Title

Cognitive Decline Screening Model for Staff at Community General Support Centers: An IRIDE Cohort Study

Short Title

Cognitive Decline Screening Model

Authors

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ABSTRACT

Background: A tool to assess cognitive function among community-dwelling older adults without cognitive testing is needed because regular cognitive assessments require considerable time and effort owing to the rapidly aging population. This study developed a screening model for the early detection of cognitive decline for use by community general support center staff and verify its accuracy.

Methods: We used a dataset from the IRIDE Cohort Study (data from five cohorts merged) and created two models. Age, sex, medical history, and lifestyle factors were included as variables in Model 1. Model 2 additionally included years of education. A binary logistic regression analysis was conducted using Mini-Mental State Examination (MMSE) scores as the objective variable. Subsequently, the integer scores of the coefficients were calculated to develop the final models.

Results: The analysis included 7,028 individuals (4,549 women, mean age = 74.8). Of the participants, 512 (7.3%) had MMSE scores below 24, indicating cognitive decline. In the final version of Model 1, the cutoff value was 4/5; sensitivity, 76.2%; and specificity, 63.1%, with an area under the receiver operating characteristic curve (AUC) of 0.774 (95% CI = 0.754–0.795). In the final version of Model 2, the cutoff value was 0/1; sensitivity, 76.6%; specificity, 68.7%; and AUC, 0.804 (95% CI = 0.786–0.823).

Conclusions: Both models had acceptable accuracy for detecting cognitive decline, but Model 2 was more accurate. Therefore, it is important for staff to ask respondents about their years of education.

*Keywords***:** community-dwelling adults, Mini-Mental State Examination, model development, Japan

INTRODCUTION

Older adults (65 years and older) account for 29.1% of the total population in Japan, and this proportion is expected to reach 36.3% by 2045[1]. Physical and mental health tend to decline with age, and cognitive function is crucial when making future decisions. The proportion of individuals with dementia in Japan is estimated to increase to 14.9% of all older adults by 2040[1], and this percentage is also rising in Western countries [2]. Although the early detection of cognitive decline is important, regular cognitive assessments or group-based health examinations of older adults require considerable time and effort owing to the rapidly aging population. Hence, if those in close contact with older adults can make assessments based on supplementary information (e.g., medical history and lifestyle), rather than relying solely on cognitive function assessments by experts, the number of people who notice cognitive decline is expected to increase. Therefore, a method of assessing cognitive function that can be used by non-experts is required.

In Japan, staff members at community general support centers are expected to play this role. Community general support centers are facilities in which public health nurses, social workers, chief care support specialists, and others work together to comprehensively aid the maintenance and stability of the health of local older adults [3]. Japan has 5,431 community general support centers that serve as consultation desks for the general nursing care of older adults, adult guardianship, and requests for preventive care. Staff also visit older adults living alone in their homes and monitor them. Thus, staff at community general support centers have a close relationship with older adults; however, their job does not include the early detection of dementia. Therefore, Japan, which is considered to be a super-aging society, requires a screening model that allows non-expert staff members to easily assess a decline in cognitive function among older adults using a cognitive screening model.

The simple models for cognitive decline presented by Abe et al. screen for cognitive decline without relying on cognitive testing [4]. People aged 65 years or older with a Mini-Mental State Examination (MMSE) score of ≤23 points are operationally defined as having cognitive decline. In addition to sex, age, and years of education, the model, which was developed based on MMSE scores of 23 and 24, evaluates 10 items such as medical history, lifestyle, gait speed, and handgrip strength. Furthermore, the examiner can convert the participant's measurement results into an integer score and evaluate the total score based on the cutoff value. However, this screening model includes items that cannot be routinely assessed in the homes of older adults because of measurement limitations, such as gait speed and handgrip strength. Items related to cognitive decline that can be assessed by community general support center staff visiting community-dwelling older adults are thus limited. Auditory cognitive function assessments such as the Kihon Checklist [5] and the 21-item Dementia Assessment Sheet for Community-based Integrated Care System [6,7] also exist; however, they are not used in regular work such as receiving consultations for care planning, and the usage rate among community general support center staff is low at approximately 36.6% [8] .

