

Original article

Changes in Kihon Checklist items and new Certification of long-term care needs among Japanese community-dwelling elders

Nobuhito Ishikawa¹, Toshiki Katsura², and Mayumi Hara³

¹Department of Nursing, Kyoto University of Advanced Science, Japan

²School of Nursing, Meiji University of Integrative Medicine, Japan

³Uji City Hall, Japan

Abstract

Objective: Physical frailty has been considered a risk factor for certification of long-term care needs (hereafter referred to as Certification) under Japan's long-term care insurance (LTCI). Therefore, assessment of frailty in elders should be studied from multiple perspectives. The Kihon Checklist (KCL) is widely used to identify need for support/care among Japanese older adults. This study aims to examine the relationship between changes in KCL items and Certification among Japan's young-old and old-old.

Material and Methods: The KCL responses of 7,092 participants were assessed in April 2012 and March 2016, along with gender, age, and living environment. Deaths, Certifications, and relocations were tracked until March 2018. Changes in KCL items were categorized as bad, worse, improved, or good.

Results: Between March 2016 and March 2018, about 7.3% of respondents obtained Certifications. KCL item changes increased the risk of new Certification for bad and worse groups, while improved cognitive function among the old-old possibly reduced the risk of new Certification.

Conclusion: Therefore, rather than administering the KCL once, identifying KCL changes among people at risk could help prevent or delay their need for long-term care.

Key words: Kihon Checklist, certification of long-term care needs, community-dwelling elders, changes with aging

(J Rural Med 2021; 16(4): 270–279)

Introduction

One of the most important characteristics of Japan's super-aging society is its number of “old-old” individuals, or those aged 75 and above, whose population is expected to increase significantly in the near future¹⁾, whereas the population of individuals aged 80 or older is estimated to increase markedly worldwide²⁾. Japan's old-old residents are often described as frail³⁾; physical frailty has been found

to be a risk factor for certification of long-term care needs (hereafter referred to as Certification) under Japan's long-term care insurance (LTCI)^{4–8)}. Frailty has three dimensions—physical, psychological, and social—which interact and influence each other and are believed to lead to negative health outcomes⁹⁾. Therefore, assessment of frailty in elders should be studied from multiple perspectives¹⁰⁾.

Japan's LTCI has widely applied the Kihon Checklist (KCL) to identify health risks among elders who need support and care. The advantages of the KCL are that the items are simple, and the response options are “yes” or “no”. The items are organized by dimension, which allows researchers to easily identify problems that suggest a need for intervention.

The KCL evaluates the decline in daily functions of older adults and is considered effective in predicting the need for long-term care for frailty. Therefore, it is considered that the maintenance of the life function is important for healthy longevity. Recent systematic reviews identified the KCL as a reliable tool for predicting aspects of frailty, including elders' overall vulnerability and functional disorders, Instrumental

Received: June 2, 2021

Accepted: September 7, 2021

Correspondence: Nobuhito Ishikawa, Department of Nursing, Kyoto University of Advanced Science, 18 Gotanda-cho, Yamanouchi, Ukyo-ku, Kyoto City, Kyoto 615-8577, Japan

E-mail: ishikawa.nobuhito@kuas.ac.jp

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Activities of Daily Living (IADL) limitations, and sadness/depression¹¹⁾. Previous longitudinal studies investigated the correlations between KCL items and Certification over one year using “response/no response” to the KCL items¹²⁾, with individual items as the independent variable¹³⁾. Meanwhile, other longitudinal studies that investigated the correlation between KCL items and Certification over one year used individual dimensions^{14–16)} and total score¹⁷⁾ as the independent variable. The purpose of this study was to find out if the risk of new nursing care certification due to changes in KCL over time could be different from that of a single year, or if changes in risk could be seen due to improvements, and thus contribute to the prevention of future nursing care. However, few studies confirmed a correlation between changes in KCL items and Certification using a sample of healthy community-dwelling elders. Furthermore, no longitudinal studies on repeated measurements of older individuals to date have revealed such age-related changes. This study will measure age-related changes in older adults with KCL items of two points, and elucidate how changes in individual KCL items relate to the new certifications of eligibility for long-term care to investigate concrete measures to prevent need for long-term care. The present research aims to clarify the relationship between changes in KCL items and Certification through a cohort study among young-old (age 65–74) and old-old (age 75 or older) Japanese elders. It was hypothesized that improvements in KCL items would reduce the incidence of Certification.

Methods

Participants

This cohort study was conducted in the Uji City, Kyoto Prefecture, Japan, in April 2012 (baseline). The study was conducted on a population of 13,552 community-dwelling elders aged 65 or older who were not certified as needing long-term care, and followed-up 11,372 respondents until the end of March 2016. Data on gender, age, residence, and the KCL were collected at baseline. The 7,092 participants (valid response rate = 52.3%) who responded to the KCL at baseline and in March 2016 provided the data used in this study. The KCL was implemented by the city staff on both occasions. Participants received the checklist by mail; if no response was received, the letter was re-sent twice. If after three attempts, there was still no response, engagement with that participant was discontinued. However, the researcher did not have the opportunity to comment on the research methodology because she was involved after the study was completed. After March 2016, the follow-up was terminated if participants died or moved out of the city, and such deaths or change of address were confirmed by the care needs assessment data from nursing care insurers, as well as the notifications of death or change of address reports of March 2018 (Figure 1).

The World Health Organization (WHO) defines people aged 65 and older as older adults. However, in Japan, people aged 65–74 are classified as young-old and people aged 75 and older as old-old in the medical care system and the long-term care insurance system. In order to examine the effects of changes in individual KCL items in the two classifications, the subjects were divided into the two age categories

