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Evaluation of the Usefulness of a Simple Touch-panel Method for the Screening of Dementia

Keiko TSUBOI[1*], Toshihide HARADA[2], Toshiyuki ISHII[1], Hiroko MORISHITA[3], Harumi OHTANI[4] and Fumiko ISHIZAKI[5]

1) Department of Nursing, Faculty of Nursing, Shikoku University, Furukawa, Ojin-cho, Tokushima, Tokushima 771-1192, Japan
2) Department of Health Services Management, Faculty of Health and Welfare, Hiroshima International University, 555-36 Kurose-gakuendai, Higashi-Hiroshima, Hiroshima 724-0695, Japan
3) Department of Nursing, Faculty of Nursing, Fukuyama Heisei University, 117-1 Masatokamiiwanari, Miyukicho, Fukuyama, Hiroshima 720-0001, Japan
4) Furukawa Clinic, Shinonome-honmachi, Minami-ku, Hiroshima 734-0021, Japan
5) Department of Communication Sciences and Disorders, Faculty of Health and Welfare, Prefectural University of Hiroshima, 1-1 Gakuen-machi, Mihara, Hiroshima 723-0053, Japan

ABSTRACT

In clinical settings, Hasegawa's dementia scale, revised (HDS-R), and the mini-mental state examination (MMSE) are widely employed as simple mental function tests useful for the diagnosis of dementia. In recent years, for the early diagnosis of dementia, a simple computerized touch panel-type screening test (touch panel-type screening test), called the "forgetfulness consultation program" (Nihon Kohden Corp.), has been developed. We performed dementia screening using this touch panel-type screening test in 95 elderly subjects, and evaluated its usefulness in comparison with HDS-R or MMSE.

The results of evaluation using the touch panel-type screening test were significantly correlated with those using HDS-R and MMSE in the elderly subjects. This touch panel-type screening test was not time-consuming (about 3 min) since it includes only a small number of test items. It could also be performed solely by the examinee, and so was free from examiner-related bias. Therefore, this method may be very useful for the diagnosis of dementia and evaluation of its severity.

Key words: *Alzheimer's type dementia, Vascular dementia, Touch panel-type screening test, Assessment of cognitive function*

The abridged life table in Japan in 2006 showed an average life expectancy of 79.00 years in males and 85.81 years in females. Japan has the longest life expectancy in the world[2].

The elderly population in Japan was 25,000,000 in 2005, but is expected to increase to 33,000,000 in 2015, when postwar baby boomers will enter the 65-74 age group, and to 35,000,000 in 2025. Thus, Japan is entering the stage of "the last steep upward slope" of aging. The number of elderly persons with dementia is estimated to increase from 1,690,000 in 2005 to 2,500,000 in 2015, and to 3,230,000 in 2025, to exceed 10% of the elderly population in 2030, and to peak at 4,000,000 in 2040[1].

In the aged society, the number of patients with dementia has been rapidly increasing, and taking measures against this increase has become a serious social issue. Alzheimer's type dementia (AD) and vascular dementia (VD) are representative types of dementia classified according to the underlying diseases, and are observed in about 70 ~80% of elderly patients with dementia[5, 10].

With aging, not only physical but also mental function decreases, but differentiation between decreased mental function due to aging and that due to pathological conditions represented by dementia is important for the early detection and appropriate management of dementia.

Various methods for evaluating the severity of impaired cognition and screening for dementia have been developed. In Japan, the mini-mental state examination (MMSE) and Hasegawa's Dementia Scale, Revised (HDS-R), are commonly used. Each method is used for the evaluation of dementia but requires about 10 min, and some-

*Address correspondence to: Keiko Tsuboi
E-mail: k-tsuboi@shikoku-u.ac.jp

times leads to differences in results among examiners.

In the treatment of dementia, early diagnosis and intervention are important. For the early diagnosis of AD, Urakami[7] developed a simple screening method using a touch-panel computer (touch panel-type screening test). This method can be performed by examinees themselves, without the involvement of an examiner. However, there is a question as to whether this method involves problems in comparison with conventional tests.

We evaluated cognitive function by the touch-panel method developed for the early screening of dementia, and also performed a simple assessment of intellectual function using HDS-R and MMSE in users of a health care facility for 95 elderly people. The correlation between the results of assessment by the touch-panel method and those using HDS-R or MMSE was analyzed to evaluate the usefulness of the former.

