Association between Receiving Feedback on the Results of an Automated Cognitive Function Test and Motivation for Dementia-preventive Behavior

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Osaka City Med. J. Vol. 68, 73-80, 2022

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Abstract

Background

Receiving feedback on the results of cognitive function tests is an effective motivating factor for producing dementia-preventive behavior, but the association between receiving feedback on the results of automated cognitive function tests and motivation for dementia-preventive behavior is unclear. We investigated the association between receiving feedback on the results of the Cogstate Brief Battery and motivation for dementia-preventive behavior.

Methods

The participants were community-dwelling older adults aged ≧65 years without a diagnosis of dementia or mild cognitive impairment. They were divided into the Cogstate Brief Battery and control groups. They responded to a questionnaire twice, 3 months apart. We compare the percentage of participants who were more motivated regarding dementia-preventive behavior between the two groups. Multivariate logistic regression analysis was conducted on the association between being in the Cogstate Brief Battery group and a stronger motivation.

Results

The study included 222 participants (105 in the Cogstate Brief Battery group and 117 in control group). Being in the Cogstate Brief Battery group was significantly associated with a stronger motivation for dementia-preventive behavior, even after adjusting for sex, age, education, and contact with persons with dementia. Factors such as sex were not significantly associated with a stronger motivation.

Conclusions

This study found that receiving feedback automatically on the results of the Cogstate Brief

Received August 24, 2022; accepted October 31, 2022.
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Battery was significantly associated with a stronger motivation for improved dementia-preventive behavior among community-dwelling older adults. This study may provide useful insights for interventions targeting dementia prevention among community-dwelling older adults.

Key Words: The Cogstate Brief Battery; Cognitive function test; Motivating factor; Behavior change; Older adults.

Introduction

Japan is a hyper-aged society with a declining birthrate and an aging population. According to the report by Ninomiya et al, 36.4 million people aged ≧65 years accounted for 29.1% of the total population in 2021, and this figure is estimated to reach 35.3% by 2040. Dementia is a major mental disorder among older adults, and its prevalence among those aged ≧65 years in Japan is estimated to reach 20.7% by 2040[1]. Dementia can lead to a variety of mental, physical, and social health problems that impair qualitative living. Inappropriate eating habits, lack of exercise, heavy alcohol consumption, and smoking are reported to be associated with the onset of dementia[2,3], and change in lifestyle involving diet and exercise is effective for preventing dementia. However, few people actually take action to prevent dementia, and Smith et al reported that less than 40% of people take action to forestall dementia[4]. Reports indicate that dementia-preventive behavior is associated with a higher level of knowledge about dementia[5,6] and awareness of cognitive decline[7]. Therefore, gaining knowledge about dementia and receiving feedback on the results of cognitive function tests should be effective in motivating behavior change for the prevention of dementia.

The usefulness of the Mini Mental State Examination (MMSE)[8] and the Montreal Cognitive Assessment (MoCA)[9] as simple bedside tests for screening mild cognitive impairment and dementia associated with Alzheimer's disease has been reported, but recently, automated cognitive function tests have begun to be widely used[10]. Tools such as the Cognitive Assessment for Dementia, iPad version 2 (CADi2)[11] and MSP-1100[12], which is produced by Nihon Kohden Corp (Tokyo, Japan), have also been developed for mass screening for the secondary prevention of dementia. Automated tools can be self-administered without the need for a specialist; they also take less time and are easier to administer than conventional cognitive function tests[13]. Among these, the Cogstate Brief Battery (CBB) has been shown to have validity as a cognitive function test[14] and has been reported to be effective in screening for mild cognitive impairment and dementia associated with Alzheimer's disease[15,16]. However, the association between receiving feedback on the results of CBB and the motivation for improved dementia-preventive behavior is unclear.

In this study, we investigated the association between receiving feedback on the results of CBB, which is an automated cognitive function test, and motivation for behavior change regarding the prevention of dementia among community-dwelling older adults. We compared the CBB group, which was administered CBB, received feedback automatically on the results, and was educated about dementia based on materials on important lifestyle changes for preventing dementia, with the non-CBB group, which was only educated about dementia.