Previous studies have shown that it is difficult for staff to conduct cognitive function tests because they lack sufficient time and/or knowledge to do so. Hence, in practice, staff use supplementary information such as medical history and lifestyle to detect cognitive decline in patients [8]. Given this real-world practice, it would be worthwhile to develop a tool that could determine cognitive decline using the related information that staff often obtain during consultation. Therefore, in this study, we developed a screening model based on items related to cognitive decline that are frequently assessed by staff at community general support centers in their routine work and examined its accuracy.

METHODS

Participants

We used a dataset provided by the Integrated Research Initiative for Living Well with Dementia (IRIDE Cohort Study: IRIDE-CS), located at the Tokyo Metropolitan Institute for Geriatrics and Gerontology. The IRIDE-CS consists of five cohorts: Otassha; Takashimadaira; Septuagenarians, Octogenarians, Nonagenarians Investigation with Centenarians (SONIC) study; Hatoyama; and Kusatsu. New data are also constantly integrated. Participants include individuals aged 65 years and over and there were no other common criteria. The total sample size currently registered is 8,180 individuals (Otassha: *n* = 3,426; Takashimadaira: *n* = 2,053; Hatoyama: *n* = 742; Kusatsu: *n* = 1,392, and SONIC: *n* = 567). Written and verbal explanations were given to participants in each cohort and consent was obtained. The aim of the IRIDE-CS, which is a combined cohort for secondary analysis, was announced on a dedicated website, and participants were given the opportunity to opt out. This study was approved by the ethics review board of the Tokyo Metropolitan Institute for Geriatrics and Gerontology (No. R21-08, June 29, 2023).

Outcome Variable

The MMSE was used to assess cognitive function [9,10]. Scores range from 0–30, with higher scores indicating better cognitive function. Scores ≤24 points indicate declining cognitive function [11].

Candidate Variables

The candidate variables for the model were selected based on the evaluability list presented by Abe et al. [8]. This list was created by staff at community general support centers who were asked about the difficulty of interviewing community-dwelling older adults about their past medical history. The items are arranged in descending order by the percentage of staff who answered that interviewing older adults about these items was “easy” or “somewhat easy.” In addition to age and sex, we selected candidate variables from this list. More than 80% of the staff answered that it was easy or somewhat easy to evaluate the following: medical history (hypertension, stroke, heart disease, and diabetes), hearing impairment, visual impairment, alcohol consumption, smoking, and frequency of going out. Items with less than 80% coverage that were excluded were related to social isolation or those that require measurement instruments. The model created using these variables was designated as Model 1. In addition, although the evaluability was not 80% or higher, we created a model that included years of education, which 40.6% of the respondents rated as easy or somewhat easy to evaluate, as this variable is strongly associated with cognitive decline (although some respondents may be reluctant to provide this information). This was designated as Model 2.

Statistical Analysis

Logistic regression analysis was performed with stepwise backward elimination (Wald test) using the MMSE score (24–30 vs ≤23) as the objective variable. The significance level for variable selection was set at $p < .1$ because $p < .05$ is considered to be strict for variable selection, and that for exclusion was set at $p < .05$. Each variable was categorized to facilitate selection. As noted above, Model 1 included age, sex, frequency of going out, smoking, alcohol consumption, medical history (hypertension, stroke, heart disease, diabetes), hearing impairment, and visual impairment. In Model 2, years of education was additionally included as an explanatory variable.

To examine the accuracy of the models, sensitivity, specificity, and the area under the receiver operating characteristic curve (AUC) were calculated. The AUC values of Models 1 and 2 were compared using the DeLong method. The sensitivity, specificity, and cutoff values for this study were determined by the highest values calculated using the Youden Index (sensitivity + specificity - 1) [12]. In this study, an AUC value above 0.71 was considered to be indicative of acceptable model accuracy [13,14]. We also applied Net Reclassification Index (NRI) and integrated discrimination improvement (IDI) to assess the effect of adding new predictors [14-16].

We adopted the procedure used in previous studies for scoring [4,17,18]. Among the variables included in the regression model, the value that would cause the smallest regression coefficient to be 1 was determined, and all the regression coefficients were multiplied by that value. Then, the multiplied value was rounded to an integer score, which was used to determine the sensitivity, specificity, AUC, and cutoff values of the final models. Stata 18 (Stata Corp, College Station, TX) was used for all statistical analyses.