METHODS

Subjects

Informed consent (IC) for this study was obtained from the director of a health care facility for the elderly requiring long-term care (referred to as health care facility for the elderly hereafter) after explaining the purpose, methods, and expected results. In addition, IC was obtained not only from users (day service users and residents) of this facility as the subjects of this study, but also from their family members, because evaluation of the ability to give IC is problematic in people with decreased cognitive function.

IC for participation in this study was also obtained from elderly inhabitants in the community after providing a similar explanation. As a result, 52 users of the health care facility for the elderly and 43 elderly inhabitants in the community (total, 95 elderly people) were enrolled as subjects.

In the 52 subjects in the health care facility for the elderly, differential diagnosis had been performed. AD was observed in 23 subjects (Group AD), VD in 24 (Group VD), and the other 5 were healthy. The 43 subjects in the community were involved in group activities of elderly associations and had never been diagnosed as having dementia. The 5 healthy subjects in the facility and 43 in the community (total, 48) were included in the healthy control group (Group HC) (Table 1).

Table 1. Age and Sex of subjects

Group	Subjects	Age Average	Sex (M/F)
AD	23	84.8 ± 5.90	6/17
VD	24	83.5 ± 9.00	8/16
HC	48	78.9 ± 6.46	12/36

Methods

The cognitive function of subjects was evaluated using HDS-R and MMSE as conventional, simple intellectual function tests and the "forgetfulness consultation program" (Nihon Kohden Corp.) as a touch panel-type screening test for dementia screening.

For statistical analysis, SPSS (Version 13.0 J for Windows) was used. An outline of the applied cognitive function tests is as follows:

1) HDS-R[3]

This scale consists of 9 items (age, orientation to time and date, orientation to place, memory of 3 words, calculation, recall of numbers in reverse order, delayed recall of 3 words, memory of 5 objects, and verbal fluency). The score range is from 0 to 30 (full score). The examination time is about 10 min. The cut-off point is 20/21. Scores ≥ 21 indicate the absence of dementia, while those ≤ 20 indicate dementia.

2) Japanese version of MMSE[4]

MMSE consists of 11 items, including orientation, memory, attention, calculation, recall, and language. The score range is from 0 to 30 (full score), and the examination time is about 10 min. The cut-off point is 23/24, and scores ≥ 21 indicate mild dementia, those of 20-11 indicate moderate dementia, and those ≤ 10 indicate severe dementia.

3) Touch panel-type screening test[7]

The contents are questions regarding the immediate recognition of words, orientation to time and date, delayed recognition of words, and spatial cognitive function by the selection of pictures showing a cube and triangular prism (Appendix). The score range is 0 to 15 (full score). Examinees answer questions asked by the computer (visual and spoken). The examination time is about 3 min. The cut-off point is 11/12, and scores ≤ 11 indicate dementia.

We're subjects with a hearing impairment also excluded.

RESULTS

Assessment using HDS-R, MMSE, and the touch-panel screening test was performed in the 95 subjects, and the following results were obtained:

1. Age and scores in each test in the 95 subjects

The 95 subjects consisted of 26 males and 69 females, with a mean age of 78.9 ± 6.46 years. The mean score by each method in the 95 subjects was 18.30 ± 7.90 for HDS-R, 21.70 ± 6.70 for MMSE, and 9.70 ± 4.18 for the touch-panel screening test.

1) Distribution of HDS-R scores

The HDS-R score was 0-4 in 6 subjects (6.32%), 5-9 in 9 (9.47%), 10-14 in 13 (13.68%), 15-19 in 18 (18.95%), 20-24 in 25 (26.32%), 25-29 in 20

(21.05%), and 30 (full score) in 4 (4.21%).

The score was ≥ 21 (cut-off point) in 41 subjects and ≤ 20 in 54.

2) Distribution of MMSE scores

The MMSE score was 0-4 in none (0%) of the subjects, 5-9 in 7 (7.37%), 10-14 in 9 (9.47%), 15-19 in 16 (16.84%), 20-24 in 20 (21.05%), 25-29 in 36 (37.90%), and 30 (full score) in 7 (7.37%).

The score was ≥ 24 (cut-off point) in 46 subjects and ≤ 23 in 49.

3) Distribution of scores with the touch panel-type screening test

The score obtained by the touch-panel screening test was 0-2 in 7 (7.37%), 3-5 in 13 (13.68%), 6-8 in 14 (14.74%), 9-11 in 14 (14.74%), 12-14 in 40 (42.10%), and 15 (full score) in 7 (7.37%).