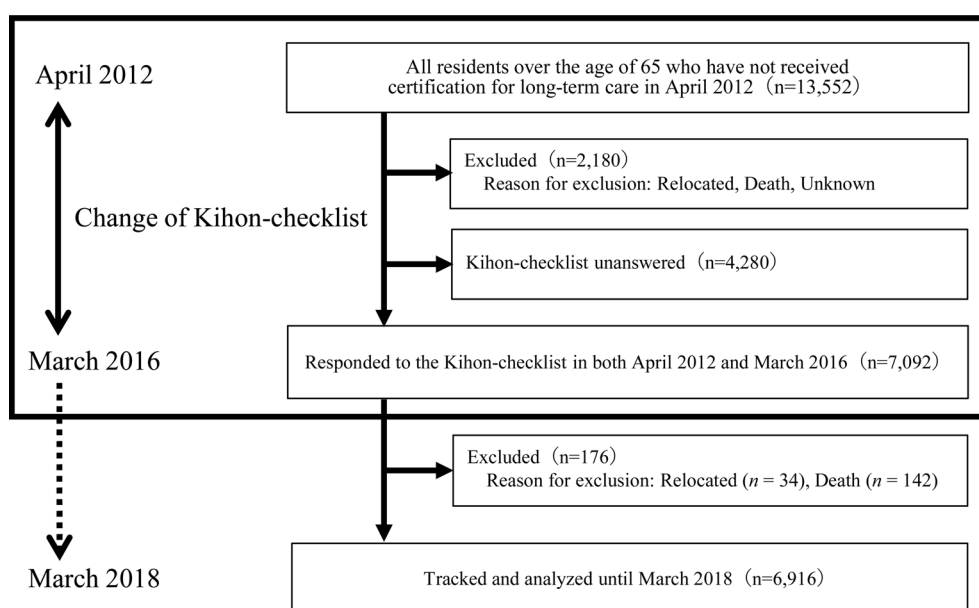


Figure 1 Participant flow chart from baseline to analysis.

in order to capture the age-related changes in daily functions of older adults based on KCL items at two points.

Regarding changes in certification over the years, Inoue *et al.*¹⁸⁾ reported that the group whose participants were independent, both initially and three years later, comprised 88.4% men and 89.2% women. This study also takes into consideration the effects of care requirements and death, analyzing changes in KCL items across three years.

The Kihon Checklist

The KCL is a 25-item self-administered questionnaire developed by the Ministry of Health, Labour and Welfare to identify elders at risk of needing care or support in the near future¹⁹⁾. It has a verified sensitivity of 75.5% and specificity of 57.8%²⁰⁾. The KCL taps into seven health dimensions: (i) frailty (i.e., on a total of 20 items, a score of 10 or more is frail), (ii) physical strength, (iii) nutritional status, (iv) oral function, (v) housebound status, (vi) cognitive function, and (vii) risk of depression, with criteria on each dimension. The change in KCL items between the April 2012 and March 2016 assessments were categorized into four groups: responses that were negative both times were “bad”, those that changed from positive to negative were “worse”, responses that changed from negative to positive were “improved”, and answers that were positive both times were “good”.

Certification

The long-term care insurance system in Japan classifies clients into eight stages: independent, requiring support (levels 1 and 2), requiring long-term care (levels 1–5), according to the degree of support or care individuals need. In this study, “Certification” refers to all people who need partial assistance (i.e., equivalent to “requiring support” in the long-term care insurance system), people who “require long-term care” due to restricted motor functions, as well as due to impaired thinking and comprehension.

The participants who were not LTCI-certified between April 2012 and March 2016 were reassessed at the end of March 2018. LTCI and Certification (i.e., long-term care level and certification period) data were derived from the LTCI section database. The date of the incident that gave rise to the need for long-term care was defined as the date of application for Certification showing the need for care (i.e., if the need for Support Required 1 or above was granted).

Statistical analyses

Statistical analyses were performed using SPSS version 24 for Windows (SPSS, Chicago, IL, USA). The sample size was 13,552 (CI: 95%, tolerance: 5%), and was set at 374. The response rate was calculated at 0.5. The incidence rates of new Certifications were compared by gender, age group (i.e., young-old [65–74] and old-old [75 or more]), and residence using chi-squared for contingency tests. The change

in each KCL item during the three-year period (April 2012–March 2016) was analyzed using the McNemar test. χ^2 tests were performed on the correlations between each KCL item’s change (i.e., four groups: bad, worse, improved, and good) and new Certifications by age group. Lastly, Cox proportional hazard models estimated the proportional hazard ratios (HR) of the incidence rates of new Certifications using the change in each KCL item by change group (i.e., bad, worse, improved, and good), with age group as the independent variable (CI: 95%). The HRs were estimated by controlling for age, gender, and residence in 2012, with the good group used as the standard. The statistical significance cut-off value was $P < 0.05$ for all tests.

Ethical considerations

The Graduate School of Medicine, Kyoto University Ethical Review Committee (R1364) approved this study. All the participants gave their written informed consent under the conditions approved by the ethics committees of the Graduate School of Medicine and Faculty of Medicine of Kyoto University and the University Hospital.

Results

Participant characteristics

In April 2012, the mean (standard deviation) age was 70.8 (\pm 5.2); 50.4% of the sample was female, and 82.0% was young-old. Between March 2016 and March 2018, about 7.3% ($n=508$) of the respondents (8.0% male, $n=271$; 6.7% female, $n=237$) obtained Certifications. There was a statistically significant difference by age group: about 4.5% ($n=261$) of the newly certified participants were young-old, while about 19.4% of them were old-old ($n=247$). For population by living area, 8.7% ($n=80$) lived in District A, 8.3% ($n=119$) in District B, 7.2% ($n=70$) in District C, 6.4% ($n=91$) in District D, 6.7% ($n=78$) in District E, and 7.0% ($n=70$) in District F (Table 1).

Table 1 Gender, age, living area, and number of new long-term care certifications (rate)

Category	Variable	Long-term care certifications	P-value
Sex	Male	271 (8.0)	0.053
	Female	237 (6.7)	
Age group	Young-old	261 (4.6)	<0.001
	Old-old	247 (20.6)	
Sphere of daily life	A-area	80 (8.7)	0.218
	B-area	119 (8.3)	
	C-area	70 (7.2)	
	D-area	91 (6.4)	
	E-area	78 (6.7)	
	F-area	70 (7.0)	

χ^2 test.

Changes in KCL items

The 25 items of the KCL were individually tested for changes between 2016 and 2018. In the overall sample, the number of participants at risk significantly increased with respect to item 19, but decreased markedly with respect to item 2; there was no significant change regarding item 4. Among the young-old, the number of participants at risk significantly increased with respect to item 17, but decreased considerably with respect to item 3; there was no significant change regarding item 5. Among the old-old, there was a significant increase in the number of participants at risk with respect to item 21, whereas there was no notable change regarding item 4 (Table 2).