RESULTS

After excluding participants with missing data, 7,028 individuals (4,549 women, mean age 74.8 [standard deviation = 6.3]) were analyzed (Table 1). Current alcohol consumption (OR = 0.75, CI = 0.59–0.94) and a history of heart disease (OR = 0.75, CI

= 0.58–0.97) were protective factors for MMSE scores below 24. These variables are usually risk factors, and in this study, they were considered as confounding with background factors and sampling bias. We conducted the analysis again after removing alcohol consumption and a history of heart disease from the explanatory variables (Table 2).

In Model 1, age, sex, frequency of going out, smoking, stroke, diabetes, hearing impairment, and visual impairment were selected, with sensitivity = 75.8%, specificity = 63.5%, and AUC = 0.77 (Table 3). In Model 2, sensitivity = 74.8%, specificity = 70.7%, and AUC = 0.80. A significant difference was found between the AUC of Models 1 and 2 ($p < .0001$).

The integer scores were calculated for both models (Table 2), and the sensitivity, specificity, AUC, and cutoff values were recalculated using these integer scores (Table 4). The NRI and IDI results showed that adding years of education improved the predictive accuracy of the model.

DISCUSSION

This study aimed to create a screening model capable of detecting cognitive decline by limiting the evaluation to those items that can be measured by staff working at community general support centers. The final version of Model 1 was acceptable based on the statistical results. The final version of Model 2 had similar values to those of the enhanced model presented by Abe et al. and was comparable to the model presented by Abe et al., which includes variables for physical function [4]. Therefore, this study provided a tool that allows staff working at community general support centers to detect cognitive decline in older adults during their daily communication. Previous assessment tools that only involve interviews have some shortcomings, including insufficient time available to interview older adults and difficult-to-ask items. This screening tool was created to address these limitations. We selected items used in previous research that were easy for community general support center staff to ask about while maintaining predictive accuracy. In many cases, information such as age and medical history is known before using the screening form. Therefore, when using this screening tool, staff need to only ask respondents about a few items, which simplifies its use with older adults.

Contrary to expectations, heart disease and alcohol consumption were not included in the model. Although these variables are risk factors for cognitive decline, they showed negative correlations in this study, suggesting that they were preventive factors. Regarding heart disease, even mild cases were coded as having heart disease at the time of the survey, which may have compromised the validity of the data. Furthermore, being diagnosed with heart disease may have led to more careful management of one's lifestyle and more scrutiny or management by their doctors, which may have prevented other risk factors associated with cognitive decline. Moreover, participant answers regarding alcohol consumption may have included other confounding factors. For instance, alcohol consumption may be associated with higher levels of social interaction and greater diversity in food intake.

Future studies should verify the validity using other cohort data as validation data. We used integrated data from five cohorts to create the model but did not use the validation cohort to test our data. However, similar to that in previous studies, the sensitivity and specificity of the tests were low. Therefore, in addition to using this screening tool, basic questions such as whether the patient is actually having difficulties in their daily life must be asked.

Moreover, we should devise an interview structure for staff members to listen to the evaluation items onsite. Given that years of education imply social status in Japan, some people do not like answering such questions. Indeed, asking about years of education was considered difficult because of the "concern about rapport being broken." When asking sensitive questions such as years of education, choosing appropriate words and phrases to avoid making older adults feel uncomfortable is important, regardless of the established relationship of trust between older adults and staff. In Japan, asking a question indirectly can make people feel less reluctant to answer. When using Model 2, rather than directly asking about the number of years of education, asking about either the highest level of education or the age at which they acquired their first job may help ease reluctance.

The model presented in this study demonstrated acceptable accuracy for primary differentiation. Despite the low sensitivity and specificity of the test, this tool does not require knowledge of cognitive function testing or measurement of physical function, thereby allowing it to be easily implemented in communities, alongside the inclusion of basic questions noted above. Future studies should evaluate staff as they use these models, investigate their usability and usefulness, and consider further improvements based on user-based data.

APPENDIX

List of the IRIDE Cohort Study investigators.

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CONFLICT OF INTEREST

We have no conflict of interest to declare.

DATA AVAILABILITY

The data used in this research cannot be shared.