The score was ≥ 12 (cut-off point) in 46 subjects and ≤ 11 in 49.

The number of subjects according to the cut-off point of each test was evaluated (Table 2).

2. States of each examination

Some elderly subjects were not familiar with panel operation, i.e., touching a personal computer screen. Therefore, the subjects were given an adequate explanation regarding the method of using the touch-panel and repeatedly practiced panel operation. The time required for examination by the touch panel -type screening test was about 3 min when the examination was smoothly performed according to sound instructions. In subjects with dementia, the examination time was generally 5-7 min.

Concerning problems with this method, when fingers other than the index finger (2nd finger) touched the panel involuntarily during the examination, the touch-panel of the computer registered the touch in some cases. In addition, when subjects could not touch the screen even though they correctly answered a question verbally, the score was low. In such cases, the correct verbal answer was taken into consideration in scoring.

In HDS-R and MMSE, the score sometimes differs among examiners. Therefore, the same examiner performed the same examination. Since the results of the touch panel-type screening test can be obtained without examiner-related bias, no differences were observed among examiners. In the touch panel -type screening test, examiners assisted subjects so that the score would not be affected by visual/hearing impairment.

3. Correlations between examination methods

The coefficient of the correlation (r) between HDS-R and MMSE was 0.852, that between HDS-R and the touch panel-type screening test was 0.774 ($p < 0.01$), and that between MMSE and the touch panel-type screening test was 0.762 ($p < 0.01$) (Figs. 1-3). Differences were analyzed by Spearman's test.

4. Comparison of the results of each cognitive function assessment method among Groups AD (23 subjects), VD (24), and HC (48) Comparison among Groups AD, VD, and HC was performed by Kruskal-Wallis' rank sum test (Table 1 & 3)

1) The mean age was 84.8 ± 5.90 years in Group AD, 83.5 ± 9.00 years in Group VD, and 78.90 ± 6.46 years in Group HC. Age did not significantly differ among the 3 groups (Table 1).

2) The HDS-R score was 10.30 ± 6.91 in Group AD, 13.58 ± 4.25 in Group VD, and 24.48 ± 3.46 in Group HC. The HDS-R score was significantly higher in Group HC than in Group AD or VD (HC vs. AD, $p < 0.00001$; HC vs. VD, $p = 0.00001$).

3) The MMSE score was 15.04 ± 6.03 in Group AD, 18.08 ± 4.96 in Group VD, and 26.65 ± 2.67

Table 2. Number of subjects according to the cut-off point of each test

TEST		< Cut-off point	≥ Cut-off point
HDS - R	(20/21)	54	41
MMSE	(23/24)	49	46
Touch panel-type screening test	(11/12)	49	46

Table 3. Comparison among Groups AD, VD, and HC performed by Kruskal-Wallis' rank sum test

Group	HDS-R		MMSE		Touch panel-type screening test	
AD	10.30 ± 6.91	**	15.04 ± 6.03	**	5.57 ± 3.19	**
VD	13.58 ± 4.25	**	18.08 ± 4.96	**	7.54 ± 3.51	*
HC	24.48 ± 3.46		26.65 ± 2.67		12.75 ± 1.95	