Relationship between changes in each KCL item and new certification

Table 3 reports the statistically significant results of the bivariate analyses found in the overall sample, young-old subsample, and old-old subsample. The bad and worse groups had the highest percentages of new Certifications. In the overall sample and the young-old subsample, the percentage of new Certifications was highest in the bad and worse groups on item 2 (i.e., “Do you go shopping to buy daily necessities by yourself?”). Among the old-old, the highest percentage of new Certifications was in the worse group on item 22 (i.e., “In the last two weeks, have you felt a lack of joy when doing the things you used to enjoy?”). New Certifications were highest in the bad group on item 2 (i.e., “Do you go shopping to buy daily necessities by yourself?”).

Table 4 presents the results of the multivariate analysis. In the overall sample, the bad group’s dimension-5 HR was significantly larger than 1; the HR of item 19 (i.e., “Do you make phone calls by looking up phone numbers?”) was 2.64 (CI: 95%, 1.18–5.89). Similarly, the worse group’s dimension-5 HR was significantly larger than 1; the HR of item 12 (i.e., “Height: cm, weight: kg, BMI: kg/m²: if BMI is less than 18.5, this item is scored”) was 2.03 (CI: 95%, 1.30–3.15). Finally, the improved group’s dimension-4 HR was significantly larger than 1.

Regarding the young-old subgroup, the bad group’s dimension-4 HR was significantly larger than 1; the HR of item 2 (i.e., “Do you go shopping to buy daily necessities by yourself?”) was 3.87 (CI: 95%, 1.74–8.62). Similarly, the worse group’s dimension-4 HR was significantly larger than 1; the HR of item 18 (i.e., “Do your family or friends point to your memory loss?” e.g., “You repeat the same questions”) was 2.38 (CI: 95%, 1.26–4.35). Finally, the improved group’s dimension-3 HR was significantly larger than 1.

Regarding the old-old subgroup, the bad group’s dimension-3 HR was significantly larger than 1; the HR of item 19 (i.e., “Do you make a phone call by looking up phone numbers?”) was 4.09 (CI: 95%, 1.08–15.50). Similarly, the worse group’s dimension-3 HR was significantly larger than 1; the

HR of item 12 (i.e., “Height: cm, weight: kg, BMI: kg/m²: if BMI is less than 18.5, this item is scored”) was 2.29 (CI: 95%, 1.15–4.57). In addition, the improved group’s dimension-1 HR was significantly larger than 1; the HR of item 5 (i.e., “Do you turn to your family or friends for advice?”) was 2.34 (CI: 95%, 1.32–4.14). However, the improved group’s dimension-1 HR was significantly lower than 1; the HR of item 18 (i.e., “Do your family or friends point to your memory loss?” e.g., “You repeat the same questions”) was 0.20 (CI: 95%, 0.04–0.88).

Discussion

New Long-term Care Insurance Certification

This study estimated the incidence of LTCI Certifications over a two-year follow-up period (i.e., 2016 through 2018) using a sample of Japanese community-dwelling elders who did not obtain Certifications during the three-year study period (i.e., from the baseline in April 2012 through March 2016). A previous survey that determined the incidence of Certification during a one-year period found a 3.3% incidence rate among the participants¹⁶. Considering that the current study had a follow-up period of two years, the incidence rate was expected to be higher than that observed in previous studies that had shorter follow-up periods. However, the trend remained similar to the previous two-year cohort studies²¹.

The number of participants at risk significantly increased for most of KCL’s 25 items. The KCL has previously been significantly related to the Frailty Index²², and the increase in the number of participants at risk during the initial three-year period is likely a reflection of elders’ frailty-related problems. However, the KCL identifies elders with risks of frailty based on the criteria of the dimensions. Therefore, even if frailty was the cause, it might be overlooked if the determination was solely based on the KCL dimensions.

Regarding items 12 (i.e., “Height: cm, weight: kg, BMI: kg/m²: If BMI is less than 18.5, this item is scored”) and 25 (i.e., “In the past two weeks, have you felt tired without a reason?”), the number of participants at risk increased in the young-old and old-old subgroups. Since weight loss and fatigue can cause frailty to rapidly progress, items 12 and 25 might help in identifying the risk of vulnerability in women²³. Moreover, detecting a bad or worsened state is believed to help alleviate frailty. Hence, if the items were relevant during a one-year period, the changes that worsened or maintained a bad state might be detected. Among the old-old, there was an increase and a non-significant decrease in the number of participants at risk. This study was unable to identify the causes of significant decrease among participants at risk (e.g., IADLs, weight loss) for the young-old.

