost 2 kg or more in the past 6 months?" taken from the Kihon Checklist, a self-report, comprehensive health checklist. Exhaustion was determined based on a response of "yes" to another question from the Kihon Checklist, "In the last 2 weeks, have you felt tired for no reason?" [34]. Weakness was defined as low muscle strength based on the grip strength assessment described earlier. Low activity level was defined as a negative response to the following questions: "Do you engage in moderate levels of physical exercise or sports aimed at health?" and "Do you engage in low levels of physical exercise aimed at health?" Slowness was defined as a walking speed of < 1.0 m/s. Participants were classified as "robust" if they had none of these symptoms, "pre-frail" if they had one or two symptoms, and "frail" in case of three or more symptoms [35].

Covariates

We collected data on sociodemographic variables, including age (years) and gender. The covariates in this study comprised these sociodemographic variables, as well as cognitive function and physical function.

Statistical analysis

All analyses were performed using IBM SPSS Statistics version 24.0 (IBM Corp., Armonk, NY, USA). P-values < 0.05 were considered to be statistically significant. To compare the depressive and non-depressive groups, we used Pearson's χ^2 tests for categorical variables, Student's t-test for continuous variables, and Mann−Whitney's U-test for ordinal variables. Non-linear logistic regression analyses were

performed to examine the association between sarcopenia, frailty, locomotive syndrome, and depressive symptoms. There were two regression models: one using crude odds ratios (ORs), while the other using adjusted ORs. Presence of depressive symptoms was the dependent variable in both models.

Results

The participant characteristics are shown in Table 1. Of the 363 participants, 102 (28.1%) had some depressive symptoms or a specific category of depressive symptoms, as determined by their GDS-15 scores. Participants in the depressive group were more likely to be frail or pre-frail and had lower MMSE scores and a higher frailty rate than those in the non-depressive group.

Table 2 shows the results of the univariate and multivariate logistic regression analyses. On univariate logistic regression analysis, pre-frailty (OR 1.81, 95% confidence interval [CI] 1.09–3.01) and frailty (OR 5.55, 95% CI 2.31–13.30) were significantly related to depressive symptoms (Crude Model). After multivariate adjusting for potential covariates, pre-frailty (OR 1.85, 95% CI 1.09–3.01) and frailty (OR 5.45, 95% CI 2.23–13.31) were found to be significantly related to depressive symptoms (Adjusted Model 1).

Discussion

This cross-sectional study showed that pre-frailty and frailty were significantly associated with depressive symptoms in older adults after adjusting for potential covariates. Thus, our results suggest that depressive symptoms are associated with pre-frailty and frailty as defined by the Japan-Cardiovascular Health Study (J-CHS). However, other geriatric syndrome, sarcopenia, locomotive syndrome were not associated with depressive symptoms.

Previous studies have reported a prevalence of depression among older adults ranging from 17.8–27.2% [36–38]. In this study, the prevalence of depressive symptoms was 28.1%, which is relatively high. It is possible that, because the participants in this study were recruited via public hall postings, city hall notices, and newspaper leaflets, the participation rate of older adults with health anxiety was higher. In a study by Tsujiguchi et al. [38] among 2,470 Japanese older adults selected from the same population, the prevalence of depression was reported to be 27.2%. The results of the present study might be generalizable to other Japanese older adults, given the similar prevalence rates.

The recent interest in "overlapping comorbidities," specifically, frailty and depression, has given rise to reviews indicating a positive association between the two [39–41]. A study with 958 adults older than 60 years found that depressive symptoms had a significant association with frailty (OR 1.8), which supports our results [42]. Another longitudinal study reported that frailty is predictive of future depressive symptoms [43].

Previous studies on frailty and depression as overlapping geriatric syndromes reported that the latent factors of frailty that were significantly correlated with depression were biological syndrome (ρ = 0.68, p < 0.01), functional domains (ρ = 0.70, p < 0.01), and frailty index (ρ = 0.61, p < 0.01) [44]. The biological

syndrome model of frailty was operationalized in terms of five criteria proposed by Fried and colleagues [14], who analyzed data from the Cardiovascular Health Study. The frailty index is a count of 70 clinical deficits, including presence of diseases, difficulty in performing daily activities, and other physical and neurological signs and symptoms. In terms of functional domains, frailty was defined as functional impairment in at least two of four domains: physical, nutritive, cognitive, and sensory. For example, a previous study [45] reported that models of frailty and depression with differing numbers of classes that represent the severity of the syndromes (two in frailty; three in depression) provided a better fit to their data, although the constructs shared a substantial amount of variance (latent kappa coefficient = 0.66); moreover, these also helped identify overlapping subgroups of participants. Using confirmatory factor analysis in the Health and Retirement Study among 3,453 participants, a moderate correlation (0.68) was found between latent categorical models of depression and the "biological definition" of frailty [46]. These findings suggest that pre-frailty and frailty are associated with depressive symptoms. Frailty comprises motor functions such as walking speed and grip strength, and these can be improved by exercise therapy, even in older adults [47]. Therefore, it may be possible to use non-pharmacological interventions to reduce depression in older adults.

