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

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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 χ² 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.
Item 15 (regarding oral function) was exclusively 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 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 remaining 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.\(^6\) 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.\(^27\) 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        | 21 (46.7)                        | 108 (18.9)                             | <0.001* |
| 10  | Do you have a fear of falling while walking?                              | Yes        | 11 (24.4)                        | 73 (12.8)                              | 0.028*  |
| 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: χ² 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/m² 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: χ² test.

†Fisher’s exact test.

Abbreviation: BMI, body mass index.
Moreover, a previous study showed that active hobbies is fulfilling and can improve the quality of life and self-rated health. Participation 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.

### 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 |
|-----|---------------------------------------------------------------------------|-------|------------|-----------------|---------|
| 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*  |

*P < 0.05.

Abbreviation: CI, confidence interval.
Disclosure statement

The authors declare no conflict of interest.

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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 remaining 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: χ² 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.

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