Table 2 Transition of each item of the Kihon Checklist

Domain	Variable	Total		<i>P</i> -value	Young-old		<i>P</i> -value	Old-old		<i>P</i> -value
		2012.4	2016.3		2012.4	2016.3		2012.4	2016.3	
(i)	1. Do you go out by bus or train by yourself?	410 (5.96)	448 (6.51)	0.099	337 (5.93)	324 (5.70)	0.545	73 (6.13)	124 (10.41)	<0.0001
	2. Do you go shopping to buy daily necessities by yourself?	242 (3.51)	224 (3.24)	0.331	196 (3.43)	157 (2.75)	<0.0001	46 (3.84)	67 (5.60)	0.010
	3. Do you manage your own deposits and savings at the bank?	722 (10.48)	672 (9.75)	0.029	599 (10.51)	533 (9.35)	0.001	123 (10.34)	139 (11.68)	0.105
	4. Do you sometimes visit your friends?	1,373 (20.02)	1,459 (21.28)	0.011	1,104 (19.47)	1,134 (20.00)	0.329	269 (22.68)	325 (27.40)	<0.0001
	5. Do you turn to your family or friends for advice?	584 (8.53)	611 (8.93)	0.329	450 (7.94)	451 (7.96)	1.000	134 (11.39)	160 (13.61)	0.058
(ii)	6. Do you normally climb stairs without using a handrail or wall for support?	1,089 (15.84)	1,654 (24.07)	<0.0001	742 (13.05)	1,125 (19.78)	<0.0001	347 (29.26)	529 (44.60)	<0.0001
	7. Do you normally stand up from a chair without any aids?	158 (2.29)	513 (7.45)	<0.0001	114 (2.00)	336 (5.90)	<0.0001	44 (3.71)	177 (14.91)	<0.0001
	8. Do you normally walk continuously for 15 minutes?	308 (4.47)	410 (5.95)	<0.0001	256 (4.50)	305 (5.36)	0.016	52 (4.37)	105 (8.82)	<0.0001
	9. Have you experienced a fall in the past year?	759 (11.02)	994 (14.43)	<0.0001	616 (10.81)	766 (13.45)	<0.0001	143 (11.99)	228 (19.11)	<0.0001
	10. Do you have a fear of falling while walking?	1,588 (23.29)	1,956 (28.69)	<0.0001	1,194 (21.16)	1,449 (25.68)	<0.0001	394 (33.53)	507 (43.15)	<0.0001
(iii)	11. Have you lost 2 kg or more in the past 6 months?	709 (10.43)	636 (9.36)	0.029	605 (10.74)	530 (9.41)	0.014	104 (8.94)	106 (9.11)	0.938
	12. Height: cm, weight: kg, BMI: kg/m ² If BMI is less than 18.5, this item is scored.	429 (6.32)	519 (7.65)	<0.0001	348 (6.18)	395 (7.01)	0.002	81 (7.03)	124 (10.76)	<0.0001
(iv)	13. Do you have any difficulties eating tough foods compared to 6 months ago?	894 (12.99)	1,318 (19.15)	<0.0001	695 (12.21)	1,001 (17.58)	<0.0001	199 (16.72)	317 (26.68)	<0.0001
	14. Have you choked on your tea or soup recently?	535 (7.76)	962 (13.95)	<0.0001	424 (7.43)	767 (13.44)	<0.0001	111 (9.33)	195 (16.39)	<0.0001
	15. Do you often experience having a dry mouth?	728 (10.62)	1,079 (15.74)	<0.0001	582 (10.26)	831 (14.65)	<0.0001	146 (12.32)	248 (20.93)	<0.0001
(v)	16. Do you go out at least once a week?	396 (5.76)	370 (5.38)	0.310	309 (5.42)	272 (4.78)	0.093	87 (7.37)	98 (8.30)	0.406
	17. Do you go out less frequently compared to last year?	845 (12.30)	1,115 (16.23)	<0.0001	598 (10.52)	781 (13.73)	<0.0001	247 (20.90)	334 (28.26)	<0.0001
(vi)	18. Do your family or your friends point out your memory loss? e.g. "You ask the same question"	461 (6.72)	589 (8.59)	<0.0001	361 (6.36)	448 (7.89)	<0.0001	100 (8.47)	141 (11.94)	0.001
	19. Do you make a call by looking up phone numbers?	390 (5.67)	494 (7.18)	<0.0001	331 (5.81)	389 (6.83)	0.010	59 (4.97)	105 (8.84)	<0.0001
	20. Do you find yourself not knowing today's date?	817 (11.87)	998 (14.50)	<0.0001	654 (11.48)	784 (13.76)	<0.0001	163 (13.72)	214 (18.01)	0.001
(vii)	21. In the last 2 weeks have you felt a lack of fulfilment in your daily life?	537 (7.83)	604 (8.81)	0.016	420 (7.40)	461 (8.12)	0.101	117 (9.90)	143 (12.10)	0.048
	22. In the last 2 weeks have you felt a lack of joy when doing the things you used to enjoy?	313 (4.56)	428 (6.24)	<0.0001	236 (4.16)	318 (5.56)	<0.0001	77 (6.53)	110 (9.33)	0.005
	23. In the last 2 weeks have you felt difficulty in doing what you could do easily before?	922 (13.42)	1,362 (19.83)	<0.0001	683 (12.02)	996 (17.54)	<0.0001	239 (20.12)	366 (30.81)	<0.0001
	24. In the last 2 weeks have you felt helpless?	615 (9.05)	768 (11.30)	<0.0001	445 (7.90)	551 (9.78)	<0.0001	170 (14.62)	217 (18.66)	0.001
	25. In the last 2 weeks have you felt tired without a reason?	846 (12.36)	1,124 (16.43)	<0.0001	641 (11.32)	843 (14.88)	<0.0001	205 (17.42)	281 (23.87)	<0.0001

McNemar test; BMI: body mass index; (I), as score of 1–20 items; (II), physical strength; (III), nutritional status; (IV), oral function; (V), houseboundness; (VI), cognitive function; (VII), depression risk. Only negative answers were posted; No answer excluded.

Table 3 Relationship between the transition of each item of the Kihon Checklist and the occurrence of certification for long-term care need: univariate analysis