REFERENCES

1. Cabinet Office. Annual report on the aging society Japanese. Accessed May 13 2025. https://www8.cao.go.jp/kourei/whitepaper/w-2024/zenbun/06pdf_index.html
2. Global action plan on the public health response to dementia 2017–2025 (2017).
3. Ministry of Health Labour and Welfare. Community comprehensive care system. Accessed May 13 2025. https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/hukushi_kaigo/kaigo_koureisha/chiiki-houkatsu/index.html
4. Abe T, Kitamura A, Yamashita M, et al. Simple screening models for cognitive impairment in community settings: The IRIDE Cohort Study. *Geriatr Gerontol Int*. Apr 2022;22(4):292-297. doi:10.1111/ggi.14360
5. Satake S, Senda K, Hong YJ, et al. Validity of the Kihon Checklist for assessing frailty status. *Geriatr Gerontol Int*. Jun 2016;16(6):709-15. doi:10.1111/ggi.12543
6. Awata S, Sugiyama M, Ito K, et al. Reliability and validity of the dementia assessment sheet for community-based integrated care System-21 items (DASC-21). *Japanese Journal of Geriatric Psychiatry*. 2015;26(6):675-686.
7. Awata S, Sugiyama M, Ito K, et al. Development of the dementia assessment sheet for community-based integrated care system. *Geriatr Gerontol Int*. Mar 2016;16 Suppl 1:123-31. doi:10.1111/ggi.12727
8. Abe T, Yamashiro D, Yamashita M, et al. Assessments of cognitive function of older adults in community general support centers: The IRIDE cohort study. *Geriatr Gerontol Int*. Nov 2023;23(11):887-888. doi:10.1111/ggi.14677
9. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. Nov 1975;12(3):189-98.

10. Sugishita M, Hemmi I, Takeuchi T. Reexamination of the validity and reliability of the Japanese version of the Mini-Mental State Examination (MMSE-J). *Jpnanese Journal of Cognitive Neuroscience*. 2016;18:168-183.
11. Sakurai R, Kim Y, Inagaki H, et al. MMSE Cutoff Discriminates Hippocampal Atrophy: Neural Evidence for the Cutoff of 24 Points. *J Am Geriatr Soc*. Mar 2021;69(3):839-841. doi:10.1111/jgs.17010
12. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. *Biometrics*. Sep 1988;44(3):837-45.
13. de Hond AAH, Steyerberg EW, van Calster B. Interpreting area under the receiver operating characteristic curve. *Lancet Digit Health*. Dec 2022;4(12):e853-e855. doi:10.1016/S2589-7500(22)00188-1
14. Pencina MJ, D'Agostino RB, Sr., D'Agostino RB, Jr., Vasan RS. Evaluating the added predictive ability of a new marker: from area under the ROC curve to reclassification and beyond. *Stat Med*. Jan 30 2008;27(2):157-72; discussion 207-12. doi:10.1002/sim.2929
15. Pencina MJ, D'Agostino RB, Sr., Steyerberg EW. Extensions of net reclassification improvement calculations to measure usefulness of new biomarkers. *Stat Med*. Jan 15 2011;30(1):11-21. doi:10.1002/sim.4085
16. Pencina MJ, D'Agostino RB, Pencina KM, Janssens AC, Greenland P. Interpreting incremental value of markers added to risk prediction models. *Am J Epidemiol*. Sep 15 2012;176(6):473-81. doi:10.1093/aje/kws207
17. Kivipelto M, Ngandu T, Laatikainen T, Winblad B, Soininen H, Tuomilehto J. Risk score for the prediction of dementia risk in 20 years among middle aged people: a longitudinal, population-based study. *Lancet Neurol*. Sep 2006;5(9):735-41. doi:10.1016/S1474-4422(06)70537-3

18. Reitz C, Tang MX, Schupf N, Manly JJ, Mayeux R, Luchsinger JA. A summary risk score for the prediction of Alzheimer disease in elderly persons. *Arch Neurol*. Jul 2010;67(7):835-41. doi:10.1001/archneurol.2010.136

