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Kihon Checklist items associated with the development of frailty and recovery to robust status during the COVID-19 pandemic

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Aim: The Kihon Checklist (KCL) is used to assess frailty in daily life. We aimed to identify KCL items associated with the development of frailty and recovery to robust status during the COVID-19 pandemic.

Methods: We conducted a 1-year prospective cohort study of community-dwelling adults aged 70 and 75 years in Otawara City, Tochigi Prefecture, Japan. Information regarding age, sex, presence of disease and KCL items was collected in May 2020 (baseline) and June 2021 (follow-up) using a mailed questionnaire. Changes in frailty status as determined by the KCL at baseline and follow-up were evaluated. To clarify factors related to changes in the frailty status, we conducted two sets of binomial logistic regression analyses with the presence/absence of development of frailty and presence/absence of recovery to robust status at follow-up as the dependent variables and the KCL items as the independent variables.

Results: The analysis included 716 participants who provided complete responses to both questionnaires. The KCL Items 6, 10, 20, 23 and 24 were related to the development of frailty, and the KCL Items 6, 15, 21 and 23 were associated with the recovery to robust status.

Conclusions: The baseline KCL items regarding physical function and associated mental aspects were related to both development of frailty and recovery to robust status during the COVID-19 pandemic. Cognitive and depressive declines were associated with the development of frailty, while good oral environment and sense of fulfillment in life were associated with the recovery to robust status. **Geriatr Gerontol Int 2022; 22: 745–752**.

Keywords: COVID-19, frailty, Kihon Checklist, robustness, SARS-CoV-2 infection.

Introduction

The COVID-19 pandemic has dramatically altered the daily lives of people worldwide. The Japanese government declared a state of emergency on April 16, 2020, and ordered restrictions on movement and group activities to prevent the spread of COVID-19. Consequently, there has been a significant decrease in opportunities for community activities among older adults. Community activities and interactions are essential for preventing frailty among older adults; however, they have considerably reduced in most areas, which have limited human interaction and exercise in the long term. A lack of community activities and interactions may have negative physical, psychological, spiritual and social effects on older adults.[1–8]

The Cardiovascular Health Study criteria and frailty index are widely used as evaluation indexes of frailty. However, the Kihon Checklist (KCL) is considered a representative assessment tool for frailty and is recommended in clinical guidelines.[9] Specifically, the KCL comprises 25 items (yes/no questions) that assess

important areas related to frailty, including activities of daily living (Items 1–5), physical function (Items 6–10), nutritional status (Items 11 and 12), oral function (Items 13–15), outdoor activity (Items 16 and 17), cognitive function (Items 18–20) and depressive mood (Items 21–25). The KCL includes questions regarding oral function, which is rarely considered in frailty assessment. Accordingly, the KCL allows a comprehensive assessment of frailty in daily life.[10,11]

As frailty is reversible, indicating a "return to a healthy state," it is important to identify key factors associated with changes in frailty status during the COVID-19 pandemic.[12–14] No previous studies have assessed factors associated with changes in frailty status using KCL items during the COVID-19 pandemic. Therefore, the objectives of this study were to clarify the KCL items at baseline, which are related to the development of frailty and recovery to robust status during the COVID-19 pandemic, and which KCL items changed in what ways, as the statuses changed. This study could contribute toward the development of countermeasures to frailty during the pandemic.

Methods

Participants

We conducted a 1-year prospective cohort study of all community-dwelling adults aged 70 and 75 years in Otawara City, Tochigi Prefecture, Japan. All eligible participants did not require nursing care and lacked a history of COVID-19. The questionnaire was administered through the mail. The baseline questionnaire was distributed in May 2020 and the follow-up questionnaire was administered in June 2021 during the first and fourth waves of the pandemic, respectively. In total, 1771 baseline questionnaires were sent to older adults. We included 716 participants who provided complete responses at baseline and follow-up (Fig. 1). The complete response rate was 58.5% (1036 of 1771) and 70.5% (716 of 1016) at baseline and follow-up, respectively.

All participants received a written explanation regarding the questionnaire and were informed that responding would indicate consent to participate in this study. This study was approved by the Ethical Review Committee of the International University of Health and Welfare (approval no. 21-Io-38) and conducted in accordance with the guidelines of the Declaration of Helsinki.