Domain	Variable	Total				Young-old				Old-old						
		Transition			P-value	Transition			P-value	Transition			P-value			
		Good group	Improve- ment group	Worse group		Bad group	Improve- ment group	Worse group		Bad group	Good group	Improve- ment group		Worse group		
(i)	1. Do you go out by bus or train by yourself?	395 (6.37)	23 (9.87)	57 (21.03)	30 (16.95)	<0.0001	204 (3.95)	16 (7.88)	26 (13.68)	14 (10.45)	<0.0001	191 (18.42)	7 (23.33)	31 (38.27)	16 (37.21)	<0.0001
	2. Do you go shopping to buy daily necessities by yourself?	440 (6.75)	12 (7.41)	31 (21.53)	21 (26.25)	<0.0001	224 (4.14)	8 (5.63)	16 (15.53)	11 (20.37)	<0.0001	216 (19.46)	4 (20.00)	15 (36.59)	10 (38.46)	0.006
	3. Do you manage your own deposits and savings at the bank?	408 (6.87)	12 (4.35)	36 (15.93)	49 (10.99)	<0.0001	210 (4.26)	7 (2.90)	18 (10.29)	26 (7.26)	<0.0001	198 (19.49)	5 (14.29)	18 (35.29)	23 (26.14)	0.018
	4. Do you sometimes visit your friends?	268 (5.48)	37 (7.24)	77 (12.90)	120 (13.92)	<0.0001	136 (3.31)	21 (4.93)	39 (8.55)	62 (9.14)	<0.0001	132 (17.01)	16 (18.82)	38 (26.95)	58 (31.52)	<0.0001
	5. Do you turn to your family or friends for advice?	340 (5.77)	47 (13.78)	66 (17.93)	45 (18.52)	<0.0001	185 (3.73)	19 (7.12)	32 (11.94)	22 (12.02)	<0.0001	155 (16.45)	28 (37.84)	34 (34.00)	23 (38.33)	<0.0001
(ii)	6. Do you normally climb stairs without using handrail or wall for support?	232 (4.80)	36 (9.30)	125 (13.10)	105 (14.90)	<0.0001	147 (3.45)	13 (4.26)	59 (8.58)	41 (9.38)	<0.0001	85 (14.76)	23 (28.40)	66 (25.10)	64 (24.06)	<0.0001
	7. Do you normally stand up from a chair without any aids?	398 (6.30)	13 (13.30)	78 (17.20)	12 (20.00)	<0.0001	214 (4.05)	7 (9.09)	33 (11.04)	5 (13.51)	<0.0001	184 (18.60)	6 (28.57)	45 (29.22)	7 (30.43)	0.009
	8. Do you normally walk continuously for 15 minutes?	423 (6.70)	23 (11.10)	48 (15.50)	6 (5.90)	<0.0001	215 (4.12)	16 (9.25)	21 (9.46)	5 (6.02)	<0.0001	208 (19.79)	7 (20.59)	27 (31.03)	1 (5.56)	0.033
	9. Have you experienced a fall in the past year?	360 (6.70)	39 (7.00)	84 (10.60)	22 (11.10)	<0.0001	197 (4.41)	14 (3.02)	38 (6.19)	12 (7.89)	0.016	163 (17.61)	25 (26.04)	46 (25.41)	10 (21.28)	0.105
	10. Do you have a fear of falling while walking?	236 (5.50)	48 (8.00)	104 (10.70)	106 (10.80)	<0.0001	142 (3.83)	26 (5.32)	53 (7.12)	37 (5.25)	0.001	94 (16.97)	22 (19.30)	51 (22.47)	69 (24.64)	0.05
(iii)	11. Have you lost 2 kg or more in the past 6 months?	367 (6.60)	57 (9.90)	45 (8.90)	24 (18.30)	<0.0001	182 (3.95)	39 (7.86)	27 (6.41)	12 (11.01)	<0.0001	185 (18.97)	18 (21.95)	18 (21.43)	12 (54.55)	0.001
	12. Height: cm, weight: kg, BMI: kg/m ² . If BMI is less than 18.5, this item is scored.	412 (6.70)	10 (10.10)	34 (18.00)	29 (8.80)	<0.0001	221 (4.29)	6 (6.90)	14 (10.45)	12 (4.60)	0.005	191 (18.80)	4 (33.33)	20 (36.36)	17 (24.64)	0.006
(iv)	13. Do you have any difficulties eating tough foods compared to 6 months ago?	334 (6.40)	33 (8.60)	84 (10.40)	53 (10.40)	<0.0001	188 (4.28)	19 (6.29)	34 (5.59)	20 (5.09)	0.206	146 (18.46)	14 (17.50)	50 (25.25)	33 (27.73)	0.029
	14. Have you choked on your tea or soup recently?	387 (6.80)	25 (10.80)	66 (10.00)	25 (8.30)	<0.0001	212 (4.46)	15 (8.15)	26 (4.93)	7 (2.92)	0.065	175 (18.48)	10 (20.83)	40 (30.30)	18 (28.57)	0.005
	15. Do you often experience having a dry mouth?	353 (6.50)	25 (6.70)	89 (12.30)	34 (9.60)	<0.0001	189 (4.17)	14 (4.52)	38 (6.80)	17 (6.25)	0.020	164 (18.74)	11 (17.74)	51 (31.10)	17 (20.24)	0.004
(v)	16. Do you go out at least once a week?	410 (6.60)	35 (11.10)	43 (14.80)	12 (15.00)	<0.0001	210 (4.06)	24 (9.64)	19 (8.96)	6 (10.00)	<0.0001	200 (19.69)	11 (16.42)	24 (30.77)	6 (30.00)	0.064
	17. Do you go out less frequently compared to last year?	280 (5.30)	44 (9.40)	104 (14.10)	70 (18.60)	<0.0001	166 (3.66)	24 (6.58)	45 (8.21)	23 (9.87)	<0.0001	114 (15.32)	20 (19.23)	59 (30.89)	47 (32.87)	<0.0001
(vi)	18. Do your family or your friends point out your memory loss? e.g. "You ask the same question"	393 (6.50)	23 (8.60)	57 (14.40)	26 (13.50)	<0.0001	203 (4.05)	17 (7.76)	25 (8.17)	14 (9.86)	<0.0001	190 (19.19)	6 (12.00)	32 (35.16)	12 (24.00)	0.001
	19. Do you make a call by looking up phone numbers?	391 (6.90)	48 (6.80)	53 (12.00)	12 (23.10)	<0.0001	212 (4.48)	20 (3.49)	23 (6.55)	6 (15.38)	0.002	179 (18.80)	28 (21.37)	30 (32.61)	6 (46.15)	0.002
	20. Do you find yourself not knowing today's date?	346 (6.40)	39 (8.90)	69 (11.10)	46 (12.20)	<0.0001	195 (4.28)	18 (5.06)	26 (5.35)	21 (7.05)	0.114	151 (16.97)	21 (25.00)	43 (31.85)	25 (31.65)	<0.0001
(vii)	21. In the last 2 weeks have you felt a lack of fulfillment in your daily life?	366 (6.20)	40 (11.60)	61 (14.80)	31 (16.10)	<0.0001	193 (3.91)	24 (8.66)	25 (7.86)	16 (11.19)	<0.0001	173 (17.80)	16 (23.88)	36 (38.71)	15 (30.00)	<0.0001
	22. In the last 2 weeks have you felt a lack of joy when doing the things you used to enjoy?	400 (6.40)	23 (10.60)	55 (16.60)	19 (19.80)	<0.0001	210 (4.04)	14 (8.33)	23 (9.20)	11 (16.18)	<0.0001	190 (18.63)	9 (18.37)	32 (39.02)	8 (28.57)	<0.0001
	23. In the last 2 weeks have you felt difficulty in doing what you could do easily before?	274 (5.40)	47 (10.80)	103 (11.80)	75 (15.40)	<0.0001	167 (3.85)	27 (7.87)	36 (5.49)	29 (6.53)	<0.0001	107 (14.64)	20 (21.98)	67 (30.73)	46 (31.08)	<0.0001
	24. In the last 2 weeks have you felt helpless?	336 (5.90)	39 (11.80)	69 (14.30)	47 (16.50)	<0.0001	191 (3.95)	14 (5.62)	31 (8.73)	20 (10.20)	<0.0001	145 (16.78)	25 (30.49)	38 (29.46)	27 (30.68)	<0.0001
	25. In the last 2 weeks have you felt tired without a reason?	303 (5.70)	38 (9.00)	89 (12.70)	65 (15.30)	<0.0001	171 (3.81)	21 (6.33)	38 (7.12)	28 (9.06)	<0.0001	132 (16.38)	17 (18.89)	51 (30.72)	37 (32.17)	<0.0001

χ^2 test; N (%): BMI: body mass index; (I), as score of 1–20 items; (II), physical strength; (III), nutritional status; (IV), oral function; (V), houseboundness; (VI), cognitive function; (VII), depression risk. Bad group, negative answer remains; Worse group, negative answer from positive answer; Improvement group, positive answer from negative answer; Good group, positive answer; No answer excluded.