Methods

Participants

Our co-researcher, Akakabe Co., Ltd. (Osaka, Japan), who operates drugstores nationwide, recruited participants for this study. Participants were recruited from January 2021 to May 2021

using personal information already held by Akakabe Co., Ltd. in its membership system. Our target participants were community-dwelling adults in Japan aged ≧65 years who had not been diagnosed with dementia or mild cognitive impairment. The required number of participants was set at 200 (100 in the CBB group and 100 in the non-CBB group) with a threshold response rate of 30%, expected response rate of 50%, power of 80%, and alpha of 0.05 (two-sided). The proportion of dropouts and ineligible participants was estimated at 50%, and 400 participants were required in the first step. Those who had been diagnosed with dementia or mild cognitive impairment or had visited a medical institution for cognitive dysfunction were excluded. This study was approved by the Ethical Committee of Osaka City University Graduate School of Medicine (approval number: 2020-238). This study was conducted in accordance with the Declaration of Helsinki and its future amendments. All participants were informed of the purpose and methods of the study, and they provided written consent.

Procedure

In the first step, 400 participants were randomly assigned to two groups (CBB and non-CBB groups) by a simple method, with 200 participants in each group. After gaining prior consent for mailing, CBB was mailed to the CBB group, and CBB was administered and the results were fed back automatically to the participants. All participants were educated on dementia and important lifestyle changes for preventing dementia using relevant materials. In addition, a questionnaire was mailed to all participants and their responses were obtained. For the CBB group, the questionnaire was provided before the CBB was administered. The questionnaire included five questions regarding sex, age, educational background, contact with dementia, and whether they were willing to change their lifestyle to prevent dementia. For education, we calculated the number of years of education. We defined "contact with dementia" as having a history of personal contact with people with dementia. In the second step (3 months after the first step), a questionnaire was mailed to all participants regarding whether they were willing to change lifestyle for the prevention of dementia, and their responses were recorded. Concerning the questionnaire on whether they were willing to change their lifestyle to prevent dementia, the respondents were asked to choose from five stages: "1: not planning to change within 6 months", "2: planning to change within 6 months", "3: planning to change within 1 month", and "4: have changed but for less than 6 months", "5: have changed for more than 6 months". Because the dropout rate from the non-CBB group was higher than expected, 150 additional non-CBB participants were added to this study, for a total of 550 participants who fully consented to the study.

The Cogstate Brief Battery

CBB which is produced by Cogstate, Ltd. (Melbourne, Australia) is an automated tool for cognitive self-assessment and consists of four cognitive tests that assess psychomotor function, attention, working memory, and visual learning[17]. CBB plays an important role in Alzheimer's disease research and clinical trials[18,19] and has been reported to be effective in screening for mild cognitive impairment and dementia associated with Alzheimer's disease[15,16]. Furthermore, because CBB is a computer-based tool, the administration, evaluation, and reporting of the test is automated and highly standardized. It can be administered in 10 minutes, making it easier to apply than conventional cognitive function tests. In addition, as CBB is not a medical device, it can be easily used at events for residents. In the US and Europe, Cognigram™, which is a medical version of CBB with a specialized feedback function for medical professionals, has been approved as a medical device and is used to assist medical professionals in examining and diagnosing mild cognitive impairment and

dementia[20,21]. The nouKNOW, developed by Eisai Co., Ltd. in Japan, was used in this study. It is the Japanese version of CBB, and the content of the nouKNOW test is the same as that of CBB, with additional advice on dementia prevention as feedback. The nouKNOW was developed as a digital tool (non-medical device) for self-checking brain performance. The results of nouKNOW are fed back to the participants with the Concentration score and the Memory score. These scores range from 0 to 50 (0-14.9: incorporate activities to maintain and improve, 15-19.9: border line, 20-50: normal). Furthermore, recommendations on lifestyle improvement such as habits of regular exercise, non-smoking, balanced diet intake, and moderate alcohol consumption as well as on physical and mental health management, such as on the management of blood pressure, blood sugar, body fat, mental health, and hearing consumption related to the test results is automatically fed back to participants.

Statistical analysis

Statistical analysis was performed using EZR software (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (version 2.13.0; R Foundation for Statistical Computing, Vienna, Austria). We investigated the association between receiving feedback on the results of CBB, which is an automated cognitive function test, and motivation for dementia-preventive behavior. Regarding the questionnaire on whether they were willing to change their lifestyle to prevent dementia, the respondents whose stage of behavior changed from "1" to "2", "3", "4", or "5", from "2" to "3", "4", or "5", and from "3" to "4" or "5", from the first to the second step, were considered to be more motivated regarding dementia-preventive behavior; the rest were considered to be less motivated. Age was compared using a student's t-test. Sex and whether participants had contacted people with dementia were compared using Fisher's exact test. Education and whether participants were willing to change their lifestyle to prevent dementia was compared using the Mann-Whitney U test. After adjusting for factors such as sex, age, education, and contact with dementia, multivariate logistic regression analysis was conducted on the association between being in the CBB group and a stronger motivation for dementia-preventive behavior. Education[4,7] and contact with dementia[22-24] have been reported to be associated with dementia-preventive behavior; therefore, they were set as confounding factors. Student's t-test was used for intergroup comparison of the Concentration and Memory scores between the group that is motivated towards dementia-preventive behavior and the one that is not. P values <0.05 were considered statistically significant.