Table 1 *Participants' Characteristics*

		All (*n* = 7,028)		MMSE > 23 (*n* = 6,516)		MMSE ≤ 23 (*n* = 512)	
		n	***%***	***n***	***%***	***n***	***%***
Age (years)	65–74	3,455	49.2%	3,362	47.8%	93	1.3%
	75–84	3,115	44.3%	2,840	40.4%	275	3.9%
	≥ 85	458	6.5%	314	4.5%	144	2.0%
Sex	Men	2,479	35.3%	2,255	32.1%	224	3.2%
	Women	4,549	64.7%	4,261	60.6%	288	4.1%
Education (years)	0–9	1,650	23.5%	1,409	20.0%	241	3.4%
	10–12	3,048	43.4%	2,855	40.6%	193	2.7%
	> 12	2,330	33.2%	2,252	32.0%	78	1.1%
Frequency of going out	Every day	5,007	71.2%	4,750	67.6%	257	3.7%
	3–6 days/week	1,615	23.0%	1,466	20.9%	149	2.1%
	0–2 days/week	406	5.8%	300	4.3%	106	1.5%
Alcohol consumption	Never	3,325	47.3%	3,072	43.7%	253	3.6%
	Past	652	9.3%	562	8.0%	90	1.3%
	Current	3,051	43.4%	2,882	41.0%	169	2.4%
Smoking	Never	4,532	64.5%	4,219	60.0%	313	4.5%
	Past	1,862	26.5%	1,713	24.4%	149	2.1%
	Current	634	9.0%	584	8.3%	50	0.7%
Hypertension	No	3,702	52.7%	3,484	49.6%	218	3.1%
	Yes	3,326	47.3%	3,032	43.1%	294	4.2%
Stroke	No	6,550	93.2%	6,099	86.8%	451	6.4%
	Yes	478	6.8%	417	5.9%	61	0.9%
Heart disease	No	5,842	83.1%	5,422	77.1%	420	6.0%
	Yes	1,186	16.9%	1,094	15.6%	92	1.3%
Diabetes	No	6,109	86.9%	5,690	81.0%	419	6.0%
	Yes	919	13.1%	826	11.8%	93	1.3%
Hearing impairment	No	6,503	92.5%	6,081	86.5%	422	6.0%
	Yes	525	7.5%	435	6.2%	90	1.3%
Visual impairment	No	6,636	94.4%	6,206	88.3%	430	6.1%
	Yes	392	5.6%	310	4.4%	82	1.2%

Table 1 *Participants' Characteristics (Continued)*

		Otassha		Takashimadaira		Hatoyama		Kusatsu		SONIC	
		n (%)		*n (%)*		*n (%)*		*n (%)*		*n (%)*	
		MMSE > 23	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**
Age (years)	65–74	1,666(51.5)	13 (0.4)	525 (29.3)	48 (2.7)	497 (69.5)	6 (0.8)	597 (63.4)	19 (2)	77 (22.6)	7 (2.1)
	75–84	1,390 (43.0)	68 (2.1)	845 (47.1)	165 (9.2)	203 (28.4)	7 (1.0)	262 (27.8)	15 (1.6)	140 (41.1)	20 (5.9)
	≥ 85	87 (2.7)	12 (0.4)	135 (7.5)	76 (4.2)	2 (0.3)	0 (0)	36 (3.8)	13 (1.4)	54 (15.8)	43 (12.6)
Sex	Men	719 (22.2)	33 (1.0)	601 (33.5)	125 (7.0)	410 (57.3)	8 (1.1)	388 (41.2)	25 (2.7)	137 (40.2)	33 (9.7)
	Women	2,424 (74.9)	60 (1.9)	904 (50.4)	164 (9.1)	292 (40.8)	5 (0.7)	507 (53.8)	22 (2.3)	134 (39.3)	37 (10.9)
Education (years)	0–9	408 (12.6)	33 (1.0)	274 (15.3)	121 (6.7)	167 (23.4)	10 (1.4)	487 (51.7)	35 (3.7)	73 (21.4)	42 (12.3)
	10–12	1,455 (45.0)	45 (1.4)	720 (40.1)	117 (6.5)	290 (40.6)	2 (0.3)	271 (28.8)	9 (1.0)	119 (34.9)	20 (5.9)
	> 12	1,280 (39.6)	15 (0.5)	511 (28.5)	51 (2.8)	245 (34.3)	1 (0.1)	137 (14.5)	3 (0.3)	79 (23.2)	8 (2.3)
Frequency of going out	Every day	2,635 (81.4)	69 (2.1)	732 (40.8)	124 (6.9)	549 (76.8)	10 (1.4)	755 (80.1)	34 (3.6)	79 (23.2)	20 (5.9)
	3–6 days/week	445 (13.8)	17 (0.5)	664 (37.0)	100 (5.6)	130 (18.2)	2 (0.3)	101 (10.7)	6 (0.6)	126 (37)	24 (7.0)
	0–2 days/week	63 (1.9)	7 (0.2)	109 (6.1)	65 (3.6)	23 (3.2)	1 (0.1)	39 (4.1)	7 (0.7)	66 (19.4)	26 (7.6)