Table 4 Relationship between the transition of each item of the Kihon Checklist and new long-term care insurance certification: multivariate analysis

Domain	Variable	Transition	Total			Young-old			Old-old					
			HR	95%CI	P-value	HR	95%CI	P-value	HR	95%CI	P-value			
(i)	1. Do you go out by bus or train by yourself?	Good group	1.00			1.00			1.00					
		Improvement group	1.77	1.08	2.9	0.023	1.89	1.06	3.39	0.032	2.18	0.78	6.12	0.139
		Worse group	1.63	1.11	2.39	0.013	1.73	1.02	2.95	0.043	1.26	0.67	2.37	0.474
		Bad group	1.25	0.75	2.06	0.392	1.01	0.5	2.04	0.986	1.08	0.46	2.5	0.863
	2. Do you go shopping to buy daily necessities by yourself?	Good group	1.00			1.00			1.00					
		Improvement group	1.01	0.54	1.89	0.966	1.11	0.5	2.43	0.8	1.45	0.48	4.43	0.511
		Worse group	0.81	0.47	1.41	0.457	1.26	0.59	2.66	0.548	0.52	0.19	1.38	0.187
		Bad group	2.35	1.32	4.17	0.004	3.87	1.74	8.62	0.001	1.72	0.68	4.38	0.255
	3. Do you manage your own deposits and savings at the bank?	Good group	1.00			1.00			1.00					
		Improvement group	0.55	0.29	1.06	0.076	0.69	0.31	1.51	0.351	0.42	0.12	1.46	0.173
		Worse group	1.16	0.74	1.8	0.517	1.2	0.65	2.22	0.562	1.31	0.6	2.84	0.498
		Bad group	0.82	0.55	1.23	0.339	0.72	0.42	1.24	0.238	1.06	0.55	2.07	0.856
	4. Do you sometimes visit your friends?	Good group	1.00			1.00			1.00					
		Improvement group	1.17	0.78	1.74	0.459	1.25	0.73	2.15	0.423	1.29	0.69	2.44	0.427
		Worse group	1.18	0.85	1.65	0.318	1.57	1.00	2.48	0.05	0.85	0.5	1.44	0.552
		Bad group	1.44	1.06	1.94	0.019	1.92	1.28	2.87	0.002	0.92	0.54	1.57	0.767
	5. Do you turn to your family or friends for advice?	Good group	1.00			1.00			1.00					
		Improvement group	1.7	1.16	2.48	0.006	1.17	0.65	2.11	0.599	2.34	1.32	4.14	0.004
		Worse group	1.6	1.14	2.25	0.007	1.89	1.17	3.04	0.009	1.19	0.68	2.06	0.541
		Bad group	1.55	1.02	2.36	0.041	1.2	0.65	2.2	0.555	2.69	1.34	5.38	0.005
(ii)	6. Do you normally climb stairs without using a handrail or wall for support?	Good group	1.00			1.00			1.00					
		Improvement group	1.12	0.73	1.73	0.61	0.66	0.32	1.37	0.263	1.5	0.83	2.72	0.182
		Worse group	1.55	1.18	2.04	0.002	1.58	1.09	2.28	0.016	1.51	0.98	2.31	0.062
		Bad group	1.27	0.93	1.73	0.141	1.59	1.02	2.49	0.042	1.08	0.68	1.72	0.747
	7. Do you normally stand up from a chair without any aids?	Good group	1.00			1.00			1.00					
		Improvement group	1.49	0.74	3.01	0.269	1.78	0.7	4.53	0.224	1.81	0.55	5.9	0.326
		Worse group	1.21	0.88	1.67	0.248	1.3	0.8	2.11	0.286	1.04	0.65	1.67	0.868
		Bad group	1.56	0.83	2.94	0.167	1.92	0.69	5.35	0.21	0.71	0.27	1.91	0.502
	8. Do you normally walk continuously for 15 minutes?	Good group	1.00			1.00			1.00					
		Improvement group	0.98	0.58	1.65	0.936	1.48	0.8	2.74	0.214	0.51	0.17	1.54	0.234
		Worse group	0.91	0.61	1.35	0.635	0.89	0.5	1.61	0.71	0.81	0.44	1.49	0.489
		Bad group	0.64	0.28	1.47	0.294	1.02	0.4	2.64	0.96	0.24	0.03	1.91	0.179
	9. Have you experienced a fall in the past year?	Good group	1.00			1.00			1.00					
		Improvement group	0.94	0.62	1.42	0.765	—	—	—	—	—	—	—	—
		Worse group	1.07	0.81	1.42	0.619	1.13	0.76	1.68	0.544	1.09	0.71	1.67	0.702
		Bad group	0.86	0.47	1.58	0.635	1.75	0.71	4.29	0.222	0.39	0.11	1.34	0.133
	10. Do you have a fear of falling while walking?	Good group	1.00			1.00			1.00					
		Improvement group	0.94	0.65	1.36	0.748	1.01	0.63	1.62	0.974	0.91	0.49	1.69	0.764
		Worse group	0.99	0.75	1.33	0.967	1.05	0.71	1.56	0.8	0.88	0.56	1.38	0.572
		Bad group	0.95	0.71	1.28	0.746	0.85	0.54	1.33	0.469	1.13	0.73	1.75	0.594
(iii)	11. Have you lost 2 kg or more in the past 6 months?	Good group	1.00			1.00			1.00					
		Improvement group	1.48	1.07	2.06	0.019	1.98	1.34	2.93	0.001	0.88	0.43	1.8	0.722
		Worse group	0.99	0.69	1.43	0.969	1.04	0.63	1.7	0.884	0.94	0.52	1.71	0.841
		Bad group	1.79	1.03	3.09	0.038	1.69	0.81	3.51	0.162	1.74	0.59	5.11	0.313
	12. Height: cm, weight: kg, BMI: kg/m ² If BMI is less than 18.5, this item is scored.	Good group	1.00			1.00			1.00					
		Improvement group	1.47	0.73	2.97	0.277	1.36	0.54	3.47	0.514	1.41	0.42	4.76	0.582
		Worse group	2.03	1.3	3.15	0.002	2.12	1.15	3.9	0.016	2.29	1.15	4.57	0.018
		Bad group	1.37	0.89	2.1	0.148	1.3	0.7	2.45	0.407	1.57	0.84	2.93	0.153
(iv)	13. Do you have any difficulties eating tough foods compared to 6 months ago?	Good group	1.00			1.00			1.00					
		Improvement group	0.92	0.6	1.42	0.713	0.91	0.5	1.66	0.768	0.74	0.37	1.48	0.389
		Worse group	0.91	0.67	1.23	0.534	0.81	0.52	1.27	0.355	1.05	0.67	1.62	0.838
		Bad group	1.1	0.78	1.56	0.58	0.81	0.48	1.38	0.446	1.22	0.72	2.07	0.46
	14. Have you choked on your tea or soup recently?	Good group	1.00			1.00			1.00					
		Improvement group	1.61	1.01	2.58	0.047	1.57	0.86	2.88	0.141	1.53	0.68	3.44	0.301
		Worse group	1.01	0.73	1.39	0.974	0.74	0.45	1.22	0.236	1.45	0.91	2.32	0.12
		Bad group	1.09	0.69	1.71	0.715	0.53	0.22	1.23	0.14	1.68	0.9	3.11	0.101
	15. Do you often experience having a dry mouth?	Good group	1.00			1.00			1.00					
		Improvement group	0.79	0.48	1.29	0.34	1.01	0.56	1.82	0.974	0.48	0.19	1.23	0.127
		Worse group	1.23	0.92	1.63	0.164	1.26	0.84	1.9	0.262	1.3	0.83	2.05	0.255
		Bad group	0.91	0.59	1.39	0.653	1.12	0.63	1.99	0.697	0.72	0.37	1.44	0.357