Results

This study included 550 (200 in the CBB group and 350 in the non-CBB group) community-dwelling older adults. After excluding 30 persons who did not respond in the first step (8 in the CBB group and 22 in the non-CBB group), 203 persons who responded in the first step but not in the second step (46 in the CBB group and 157 in the non-CBB group), and 95 persons whose questionnaires were invalid due to missing values (41 in the CBB group and 54 in the non-CBB group), 222 participants (105 in the CBB group and 117 in the non-CBB group) were included in the analysis.

Table 1 shows the characteristics of the participants assigned to the CBB and non-CBB groups. Significant differences were found in sex ($p=0.037$), age ($p=0.004$), and education ($p=0.049$).

Table 2 shows the odds ratios (ORs) and 95% confidence intervals (CIs) for the multivariate logistic regression analysis of the association between being in the CBB group and a stronger motivation for dementia-preventive behavior, after adjusting for factors such as sex, age, education,

and contact with dementia. Being in the CBB group was significantly associated with a stronger motivation for dementia-preventive behavior (OR=1.99; CI: 1.10-3.61; p=0.023). Sex, age, education, and contact with dementia were not significantly associated with a stronger motivation for dementia-preventive behavior.

Table 3 shows the association between the score of CBB and motivation for dementia-preventive behavior. Significant differences were not found in both Concentration (p=0.117) and Memory (p=0.189) scores.

Table 1. Characteristics of the participants

		CBB group	Non-CBB group	p-value
n		105	117	
Sex	Men	17 (16.2%)	33 (28.2%)	0.037
	Women	88 (83.8%)	84 (71.8%)	
Age, years (mean±SD)		71.70±4.67	73.81±6.05	0.004
Education, years (range)		12 (9-16)	12 (9-16)	0.049
Contact with dementia	No	55 (52.4%)	77 (65.8%)	0.055
	Yes	50 (47.6%)	40 (34.2%)	
Question about change	1	60	64	0.832
in lifestyle † (first step)	2	15	20	
	3	5	6	
	4	2	2	
	5	23	25	
Question about change	1	36	50	0.114
in lifestyle † (second step)	2	16	21	
	3	8	6	
	4	5	6	
	5	40	34	
Results of CBB	C-score	22.87±4.58		
(mean±SD)	M-score	24.08±5.45		

† 1: not planning to change within 6 months, 2: planning to change within 6 months, 3: planning to change within 1 month, 4: have changed but for less than 6 months, 5: have changed for more than 6 months. Abbreviations: CBB, Cogstate Brief Battery; SD, standard deviation; C-score, Concentration score; and M-score, Memory score.

Table 2. Influencing factors for improved dementia-preventive behavior

		All	N of participants with improved dementia-preventive behavior	OR † (95% CI)	p-value
Group	CBB	105	43 (41.0%)	1.99 (1.10-3.61)	0.023
	Non-CBB	117	32 (27.4%)		
Sex	Men	50	14 (28.0%)	0.81 (0.39-1.69)	0.57
	Women	172	61 (35.5%)		
Age, years				1.04 (0.99-1.10)	0.15
Education, years				0.97 (0.84-1.12)	0.67
Contact with dementia	No	132	42 (31.8%)	0.88 (0.48-1.59)	0.66
	Yes	90	33 (36.7%)		

† OR was adjusted for sex, age, education, and contact with dementia. Abbreviations: N, number; OR, odds ratio; CI, confidence interval; and CBB, Cogstate Brief Battery.

Table 3. Association between the scores of CBB and motivation towards dementia-preventive behavior

	Motivated to change lifestyle	Not motivated to change lifestyle	p-value
n	43	62	
C-score (mean±SD)	23.71±4.51	22.29±4.57	0.117
M-score (mean±SD)	23.24±5.63	24.66±5.28	0.189

Abbreviations: CBB, Cogstate Brief Battery; C-score, Concentration score; M-score, Memory score, and SD, standard deviation.