Evaluation of frailty

The KCL was used to assess frailty at baseline and follow-up. Based on previous studies, a total score of 0–3, 4–7 and ≥8 was considered to indicate robust, pre-frailty and frailty participants, respectively.[15]

Grouping for analysis

We performed a two-part analysis. The first analysis assessed factors related to the development of frailty. Of the 716 eligible participants, 617 (robust and pre-frailty participants at baseline) were included after excluding 99 participants with frailty at baseline (Fig. 2). Among these participants, those who developed frailty between baseline and follow-up were assigned to the frailty occurrence group, and the rest were assigned to the no new frailty occurrence group.

The second analysis assessed factors associated with return to robust status. Of the 716 eligible participants, 282 (pre-frailty and frailty at baseline) were included in the analysis after excluding 434 participants who were robust at baseline (Fig. 2). Among these participants, those who developed a robust status at follow-up were assigned to the recovery to robust group, and the rest were assigned to the recovery to non-robust group.

Other variables

Data regarding age, sex and presence of disease (hypertension, hyperlipidemia, cerebrovascular disease and cancer) were collected at baseline. Furthermore, height, weight and body mass index were calculated based on the responses to Item 12 of the KCL at baseline.

Main statistical analysis

In the first analysis, binomial logistic regression was performed to assess factors associated with the development of frailty as the dependent variable. In the second analysis, binomial logistic regression was performed to assess factors associated with recovery to robust status as the dependent variable. These analyses set questionnaire items with significant between-group differences at baseline as independent variables using the stepwise method and were adjusted for age and sex. The significance of differences between groups of each item was assessed using the χ^2 test and Fisher's exact test. Statistical significance was set at 5%. All statistical analyses were performed using IBM SPSS Statistics V27.0 (IBM Corp., Armonk, NY, USA).
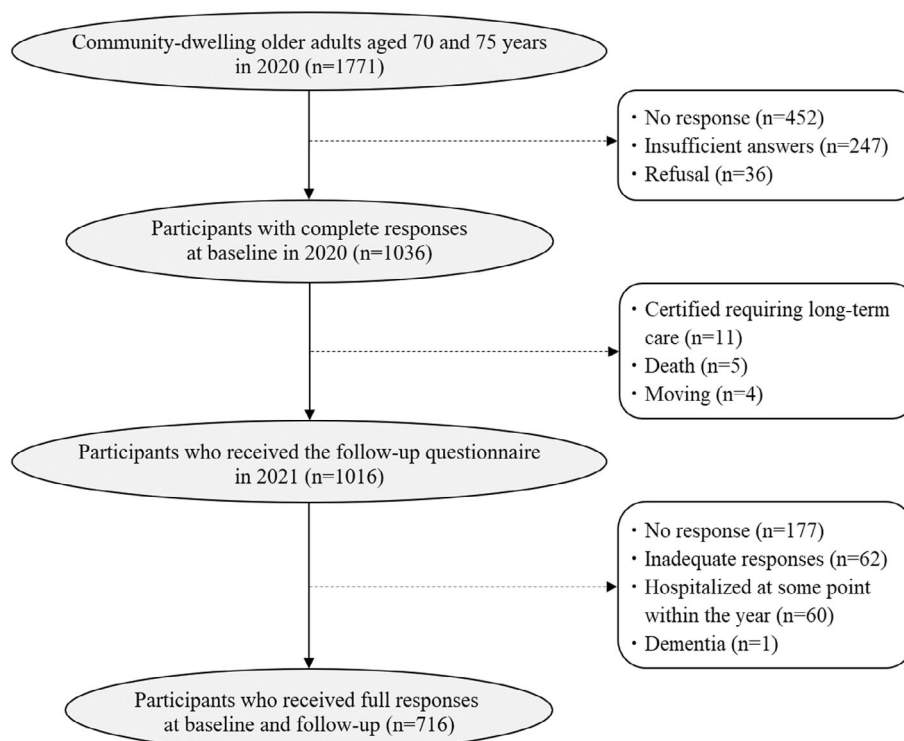
Figure 1 Flowchart of participant selection.

| | Follow-up survey in 2021 | | | |
	Robust	Pre-frailty	Frailty	Total
Robust	319	100	15	434 (60.6)
Pre-frailty	69	84	30	183 (25.6)
Frailty	5	26	68	99 (13.8)
Total	393 (54.9)	210 (29.3)	113 (15.8)	716

(Baseline survey in 2020 label spans the Robust/Pre-frailty/Frailty rows)

n (%)

First analysis (Tables 1, 3)

☐ Participants for analysis of new frailty occurrence

■ New frailty occurrence

Second analysis (Tables 2, 3)

⊡ Participants for analysis of recovery to robust status

▨ Recovery to robust status

Figure 2 Changes in the frailty status and group based on the two-part analysis.