Table 4 (continue)

Domain	Variable	Transition	Total				Young-old				Old-old				
			HR	95%CI		P-value	HR	95%CI		P-value	HR	95%CI		P-value	
(v)	16. Do you go out at least once a week?	Good group	1.00				1.00				1.00				
		Improvement group	1.26	0.83	1.92	0.287	1.71	1.03	2.85	0.038	0.78	0.34	1.82	0.567	
		Worse group	1.03	0.68	1.55	0.891	1.01	0.55	1.86	0.985	1.1	0.6	2.03	0.761	
		Bad group	1.13	0.57	2.24	0.724	1.04	0.4	2.71	0.935	2.34	0.8	6.81	0.119	
	17. Do you go out less frequently compared to last year?	Good group	1.00				1.00				1.00				
		Improvement group	0.96	0.64	1.44	0.847	1.12	0.66	1.91	0.674	0.77	0.39	1.54	0.465	
		Worse group	1.5	1.11	2.01	0.008	1.41	0.91	2.19	0.126	1.91	1.24	2.95	0.003	
		Bad group	1.42	0.99	2.02	0.057	1.65	0.96	2.85	0.071	1.24	0.72	2.16	0.438	
(vi)	18. Do your family or your friends point out your memory loss? e.g. “You ask the same question”	Good group	1.00				1.00				1.00				
		Improvement group	1.01	0.6	1.68	0.983	1.86	1.06	3.28	0.031	0.2	0.04	0.88	0.033	
		Worse group	1.25	0.87	1.81	0.227	1.38	0.81	2.35	0.233	1.18	0.68	2.04	0.56	
		Bad group	1.4	0.87	2.27	0.167	2.34	1.26	4.35	0.007	0.74	0.32	1.72	0.484	
	19. Do you make a call by looking up phone numbers?	Good group	1.00				1.00				1.00				
		Improvement group	–	–	–	–	0.71	0.38	1.31	0.268	1.38	0.75	2.54	0.295	
		Worse group	0.9	0.63	1.28	0.546	0.71	0.43	1.2	0.205	1.17	0.68	2.03	0.567	
		Bad group	2.64	1.18	5.89	0.018	1.52	0.55	4.18	0.421	4.09	1.08	15.49	0.038	
	20. Do you find yourself not knowing today’s date?	Good group	1.00				1.00				1.00				
		Improvement group	0.94	0.63	1.41	0.76	0.94	0.54	1.62	0.811	1.12	0.58	2.18	0.731	
		Worse group	0.96	0.69	1.32	0.782	0.8	0.5	1.3	0.372	1.21	0.75	1.97	0.432	
		Bad group	1.01	0.68	1.49	0.972	0.83	0.48	1.45	0.513	2.03	1.09	3.77	0.025	
	(vii)	21. In the last 2 weeks have you felt a lack of fulfilment in your daily life?	Good group	1.00				1.00				1.00			
			Improvement group	1.45	0.95	2.21	0.084	1.43	0.83	2.47	0.193	1.21	0.57	2.57	0.62
			Worse group	1.26	0.87	1.84	0.227	0.97	0.54	1.73	0.905	1.44	0.81	2.54	0.213
			Bad group	1.16	0.67	1.99	0.597	1.22	0.58	2.56	0.602	0.82	0.31	2.19	0.699
22. In the last 2 weeks have you felt a lack of joy when doing the things you used to enjoy?		Good group	1.00				1.00				1.00				
		Improvement group	0.73	0.42	1.27	0.262	1.11	0.54	2.29	0.778	0.58	0.2	1.68	0.313	
		Worse group	0.92	0.61	1.39	0.7	0.82	0.43	1.57	0.552	0.92	0.51	1.68	0.79	
		Bad group	1.24	0.59	2.6	0.564	1.41	0.53	3.8	0.492	1.73	0.45	6.63	0.421	
23. In the last 2 weeks have you felt difficulty in doing what you could do easily before?		Good group	1.00				1.00				1.00				
		Improvement group	1.21	0.81	1.8	0.347	1.14	0.67	1.93	0.633	1.3	0.65	2.61	0.455	
		Worse group	0.94	0.69	1.29	0.703	0.77	0.49	1.23	0.273	1.21	0.75	1.97	0.432	
		Bad group	0.86	0.57	1.3	0.478	0.67	0.35	1.27	0.223	1.12	0.62	2.03	0.714	
24. In the last 2 weeks have you felt helpless?		Good group	1.00				1.00				1.00				
		Improvement group	1.06	0.68	1.65	0.814	0.82	0.41	1.62	0.561	1.21	0.63	2.34	0.57	
		Worse group	1.21	0.86	1.7	0.265	1.32	0.82	2.13	0.252	1.03	0.61	1.74	0.914	
		Bad group	1.09	0.73	1.65	0.672	1.23	0.68	2.25	0.493	1.11	0.59	2.12	0.74	
25. In the last 2 weeks have you felt tired without a reason?		Good group	1.00				1.00				1.00				
		Improvement group	0.98	0.65	1.48	0.925	0.78	0.44	1.4	0.41	1.04	0.54	2.01	0.908	
		Worse group	1.32	0.97	1.82	0.081	1.07	0.68	1.69	0.778	1.45	0.89	2.36	0.133	
		Bad group	1.16	0.78	1.72	0.474	1.12	0.64	1.96	0.68	1.16	0.63	2.15	0.633	