Discussion

This study aimed to determine whether there is an association between receiving feedback on the results of CBB, which is an automated cognitive function test, and motivation for dementia-preventive behavior among community-dwelling older adults. The study found two things. First, receiving feedback on results of CBB, not the score of CBB, was significantly associated with a stronger motivation. Second, factors such as sex, age, education, and contact with dementia were not significantly associated with a stronger motivation. These results suggest that receiving feedback on the results of CBB is effective in motivating community-dwelling older adults who have not been diagnosed with dementia or mild cognitive impairment to change their lifestyles for the prevention of dementia.

First, receiving feedback on the results of CBB motivated dementia-preventive behavior. Prochaska et al. identified dramatic relief as one of the 10 processes (Consciousness raising, Dramatic relief, Environmental reevaluation, Self-reevaluation, Self-liberation, Social liberation, Contingency management, Helping relationship, Counterconditioning, and Stimulus control) that produce behavior change[25]. Dramatic relief refers to the experience of various emotional reactions and feelings that motivate behavior change, and in this study, learning about one's own cognitive functioning by receiving feedback on the results of CBB, and the resulting emotional reactions, such as being happy or sad, were considered to fall under the category of dramatic relief. A report noted that awareness of the importance of actions for preventing dementia was associated with actual preventive actions[26], and in this study, the combination with dramatic relief seemed more effective. Among automated tools for self-checking cognitive function, CBB is sufficient to detect mild cognitive impairment related to Alzheimer's disease associated with Alzheimer's disease[15,16]. Therefore, it is considered that no ceiling effect occurred and the test was able to provide appropriate feedback, even when used for people who are generally considered cognitively normal, such as community-dwelling older adults.

Second, factors such as sex, age, education, and contact with dementia were not significantly associated with a stronger motivation for improved dementia-preventive behavior. Education[4,7] and contact with dementia[22-24] have been reported to be associated with dementia-preventive behavior. Although studies indicate that people who have contact with dementia are less likely to believe that dementia is preventable[27], in this study, contact with dementia was not a significant inhibitor of motivation for dementia-preventive behavior. These results suggest that CBB-based interventions are effective for a wide range of people with different backgrounds, and CBB may enable us to reach those who are less likely to take action to prevent dementia.

There are several limitations to this study. First, there were significant differences in sex, age, and education between CBB and non-CBB groups. This may have been due to participation bias, as

those who cooperated in the study, which was more time-consuming than the non-CBB group, participated in the CBB group. However, even after adjusting for known factors that influence dementia-preventive behavior, such as sex, age, education, and contact with dementia, receiving feedback on results of CBB was significantly associated with a stronger motivation for dementia-preventive behavior. Therefore, the bias in characteristics between CBB and non-CBB groups does not seem to weaken our argument. Second, the dropout rate was high between the first and second steps. Since many of the participants who dropped out were considered less likely to be motivated to change their lifestyle for the prevention of dementia, it is possible that the proportion of participants who became more motivated was actually higher than noted. However, the CBB group had a lower dropout rate than the non-CBB group. Therefore, this does not weaken our argument that the CBB group was more motivated. Third, 6 months is the standard definition of each stage in the behavior change stages proposed by Prochaska et al[25], but in this study, participants were asked in a questionnaire about their willingness to change their lifestyle for the prevention of dementia 3 months after the first step. Therefore, the long-term effects are not known. Fourth, although this study showed an association between receiving feedback on CBB results and motivation for dementia-preventive behavior, we were unable to follow the progress after that point. Therefore, we do not know whether the increased motivation actually led to the prevention of dementia. Future longitudinal studies on the development of dementia after receiving feedback on the results of CBB are awaited.

This study found that receiving feedback on results of CBB was significantly associated with a stronger motivation for dementia-preventive behavior among community-dwelling older adults aged ≧65 years who were undiagnosed with dementia or mild cognitive impairment. This study should provide useful insights regarding dementia prevention among community-dwelling older adults.

Acknowledgements

All authors have no COI to declare regarding the present study.

This study was conducted with the support of the Wellness Open Living Lab, which provided the nouKNOW and funds for this study, among other forms of support. We would like to thank Editage (https://www.editage.com) for the English language editing. The authors also acknowledge the role of Akakabe Co., Ltd. in conducting this study. We would also like to express our sincere gratitude to the associations in the target areas and to all the people who understood the purpose of this study and willingly cooperated.

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