Sub-analysis

In the first sub-analysis, baseline and follow-up comparisons of 25 items in each of the three groups (frailty occurrence, recovery to robust and remained frailty status groups) were performed by the McNemar test. The second sub-analysis was conducted using binomial logistic regression in which data on social activities were used as independent variables. The dependent variables were the same as those used in the main statistical analysis.

Results

Of the 716 participants, there were 354 men (49.4%) and 362 women (50.6%); 480 (67.0%) were aged 70 years and 236 (33.0%) were aged 75 years; 317 had hypertension, 103 hyperlipidemia, 13 cerebrovascular disease and 25 cancer.

Figure 2 shows participants' frailty status at baseline and follow-up. At baseline, there were 434 (60.6%) robust, 183 (25.6%) pre-frailty and 99 (13.8%) frailty participants. At the time of follow-up, there were 393 (54.9%) robust, 210 (29.3%) pre-frailty and 113 (15.8%) frailty participants. Of these, 45 participants developed frailty in the first analysis, and 74 participants had a recovery to robust status in the second analysis (Fig. 2).

Tables 1 and 2 show the between-group comparisons of each KCL item. There were significant differences between the frailty and non-frailty occurrence groups in KCL Items 6–10, 14, 15, 20, 21 and 23–25 (Table 1). Furthermore, there were significant between-group differences between the recovery and non-recovery to robustness groups in KCL Items 6, 7, 15 and 21–25 (Table 2).

Table 3 shows the results of binomial logistic regression analysis. The following KCL items were associated with the development of frailty: "No" for Item 6 ("Do you normally climb stairs without using handrail or wall for support?"); "Yes" for Item 10 ("Do you have a fear of falling while walking?"); "Yes" for Item 20 ("Do you find yourself not knowing today's date?"); "Yes" for Item 23 ("In the last 2 weeks have you felt difficulty in doing what you could do easily before?"); and "Yes" for Item 24 ("In the last 2 weeks have you felt helpless?"). Moreover, the following KCL items were associated with recovery to robust status: "Yes" for

Item 6 ("Do you normally climb stairs without using handrail or wall for support?"); "No" for Item 15 ("Do you often experience having a dry mouth?"); "No" for Item 21 ("In the last 2 weeks have you felt a lack of fulfillment in your daily life?"); and "No" for Item 23 ("In the last 2 weeks have you felt difficulty in doing what you could do easily before?").

In the first sub-analysis, changes in the 25 items of the KCL between baseline and follow-up are shown in Table S1. The frailty occurrence group showed significant changes in KCL Items 5, 6, 9, 10, 14, 15, 17, 18, 20, 21, 22, 23, 24 and 25, all of which indicate deterioration. The recovery to robust group showed significant changes in KCL Items 4, 5, 9, 10, 11, 13, 14, 17, 18, 20, 21, 22, 23, 24 and 25, all of which indicate improvement. The remained frail status group showed significant changes in only KCL Item 20 and it was deterioration. In the second sub-analysis, not participating in community activities was significantly associated with the development of frailty (Tables S2 and S3) and enjoying hobby activities was significantly associated with recovery to robust status (Tables S2 and S3).

Discussion

To the best of our knowledge, this is the first study to determine the KCL items at baseline associated with the development of frailty and recovery to robust status and which KCL items changed in what way as the status of frailty changed since the start of the COVID-19 pandemic. As the KCL items are directly related to daily lives, these findings could inform frailty countermeasures during the COVID-19 pandemic.