Contrary to expectations, no geriatric syndromes other than frailty were associated with depressive symptoms. Although locomotive syndrome is an independent risk factor for depression [16, 26], in this study we found no significant difference between the non-depressive and depressive groups. However, an earlier study based on the 25-item Geriatric Locomotive Function Scale (GLFS-25) reported a correlation between depressive symptoms and locomotive syndrome among 224 community-dwelling older adults [26]. The reason for this discrepancy may be that the GLFS-25 questionnaire includes items on psychological characteristics, such as pain and anxiety, which may be better measures of depressive symptoms.

Previous studies of sarcopenia [23–25] found a correlation between sarcopenia and depression; however, the present study did not find a significant correlation between the two. In a 6-year prospective study with 1,731 community-dwelling older adults, sarcopenia alone was not associated with depression, but was associated with sarcopenia obesity [48]. Therefore, sarcopenia, which indicates muscle wastage, is not associated with depression alone, but may be associated with depression with regard to BMI. Speed et al. [49] investigated the relationship between fat weight, non-fat weight, and depression by analyzing the body composition data of 800,000 people and reported that fat weight was a risk factor for depression. The aforementioned findings suggest that it is important to consider sarcopenia obesity and obesity, rather than sarcopenia alone, when assessing the risk of depression.

Our study had some limitations. First, we used screening tools rather than full diagnostic procedures to assess depressive symptoms. Second, the cross-sectional design of the study precluded the assumption of a causal relationship between depressive symptoms and frailty. Third, study data were obtained from a single city, which limits the generalizability of the results, as meaningful activities in daily life are also affected by geographic characteristics. Finally, the 363 older adults enrolled represented approximately

3% of older adults living in urban areas and were not randomly selected. Therefore, sampling bias cannot be ruled out.

Conclusion

This study found a significant association of pre-frailty and frailty with depressive symptoms among community-dwelling older adults. Among the geriatric syndromes considered, frailty was strongly related to depressive symptoms, suggesting that it is possible to prevent depression by reducing frailty. We believe that the present study may be useful in developing measures to reduce the risk of future depressive symptoms among older adults.

Abbreviations

GDS-15: Geriatric Depression Scale-15, BMI Body:mass index, SMI:Skeletal muscle index, MMSE:Mini-Mental State Examination, AWGS:Asian Working Group for Sarcopenia

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the authors' affiliate institution. Written informed consent was obtained from all participants in accordance with the tenets of the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the Kaizuka Dementia Prevention Study Project Team; however, restrictions apply to the availability of these data, which were used under license for the current study, and are therefore not publicly available. Data are, however, available from the authors upon reasonable request and with permission from the Kaizuka Dementia Prevention Study Project Team.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

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Tables

Table 1. Characteristics of the participants

Variable	All participants (n = 363) mean ± SD			Non-depressive group (n = 261) mean ± SD			Depressive group (n = 102) mean ± SD			p-value
Age, years	73.6	±	6.6	73.4	±	6.5	74.1	±	6.8	0.33
Female sex, n (%)	275	(75.8)		197	(75.5)		76	(74.5)		0.89
Grip strength, kg	23.9	±	6.9	24.1	±	6.9	23.5	±	7.0	0.43
Gait speed, m/s	1.3	±	0.2	1.3	±	0.2	1.3	±	0.2	0.27
SMI, kg/m^2	6.0	±	0.9	6.1	±	0.9	6.0	±	0.9	0.56
MMSE score	28.5	±	2.3	28.7	±	2.1	28.0	±	2.6	0.02
GDS-15 score	3.3	±	2.3	2.0	±	1.4	6.3	±	1.4	0.00
Frailty, n (%)										
Robust	152	(41.9)		122	(46.7)		30	(29.4)		0.00
Pre-frail	185	(51.0)		128	(49.0)		57	(55.9)		
Frail	26	(7.2)		11	(4.2)		15	(14.7)		
Locomotive syndrome, n (%)										
Robust	97	(26.8)		71	(27.3)		26	(25.5)		0.28
Locomo1	160	(44.1)		120	(46.0)		40	(39.2)		
Locomo2	106	(29.3)		70	(26.9)		36	(35.3)		
Sarcopenia, n (%)										
Robust	178	(49.0)		128	(49.0)		50	(49.0)		0.97
Pre-sarcopenia	134	(36.9)		97	(37.2)		37	(36.3)		
Sarcopenia	51	(14.0)		36	(13.8)		15	(14.7)		

SD: standard deviation, SMI: Skeletal Muscle Mass Index,

MMSE: Mini-Mental State Examination, GDS-15: Geriatric Depression Scale

Table 2. Association between depressive symptoms and geriatric syndrome in study participants*