*p<0.0001 **p<0.00001

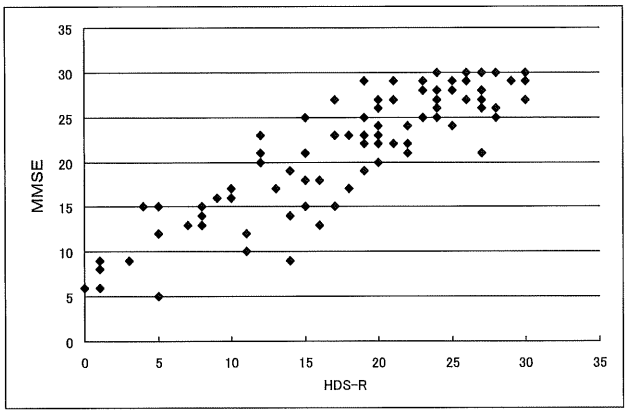

Fig. 1. Correlation between HDS-R and MMSE

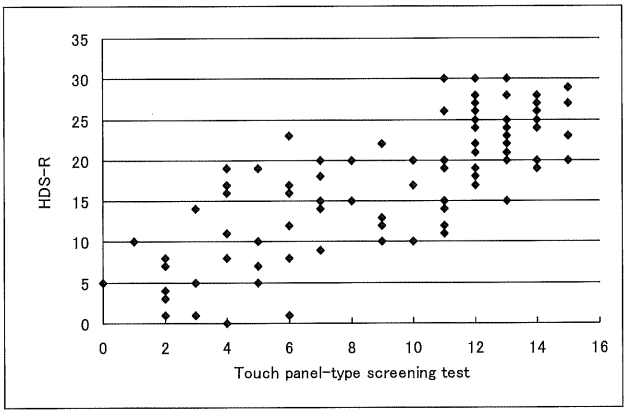

Fig. 2. Correlation between HDS-R and Touch panel-type screening test

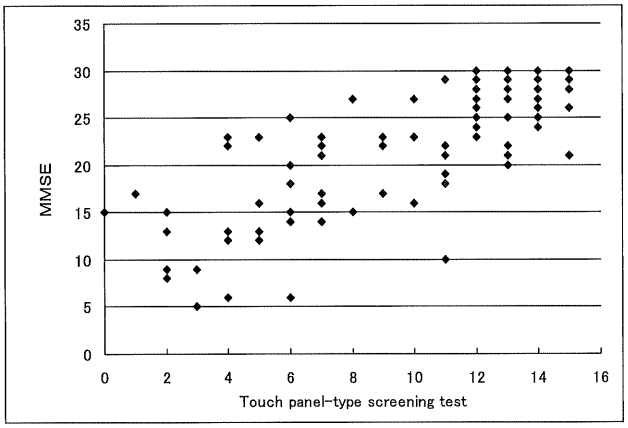

Fig. 3. Correlation between MMSE and Touch panel-type screening test

in Group HC. The MMSE score was significantly higher in Group HC than in Group AD or VD (HC vs. AD, $p < 0.00001$; HC vs. VD, $p = 0.00001$).

4) The touch panel-type screening test score was 5.57 ± 3.19 in Group AD, 7.54 ± 3.51 in Group VD, and 12.75 ± 1.95 in Group HC. The touch panel-type screening test score was significantly higher in Group HC than in Group AD or VD (HC vs. AD, $p < 0.00001$; HC vs. VD, $p < 0.0001$).

5) No significant difference was observed in the score of each examination (HDS-R, MMSE, The touch panel-type screening test) between Groups AD and VD.

DISCUSSION

We evaluated cognitive function in the elderly using the touch panel-type screening test, HDS-R, and MMSE.

MMSE as a cognitive function test was developed in 1975 and has been widely used in Western countries and Japan. HDS-R is also a cognitive function assessment method that was established in Japan, and has been used as a dementia screening method comparable to MMSE.

The elderly subjects in this study consisted of 52 users (26 residents and 26 day service users) of a health care facility for the elderly and 43 elderly inhabitants in the community (total, 95 subjects). The coefficient of the correlation (r) between HDS-R and the touch panel-type screening test was 0.774, and that between MMSE and the touch panel-type screening test was 0.762. Differences were analyzed by Pearson's test.

There were marked correlations, suggesting that the touch panel-type screening test is an accurate method for diagnosing dementia that is comparable to the conventional methods.

When the subjects were classified according to the cut-off point, the numbers of subjects with and without dementia were 49 and 46, respectively, using MMSE as well as the touch panel-type screening test, showing complete agreement, and classifications were also similar between HDS-R and the touch panel-type screening test. Therefore, classification according to the cut-off point of the touch panel-type screening test was consistent with that using each conventional test for the diagnosis of dementia. Concerning the disadvantages of the touch panel-type screening test, accurate evaluation is not possible when physical disabilities such as hearing or visual impairment are present.

In the touch panel-type screening test, assistance is necessary for examinees with visual impairment to prevent its influences on the score.

In addition, when subjects' fingers move involuntarily during touch-panel operation and accidentally touch the screen, the computer may register the touch as an answer. Therefore, before the touch-panel screening test, physical disabilities should be clarified, and assistance and advice, or re-examination in some cases, may be necessary for examinees with disabilities. In addition, if there is a "return" function for correction when examinees become aware of their mistakes during touch-panel operation, correction is possible and immediately reflected by the results. Thus, such a "return" function may be necessary. Some elderly examinees are not familiar with panel operation

such as touching the screen of a personal computer, as is observed in the touch-panel operation of ATMs at financial institutions. For such examinees, an assistant should be present to give explanations or advice. In the present study, unlike HDS-R or MMSE, the touch panel-type screening test could be individually performed, and results excluding examiner-related bias were obtained. Therefore, the touch-panel method may be useful for the diagnosis of dementia and evaluation of its severity in the elderly.