First, we discussed the characteristics of the KCL items at baseline in the changes in frailty status in the main statistical analysis. KCL Items 6 and 23 were associated with the development of frailty and recovery to robust status. Item 6 asked this question: "Do you normally climb stairs without using a handrail or wall for support?" Physical function, particularly adequate muscle strength and balance, is essential for preventing and recovering from frailty. Item 23, "In the last 2 weeks have you felt difficulty in doing what you could do easily before?" is related to physical function and mental health. Specifically, there are mutually negative effects of physical and mental aspects of frailty. There were significant differences between the frailty and non-frailty occurrence groups in Items 6–10, which involve motor function. Taken together, our findings indicated that the specific decline in "physical function" was related to the development of frailty. In addition, cognitive function (Item 20) and depression (Item 24) were associated with the development of frailty. In particular, cognitive function was associated with the development of frailty but not with recovery to robust status, which indicates that it is a characteristic aspect related to frailty occurrence. Increased anxiety levels have a strong psychological impact and are associated with cognitive functioning.[6,7,16,17] In addition, there is a relationship between cognitive function and depression, with a possible aggravating effect on frailty progression.[18] Item 15 (regarding oral function) was exclusively associated with recovery to robust status, which is an important finding. The KCL includes items regarding oral function, which are not included in most other frailty assessment tools. Oral and general health are correlated; moreover, oral function is associated with physical function.[19–23] Moreover, saliva plays various roles in maintaining oral health, food intake and preventing oral diseases.[24–26] A previous study showed that self-reported assessment of dry mouth was more useful than objective assessment, which is consistent with our findings.[24] Recovery to robust status was associated with a "No" response to "In the last 2 weeks have

Table 1 Comparison of the 25 Kihon Checklist items between participants with or without the development of frailty

No.	Question	Answer = 1	Frailty occurrence group ($n = 45$)	Non-frailty occurrence group ($n = 572$)	*P* value
1	Do you go out by bus or train by yourself?	No	2 (4.4)	24 (4.2)	1.000†
2	Do you go shopping to buy daily necessities by yourself?	No	0 (0.0)	6 (1.0)	1.000†
3	Do you manage your own deposits and savings at the bank?	No	3 (6.7)	32 (5.6)	0.735†
4	Do you sometimes visit your friends?	No	15 (33.3)	120 (21.0)	0.054
5	Do your family or friends turn to you for advice?	No	5 (11.1)	26 (4.5)	0.067†
6	Do you normally climb stairs without using handrail or wall for support?	No	16 (35.6)	67 (11.7)	<0.001*
7	Do you normally stand up from a chair without any aids?	No	7 (15.6)	32 (5.6)	0.018†,*
8	Do you normally walk continuously for 15 min?	No	7 (15.6)	38 (6.6)	0.037†,*
9	Have you experienced a fall in the past year?	Yes	11 (24.4)	73 (12.8)	0.028*
10	Do you have a fear of falling while walking?	Yes	21 (46.7)	108 (18.9)	<0.001*
11	Have you lost 2 kg or more in the past 6 months?	Yes	3 (6.7)	54 (9.4)	0.789†
12	Height: cm, weight: kg, BMI: kg/m² If BMI is less than 18.5, this item is scored.	Yes	3 (6.7)	29 (5.1)	0.501†
13	Do you have any difficulties eating tough foods compared to 6 months ago?	Yes	9 (20.0)	76 (13.3)	0.208
14	Have you choked on your tea or soup recently?	Yes	11 (24.4)	77 (13.5)	0.042*
15	Do you often experience having a dry mouth?	Yes	10 (22.2)	67 (11.7)	0.040*
16	Do you go out at least once a week?	No	3 (6.7)	12 (2.1)	0.089†
17	Do you go out less frequently compared to last year?	Yes	9 (20.0)	118 (20.6)	0.920
18	Do your family or your friends point out your memory loss? e.g. "You ask the same question over and over again."	Yes	4 (8.9)	23 (4.0)	0.126†
19	Do you make a call by looking up phone numbers?	No	2 (4.4)	17 (3.0)	0.642†
20	Do you find yourself not knowing today's date?	Yes	8 (17.8)	41 (7.2)	0.019†,*
21	In the last 2 weeks have you felt a lack of fulfillment in your daily life?	Yes	11 (24.4)	57 (10.0)	0.010†,*
22	In the last 2 weeks have you felt a lack of joy when doing the things you used to enjoy?	Yes	4 (8.9)	43 (7.5)	0.768†
23	In the last 2 weeks have you felt difficulty in doing what you could do easily before?	Yes	22 (48.9)	106 (18.5)	<0.001*
24	In the last 2 weeks have you felt helpless?	Yes	9 (20.0)	34 (5.9)	0.002†,*
25	In the last 2 weeks have you felt tired without a reason?	Yes	14 (31.1)	64 (11.2)	<0.001*

Data are n (%).

*$P < 0.05$.

No symbol: χ^2 test.

†Fisher's exact test.

Abbreviation: BMI, body mass index.