Frailty	Crude OR*	95%CI	p-value	aOR†	95%CI	p-value
Robust	1.00			1.00		
Pre-frail	1.81	1.09–3.01	0.02	1.85	1.09–3.01	0.02
Frail	5.55	2.31–13.30	0.00	5.45	2.23–13.31	0.00

* Presence of depressive symptoms was the dependent variable, and frailty was an independent variable;
† Adjusted for age and gender

Figures

Enrolled in the Kaizuka study 2018, 2019
($n = 591$)

Inspection non-participation ($n = 183$)

Participants in the Kaizuka study 2018, 2019
($n = 408$)

Exclusion ($n = 45$)
- Aged 60 years or under ($n = 25$)
- History of depression ($n = 13$)
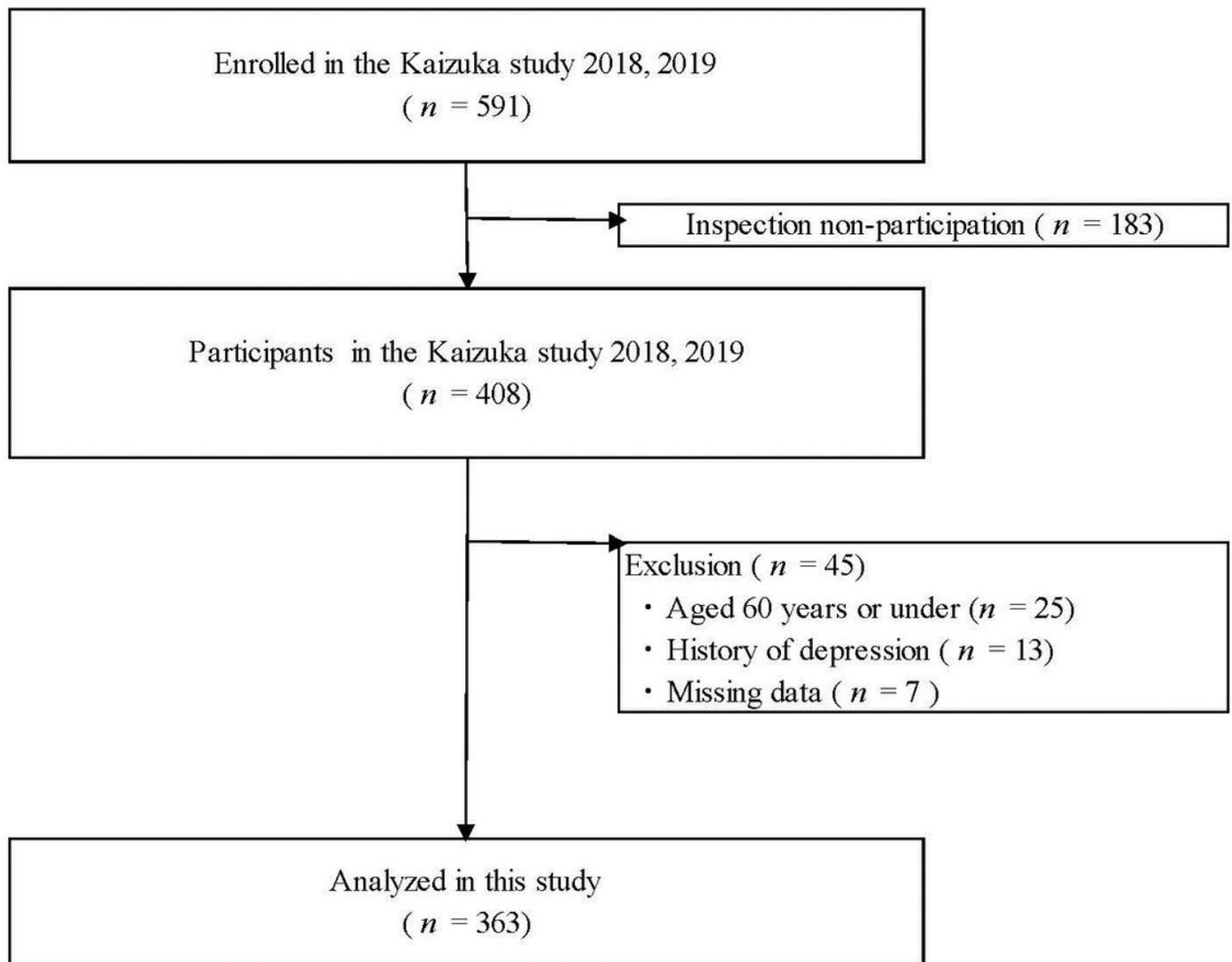- Missing data ($n = 7$)

Analyzed in this study
($n = 363$)

Figure 1

Flow chart for participant recruitment