Table 1 *Participants' Characteristics (Continued)*

		Otassha		Takashimadaira		Hatoyama		Kusatsu		SONIC	
		n (%)		***n (%)***		***n (%)***		***n (%)***		***n (%)***	
		MMSE > 23	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**
Alcohol consumption	Never	1,612 (49.8)	47 (1.5)	632 (35.2)	140 (7.8)	331 (46.3)	6 (0.8)	359 (38.1)	16 (1.7)	138 (40.5)	44 (12.9)
	Past	186 (5.7)	14 (0.4)	228 (12.7)	66 (3.7)	40 (5.6)	2 (0.3)	77 (8.2)	3 (0.3)	31 (9.1)	5 (1.5)
	Current	1,345 (41.6)	32 (1.0)	645 (36)	83 (4.6)	331 (46.3)	5 (0.7)	459 (48.7)	28 (3.0)	102 (29.9)	21 (6.2)
Smoking	Never	2,267 (70.1)	58 (1.8)	916 (51.1)	173 (9.6)	380 (53.1)	7 (1)	502 (53.3)	25 (2.7)	154 (45.2)	50 (14.7)
	Past	649 (20.1)	29 (0.9)	473 (26.4)	85 (4.7)	240 (33.6)	5 (0.7)	253 (26.9)	13 (1.4)	98 (28.7)	17 (5.0)
	Current	227 (7.0)	6 (0.2)	116 (6.5)	31 (1.7)	82 (11.5)	1 (0.1)	140 (14.9)	9 (1.0)	19 (5.6)	3 (0.9)
Hypertension	No	1,789 (55.3)	58 (1.8)	685 (38.2)	99 (5.5)	385 (53.8)	4 (0.6)	527 (55.9)	26 (2.8)	98 (28.7)	31 (9.1)
	Yes	1,354 (41.8)	35 (1.1)	820 (45.7)	190 (10.6)	317 (44.3)	9 (1.3)	368 (39.1)	21 (2.2)	173 (50.7)	39 (11.4)
Stroke	No	2,988 (92.3)	84 (2.6)	1,368 (76.3)	258 (14.4)	645 (90.2)	11 (1.5)	844 (89.6)	41 (4.4)	254 (74.5)	57 (16.7)
	Yes	155 (4.8)	9 (0.3)	137 (7.6)	31 (1.7)	57 (8)	2 (0.3)	51 (5.4)	6 (0.6)	17 (5.0)	13 (3.8)
Heart disease	No	2,668 (82.4)	82 (2.5)	1,188 (66.2)	234 (13)	557 (77.9)	8 (1.1)	806 (85.6)	42 (4.5)	203 (59.5)	54 (15.8)
	Yes	475 (14.7)	11 (0.3)	317 (17.7)	55 (3.1)	145 (20.3)	5 (0.7)	89 (9.4)	5 (0.5)	68 (19.9)	16 (4.7)