Table 2 Comparison of the 25 Kihon Checklist items between participants with or without recovery to robust status

No.	Question	Answer = 0	Recovery to robust group ($n = 74$)	Recovery to non-robust group ($n = 208$)	P value
1	Do you go out by bus or train by yourself?	Yes	67 (90.5)	170 (81.7)	0.076
2	Do you go shopping to buy daily necessities by yourself?	Yes	70 (94.6)	195 (93.8)	1.000[†]
3	Do you manage your own deposits and savings at the bank?	Yes	66 (89.2)	182 (87.5)	0.702
4	Do you sometimes visit your friends?	Yes	42 (56.8)	111 (53.4)	0.615
5	Do your family or friends turn to you for advice?	Yes	61 (82.4)	163 (78.4)	0.457
6	Do you normally climb stairs without using handrail or wall for support?	Yes	59 (79.7)	111 (53.4)	<0.001*
7	Do you normally stand up from a chair without any aids?	Yes	67 (90.5)	146 (70.2)	<0.001*
8	Do you normally walk continuously for 15 min?	Yes	64 (86.5)	159 (76.4)	0.068
9	Have you experienced a fall in the past year?	No	54 (73.0)	143 (68.8)	0.497
10	Do you have a fear of falling while walking?	No	45 (60.8)	99 (47.6)	0.051
11	Have you lost 2 kg or more in the past 6 months?	No	58 (78.4)	165 (79.3)	0.863
12	Height: cm, Weight: kg, BMI: kg/m^2 If BMI is less than 18.5, this item is scored.	No	69 (93.2)	190 (91.3)	0.609
13	Do you have any difficulties eating tough foods compared to 6 months ago?	No	54 (73.0)	132 (63.5)	0.138
14	Have you choked on your tea or soup recently?	No	50 (67.6)	135 (64.9)	0.679
15	Do you often experience having a dry mouth?	No	55 (74.3)	125 (60.1)	0.029*
16	Do you go out at least once a week?	Yes	72 (97.3)	195 (93.8)	0.368[†]
17	Do you go out less frequently compared to last year?	No	47 (63.5)	110 (52.9)	0.114
18	Do your family or your friends point out your memory loss? e.g. "You ask the same question over and over again."	No	64 (86.5)	164 (78.8)	0.151
19	Do you make a call by looking up phone numbers?	Yes	71 (95.9)	188 (90.4)	0.133
20	Do you find yourself not knowing today's date?	No	60 (81.1)	144 (69.2)	0.050
21	In the last 2 weeks have you felt a lack of fulfillment in your daily life?	No	55 (74.3)	118 (56.7)	0.008*
22	In the last 2 weeks have you felt a lack of joy when doing the things you used to enjoy?	No	59 (79.7)	140 (67.3)	0.044*
23	In the last 2 weeks have you felt difficulty in doing what you could do easily before?	No	43 (58.1)	76 (36.5)	0.001*
24	In the last 2 weeks have you felt helpless?	No	61 (82.4)	137 (65.9)	0.007*
25	In the last 2 weeks have you felt tired without a reason?	No	54 (73.0)	114 (54.8)	0.006*

Data are n (%).

*$P < 0.05$.

No symbol: χ^2 test.

[†]Fisher's exact test.

Abbreviation: BMI, body mass index.

Table 3 Kihon Checklist items associated with the development of frailty and recovery to robust status using binomial logistic regression

No.	Questions	β	Odds ratio	95% CI	*P* value
	Analysis of the development of frailty				
6	Do you normally climb stairs without using handrail or wall for support?	1.157	3.181	1.481–6.833	0.003*
10	Do you have a fear of falling while walking?	1.036	2.819	1.359–5.846	0.005*
20	Do you find yourself not knowing today's date?	0.925	2.522	1.008–6.312	0.048*
23	In the last 2 weeks have you felt difficulty in doing what you could do easily before?	1.094	2.985	1.531–5.821	0.001*
24	In the last 2 weeks have you felt helpless?	1.363	3.906	1.625–9.391	0.002*
	Analysis of recovery to robust status				
6	Do you normally climb stairs without using handrail or wall for support?	−1.172	0.310	0.158–0.606	0.001*
15	Do you often experience having a dry mouth?	−0.670	0.512	0.266–0.983	0.044*
21	In the last 2 weeks have you felt a lack of fulfillment in your daily life?	−0.876	0.416	0.219–0.790	0.007*
23	In the last 2 weeks have you felt difficulty in doing what you could do easily before?	−0.878	0.416	0.232–0.744	0.003*

*$P < 0.05$.