CI: confidence interval; HR: hazard ratio; BMI: body mass index; (I), as score of 1–20 items; (II), physical strength; (III), nutritional status; (IV), oral function; (V), houseboundness; (VI), cognitive function; (VII), depression risk; Adjusted age, gender, and living area.

Relationship between change in each KCL item and new Certification

Among the young-old, there was a relationship between the bad and worse groups regarding new Certification and items 2 (i.e., "Do you go shopping to buy daily necessities by yourself?"), 4 (i.e., "Do you sometimes visit your friends?"), 6 (i.e., "Do you normally climb stairs without using a handrail or wall for support?"), and 18 (i.e., "Do your family or friends point to your memory loss?" e.g., "You repeat the same questions"). Among the old-old, associations were found for items 5 (i.e., "Do you turn to your family or friends for advice?"), item 19 ("Do you make phone calls by looking up phone numbers?") and 20 (i.e., "Do you find yourself not knowing today's date?"). The largest HR was a strong correlation that is greater than 3.0. Furthermore, among the young-old, associations were found for the worse

group regarding Certification and items 1 (i.e., "Do you go out by bus or train by yourself?"), 5 (i.e., "Do you turn to your family or friends for advice?"), 6 (i.e., "Do you normally climb stairs without using a handrail or wall for support?"), and 12 (i.e., "Height: cm, weight: kg, BMI: kg/m²: if BMI is less than 18.5, this item is scored."). Among the old-old, correlations were found for items 12 (i.e., "Height: cm, weight: kg, BMI: kg/m²: if BMI is less than 18.5, this item is scored.") and 17 (i.e., "Do you go out less frequently now than you did last year?").

In previous studies, the odds ratios of the KCL items over one year with respect to Certification were 1.25–2.71^{15, 16)}, while the proportional HRs were 1.13–2.26^{13, 14)}. The present study differs from previous studies since it identifies changes over a three-year period, with a subsequent two-year follow-up on the incidence of new LTCI Certifications.

The finding that risks of Certification increased in the bad and worse groups after controlling for the effects of factors such as age suggests that it is important to not only assess the KCL items for one year, but also identify the changes in those items, particularly changes to worse states or maintenance of bad conditions.

KCL dimension-4 is assessed using the sum of the scores in items 1–20. Items 1–5 assess IADLs; however, given that IADLs are included in dimension-4, they are not solely used to assess frailty risk. Dimension-4 did not predict new Certifications; men's motor function was the only significant predictor of new Certifications¹⁴. Therefore, it is possible that elders' frailty might be overlooked, and it is necessary to evaluate not only the total score, but also the changes in each item within the dimensions to reduce the number of new LTCI Certifications. In addition, item 12, which assesses undernutrition, correlated with Certifications in the worse group of the young-old and old-old subgroups^{24, 25}. Undernutrition might cause rapid onset frailty²³ and create risk of Certification. Thus, individuals who identify with this item should be assessed regarding risk of undernutrition, and, if found, immediate intervention should ensue.

However, new Certifications suggested that improvement on some KCL items did not necessarily lower risk of Certification. Hence, rather than evaluating changes in the items, assessing and examining appropriate interventions in cases of initially negative responses are needed.

Ultimately, the current study found that improvements in the KCL reduced the incidence of new Certification. However, as only new occurrences were collected, and the changes measured were only in relation to the performance of the good group, our results are not surprising. Nevertheless, our findings contribute to the limited literature on changes in the KCL.

Limitations of the study

This study has several limitations. First, considering that Japanese elders are likely in better health than their American counterparts²⁶ and changes in KCL items might differ between them, it is imperative to conduct comparative studies across developed countries. In addition, the findings are difficult to generalize because this was a sample study conducted in one city. In order to confirm this study's results, it is important to replicate it using data from other regions.

Second, the independent variable was limited to the

KCL because of this study's focus on changes in KCL items and LTCI Certification. To further prevent the need for long-term care, it is important to identify risks by simultaneously analyzing health checkups, medical, nursing care, and social costs.

Third, changes in each KCL item were monitored across three years. Since there have been few previous studies and the city's voluntary exhaustive survey was conducted three years later, this study set the observation period as three years. In Japan, a KCL investigation is conducted when applying for LTCI. Changes in KCL items should be tracked yearly among healthy and independent community-dwelling elders through continuous annual surveys, if possible, as a way to facilitate detailed analysis for preventing long-term care.

Lastly, the researcher did not intervene in the study, and follow-up with dropouts was not possible. Essentially, we were unable to devise ways to reduce the number of dropouts. However, there was no significant difference in gender or age between those who completed and those who dropped out of the study.

Conclusion

Among Japan's community-dwelling elders, changes in KCL items increased the risk of new Certification for the bad and worse groups. However, improvement in cognitive function in the old-old group indicated a possibly reduced risk of new Certification. The results suggested that improvement on certain items might not necessarily reduce the risk of new Certification. Hence, rather than administering KCL one time, identifying changes in KCL for people at risk would likely help to prevent or delay the need for long-term care.

Author contribution: NI analyzed and interpreted the data on care and prevention. KT provided insights into preventive nursing and care prevention and contributed significantly to the writing of the manuscript. HM collected data. All authors read and approved the final manuscript.

Funding: This work was supported by the 2018 gerontology research grants of the Sompo Japan Nipponkoa Welfare Foundation.

Conflict of interest: None.

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