Table 1 *Participants' Characteristics (Continued)*

		Otassha		Takashimadaira		Hatoyama		Kusatsu		SONIC	
		n (%)		***n (%)***		***n (%)***		***n (%)***		***n (%)***	
		MMSE > 23	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**	**MMSE > 23**	**MMSE ≤ 23**
Diabetes	No	2,783 (86)	78 (2.4)	1,281 (71.4)	233 (13.0)	591 (82.7)	10 (1.4)	799 (84.8)	39 (4.1)	236 (69.2)	59 (17.3)
	Yes	360 (11.1)	15 (0.5)	224 (12.5)	56 (3.1)	111 (15.5)	3 (0.4)	96 (10.2)	8 (0.8)	35 (10.3)	11 (3.2)
Hearing impairment	No	3,011 (93.0)	78 (2.4)	1,346 (75.0)	230 (12.8)	644 (90.1)	13 (1.8)	815 (86.5)	35 (3.7)	265 (77.7)	66 (19.4)
	Yes	132 (4.1)	15 (0.5)	159 (8.9)	59 (3.3)	58 (8.1)	0 (0)	80 (8.5)	12 (1.3)	6 (1.8)	4 (1.2)
Visual impairment	No	3,090 (95.5)	81 (2.5)	1,428 (79.6)	245 (13.7)	652 (91.2)	12 (1.7)	799 (84.8)	38 (4.0)	237 (69.5)	54 (15.8)
	Yes	53 (1.6)	12 (0.4)	77 (4.3)	44 (2.5)	50 (7)	1 (0.1)	96 (10.2)	9 (1.0)	34 (10.0)	16 (4.7)

Table 2 *Models Used for Screening Cognitive Decline*

	Category	*B*	Score	OR (95% CI)	*P*-value	*B*	Score	OR (95% CI)	*P*-value
Age (ref. 65–74)	75–84	1.15	5	3.16 (2.47–4.05)	< .001	1.05	4	2.86 (2.24–3.66)	<.001
	≥ 85	2.42	10	11.19 (8.25–15.18)	< .001	2.30	8	9.93 (7.32–13.49)	<.001
Sex (ref. Men)	Women	-0.26	-1	0.77 (0.63–0.94)	.011	-0.41	-1	0.67 (0.54–0.81)	<.001
Education (ref. 0–9 years)	10–12 years	-	-	-	-	-0.77	-3	0.46 (0.37–0.58)	<.001
	> 12 years	-	-	-	-	-1.43	-5	0.24 (0.18–0.32)	<.001
Frequency of going out (ref. every day)	3–6 days/week	0.33	1	1.39 (1.12–1.74)	.003	0.38	1	1.46 (1.17–1.83)	.001
	0–2 days/week	1.18	5	3.27 (2.46–4.34)	< .001	1.17	4	3.23 (2.42–4.31)	<.001
Smoking (ref. No)	Yes	0.31	1	1.36 (0.97–1.89)	.071	-	-	-	-
Stroke (ref. No)	Yes	0.31	1	1.36 (1.00–1.85)	.051	0.36	1	1.43 (1.05–1.96)	.024
Diabetes (ref. No)	Yes	0.25	1	1.29 (1.00–1.66)	.053	0.28	1	1.32 (1.02–1.71)	.034
Hearing impairment (ref. No)	Yes	0.37	1	1.45 (1.10–1.92)	.010	0.28	1	1.33 (1.00-1.77)	.052
Visual impairment (ref. No)	Yes	0.80	3	2.21 (1.64–3.00)	< .001	0.64	2	1.90 (1.40–2.59)	< .001

Note. B: unstandardized beta; OR, odds ratio; CI, confidence interval

Table 3 *Performance of the Models for Screening Cognitive Decline*

Model	Model 1	Model 2
Sensitivity	75.8%	74.8%
Specificity	63.5%	70.7%
AUC (95% CI)	0.774 (0.754–0.795)	0.804 (0.786–0.823)
Model 1 vs. Model 2		
P-value for AUC difference	.030, $p < .0001$	
NRI	0.5169, $p < .0001$	
IDI	0.0219, $p < .0001$	

Note. AUC, the area under the receiver operating characteristic curve; NRI, net reclassification improvement; IDI, integrated discrimination improvement

Table 4 *Performance of the Final Models for Screening Cognitive Decline*

Variable	Model 1	Model 2
Sensitivity	76.2%	76.6%
Specificity	63.1%	68.7%
AUC	0.77	0.80
95% CI	0.75–0.79	0.78–0.82
Cutoff score	4/5	0/1
Model 1 vs. Model 2		
P-value for AUC difference	-.030, $p < .0001$	
Model 1 vs. Model 2	-.030, $p < .0001$	
NRI	0.511, $p < .0001$	
IDI	0.025, $p < .0001$	

Note. AUC, the area under the receiver operating characteristic curve; NRI, net reclassification improvement; IDI, integrated discrimination improvement