Abbreviation: CI, confidence interval.

you felt a lack of fulfillment in your daily life?". Participating in hobbies is fulfilling and can improve the quality of life and self-rated health.[27,28] Moreover, a previous study showed that active individuals tended to have higher levels of satisfaction with their quality of life.[29] This suggests that a good oral environment, particularly adequate moisture in the mouth, and a sense of well-being are key to recovery to robust status during the COVID-19 pandemic.

Next, we discuss the characteristics of changes in baseline and follow-up KCL responses in the first sub-analysis from three perspectives. The first perspective is the change in the items of mental health and cognitive function. The newly-occurring frailty group exhibited worsening changes, and, in contrast, the robust recovery group exhibited improving changes. Among these characteristics, all items regarding mental health (nos 21–25) exhibited significant between-group differences. "Mental health" was speculated to be an important key factor in the change in frailty status during the COVID-19 pandemic. The second perspective is the change in the frequency of giving advice and going out. The newly-occurring frailty group displayed a decrease in the frequency of those, while the robust recovery group displayed an increase in the frequency of those. It is presumed that this group was able to adapt under circumstances in which self-restraint in daily life was imposed due to the COVID-19 pandemic, i.e., they were able to ensure interactions with people and opportunities to go out. Finally, for the third perspective, analyses for fluctuations in the responses to question items even when the frailty status after 1 year was unchanged indicated that the group with no change showed a significant increase for only "Yes" to the answer to Item 20 "Do you find yourself not knowing today's date?." Decreased cognitive function is associated with the progression of frailty.[30] It is suggested that Item 20 under "Area of cognitive function" may reveal the "first symptom" of frailty deterioration during the remaining frailty status phase.

We also observed that the number of participants who recovered to robust status (74 participants) was higher than that of participants who became frail (45 participants) in the same population. In addition, the prevalence of frailty at follow-up (15.8%) was only slightly higher than the prevalence of frailty at baseline (13.8%). A previous study found a difference in the proportion of older adults with frailty before and during the COVID-19 pandemic.[8] Frailty can reportedly be reversed to a healthy state through appropriate interventions.[12–14] Our findings indicate that recovery to robust status is possible even when restrictions are being imposed during the COVID-19 pandemic.

The results of the second sub-analysis suggest engaging in hobbies that are personally enjoyed may be key to preventing the development of frailty in older adults during the COVID-19 pandemic. Furthermore, preventing the development of frailty is associated with rebuilding the local community while ensuring infection prevention.

This study has some limitations. First, we only focused on the responses to the KCL questionnaire items. Second, as this survey was only conducted in one city and among two age groups, the findings may not be generalizable to all regions in Japan or to other age groups. Third, there were no data for measured values, and detailed frailty investigations could not be conducted. Nevertheless, the study identified the KCL items associated with the development of frailty and recovery to robust status during the COVID-19 pandemic. The KCL could allow comprehensive assessment of individuals during the COVID pandemic and help prevent frailty as it is experienced in daily life.

This study identified key factors associated with changes in frailty status during the COVID-19 pandemic. The results show that the development of frailty was associated with decreased physical function and mental aspects at baseline; moreover, recovery to robust status was associated with a favorable oral environment, particularly a non-dry mouth, and a sense of fulfillment in life at baseline. Furthermore, those who newly developed frailty experienced decreased mental health, and those who underwent robust recovery had improved mental health. Item 20 under the "Area of cognitive function" may be a key factor for frailty deterioration in individuals where the frailty status remained.

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Disclosure statement

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Data availability statement

Research data are not shared.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Table S1. Comparison of the 25 Kihon Checklist items between baseline and follow-up in three groups, n (%).*P < 0.05. The remained frailty status group only includes those with the no change in frailty status at baseline and follow-up. Frailty occurrence group: answer = 1; recovery to robust group: answer = 0; remained frailty status group: answer = 1.

Table S2. Comparison of social activities among new frailty versus no new frailty occurrence and recovery to robust versus non-robust status. †Of the 617 participants in the main analysis, 47 were excluded due to missing data. ‡Of the 282 participants in the main analysis, 20 were excluded due to missing data. No symbol: χ^2 test. §Fisher's exact test.

Table S3. Social activity variables associated with the development of frailty and recovery to robust status in the binomial logistic regression analyses. *$P < 0.05$. CI, confidence interval. †Absence = 1, presence = 0; community activities. ‡Presence = 1, absence = 0; enjoying hobbies activities and working. Social activities with $P < 0.10$ in the two-group comparison (Table S2) were input into the logistic regression model as independent variables in a stepwise manner, and age and sex were included in the model.