Urakami et al[8] reported that the touch panel-type screening test causes only slight psychological stress, is noninvasive, produces no examiner-related differences in the score, can be readily performed in a short time (about 3 min), and is therefore appropriate for the screening of dementia represented by AD. They also reported a sensitivity of 96% and a specificity of 97% using a score of 12 as the cut-off point in subjects with AD and controls.

Urakami[9] performed dementia screening using this touch panel-type screening test in subjects diagnosed as normal by specialists, and observed dementia in 38.9% of them. Regarding the present status of insurance-based medicine in Japan, it is difficult to provide long consultation times even in specialized medical institutions. In this respect, also, Urakami explained the necessity for simple screening methods such as this touch panel-type screening test in "outpatient clinics specializing in memory impairment".

Saito et al[6] suggested that the results of the touch panel-type screening test reflect temporal and parietal lobe functions. They also affirmed that this screening test causes minimal psychological stress and is noninvasive because examinees answer questions asked by a computer rather than a person. It also produces no differences among raters because of the absence of differences among examiners.

As explained in the present study, the touch panel-type screening test consists of only a few items and can be performed in a short time (about 3 min). Therefore, this method may be useful for dementia screening in daily clinical practice, care, and health examinations. In the present study, dementia was detected in 1 subject each among elderly inhabitants in the community and residents of a health care facility for the elderly who had been diagnosed as normal before this screening.

CONCLUSION

In the elderly, the score generated by the simple touch-panel dementia screening method (touch-panel screening test) was significantly correlated with that of HDS-R as well as MMSE as conventional screening methods. Unlike assessment using HDS-R or MMSE, in which the examiner asks questions, the touch-panel screening test involves the active participation of examinees and can be readily performed in a short time without examiner-related bias. Therefore, this test may be a useful, simple screening method for dementia in the settings of clinical practice, care, and health examinations.

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REFERENCES

1. **Akasaka, H.** 2006. Situations regarding dementia and promotion of anti-dementia measures. Journal of Japanese Society for Dementia Care **5**: 68-74.
2. **Health and Welfare Statistics Association** 2007. Journal of Health and Welfare Statistics **54(9)**: 68.
3. **Katoh, S., Simogaki, H., Onodera, A., Ueda, H., Oikawa, K., Ikeda, K., Kosaka, A., Imai, Y. and Hasegawa, K.** 1991. Development of the revised version of Hasewaga's Dementia Scale (HDS-R). Japanese Journal of Geriatric Psychiatry **2**: 1339-1347.
4. **Mori, E., Mitani, Y. and Yamadori, A.** 1985. Usefulness of a Japanese Version of the Mini-Mental State Test in Neurological Patients. Neuropsychology **1**: 82-89.
5. **Nakamura, S.** 2004 .A Guideline for the Treatment of Dementia in Japan. Intern Med. **43**: 18-29.
6. **Saito, J., Inoue, M., Kitaura, M., Taniguchi, M., Kimura, Y., Sato, C., Umazume, M., Fukuda, Y., Yamamoto, T. and Urakami, K.** 2005. Assessment of new subject selection methods and evaluation methods for dementia prevention classes. Dementia Japan **19**: 177-186.
7. **Urakami, K.** 2002. Polymorphism in Alzheimer's disease and a simple screening method. Clinic Magazine **6**: 50.
8. **Urakami, K., Taniguchi, M., Sakuma, K., Yamagata, K., Wada, K., Wakutani, Y., Nakashima, K. and Inoue, H.** 2002. Polymorphism in Alzheimer's disease and a simple screening method. Japanese Journal of Geriatric Psychiatry **13**: 5-10.
9. **Urakami, K.** 2004. Techniques for the early differential diagnosis of dementia in the "outpatient clinic specializing in memory impairment". Geriatric Medicine **42**: 737-742.
10. **Urakami, K., Wakutani, Y., Wada, K. and Nakashima, K.** 2005. Epidemiology of dementia of the aged. Nippon Naika Gakkai Zasshi **94**:1467-1472.