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ORIGINAL RESEARCH

The Yamaguchi fox/pigeon-imitation test, a brief cognitive performance rating tool, in a community-dwelling population: normative data for Japanese subjects – a preliminary study

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Introduction: Screening tools for dementia should be valid and easy to complete and have a low psychological burden. Consistent with these principles, the Yamaguchi fox/pigeon-imitation test (YFPIT) has been developed. However, there is little information on the utility of the YFPIT for preclinical populations, although the detection of proven prodromal and preclinical states is important.

Materials and methods: We recruited 392 volunteers who were at least 60 years old (139 men and 253 women) and had participated in the Iwaki Health Promotion Project. The YFPIT was administered to all participants.

Results: Most subjects succeeded in imitating the fox gesture regardless of their cognitive function impairment, while the success rates for the pigeon gesture were 75.3% in the normal group and 56.3% in the cognitive impairment group. The sensitivity, specificity, positive predictive value (PV^+), and negative predictive value (PV^-) were 43.8%, 75.3%, 7.0%, and 97.0%, respectively. The greatest significant difference between the imitation of the pigeon gesture and cognitive impairment was found in females with subjective memory impairments (P=0.001). In that group, the sensitivity, specificity, PV^+, and PV^- were 100%, 81.9%, 18.8%, and 100%, respectively.

Conclusion: This study suggests that the utility of the YFPIT is limited in the general population, but that it is a useful tool in females with subjective memory impairments in a community-dwelling population.

Keywords: dementia, gesture imitation, brief screening

Introduction

The prevalence of all types of dementia ranges from 2.9% to 12.5% in Japan, and has been rapidly increasing over the past few years.[1,2] The total cost of caring for individuals with dementia has not been calculated in Japan, but it was estimated to be US $189 billion in 2007 in the EU, which was higher than the cost of heart disease, stroke, and cancer.[3] There are approximately 12 million individuals with dementia worldwide, and this number is likely to increase to 80 million by 2040.[4] Governments worldwide are committed to prevention, including primary prevention (reduction of risk factors), secondary prevention (detection of proven preclinical states, during which early intervention has been proven to be better than usual presentation), and tertiary prevention (best possible care for individuals with manifest dementia).

Alzheimer's disease (AD) is an irreversible, progressive disorder characterized by a loss of cognitive function, particularly memory and judgment. AD is the most

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common form of dementia, and the diagnosis of this disease attracts significant attention. However, at least 66% of individuals with dementia are not diagnosed in the early stages.[5] Obtaining an early diagnosis can help patients begin treatment as soon as possible to help slow cognitive and functional decline with pharmacological treatment.[6] However, a dementia-screening and -diagnosis program in the US showed that patients had high refusal rates for a dementia diagnostic workup following a positive screening.[7] Therefore, it is important that screening tools be valid and easy to complete and have a low psychological burden. Because visual processing abnormalities commonly contribute to early stage AD symptoms,[8,9] the development of simple visual perception tests may be effective in screening for AD. In fact, many visual perception tests have been developed worldwide in the last two decades,[10–12] such as the clock-drawing test, the complex picture test, and pantomime and imitation of limb gestures.

Based on these principles, the Yamaguchi fox/pigeon-imitation test (YFPIT) was developed in Japan.[13] This test is composed of a simple one-hand sign for "fox" and a two-hand sign for "pigeon", providing a simple, enjoyable test for AD and dementia of Lewy bodies with a low psychological stress. One study reported associations between the percentage of correct answers on the YFPIT and the Clinical Dementia Rating scale score.[13] Although the detection of prodromal and preclinical states is important, there is little information on the utility of the YFPIT in preclinical populations.

In this study, we examined the utility of the YFPIT in a Japanese community-dwelling population. To establish the validity of this test, we evaluated the relationship between the YFPIT and a widely used screening tool: the Mini-Mental State Examination (MMSE). In addition, the influence of demographic factors on the performance of healthy individuals, as measured by the percentage of correct answers on the YFPIT, was examined. To the best of our knowledge, this is the first article on normative sample data for the YFPIT in a Japanese community-dwelling population.

Materials and methods

Participants

The study was conducted in June 2011. We recruited 392 volunteers who were at least 60 years old (139 men and 253 women) and had participated in the Iwaki Health Promotion Project. The mean age of the subjects was 68.8±6.4 years. The average score on the MMSE was 28.2±2.3. The mean number of years of education among subjects was 10.6±2.0 years and was significantly different between males and females (males 11.0±2.2 years, females 10.4±1.9 years; $P<0.01$). Demographic data (education, age, and sex) were acquired with interviews and self-questionnaires. We also assigned participants to one of three groups based on their number of years of education in the Japanese educational system: compulsory education, 1–9 years; high school education, 10–12 years; or any university-level education, 13+ years. The Ethics Committee of the Hirosaki University School of Medicine approved the data collection for this study, and all subjects provided written informed consent before participating.

Procedure

The YFPIT was administered to all participants, and consists of a hand-gesture imitation of a fox contiguous with a pigeon, according to the procedure described previously.[14] Briefly, the protocol was as follows:

1. The examiner sat in front of the subject.
2. The examiner instructed: "Please watch my hand gesture and imitate it".
3. Then, the examiner made the fox gesture sign using their hand: fingers III and IV touched the thumb on the flexion of the metacarpophalangeal joints, with fingers II and V touching. The examiner could use either hand (Figure 1).
4. The examiner kept the hand gesture for 10 seconds. The subject imitated the gesture with the examiner at the same time. The examiner did not talk any more for 10 seconds of the test.
5. The examiner judged whether the subject imitated the same sign within 10 seconds.
6. For the pigeon sign, the examiner gave similar instructions and then made a pigeon sign using both hands: the hands were crossed, palms facing the body, with fingers II–V extended upward and the two thumbs crossing each other.
7. The examiner kept the gesture without saying a word to a subject during the 10 seconds of the test.
8. The examiner judged whether the subject imitated the same sign within 10 seconds.
9. Scoring was based on previous research.[14]

A Japanese version of the MMSE[15] was also administered to all participants to measure their cognitive status. A comparison of the score from this test with scores on the YFPIT enabled us to assess the validity of the YFPIT as a screening tool for cognitive dysfunction. In approximately 10 minutes, the MMSE (maximum score =30) examines cognitive function including arithmetic, memory, and orientation. We defined

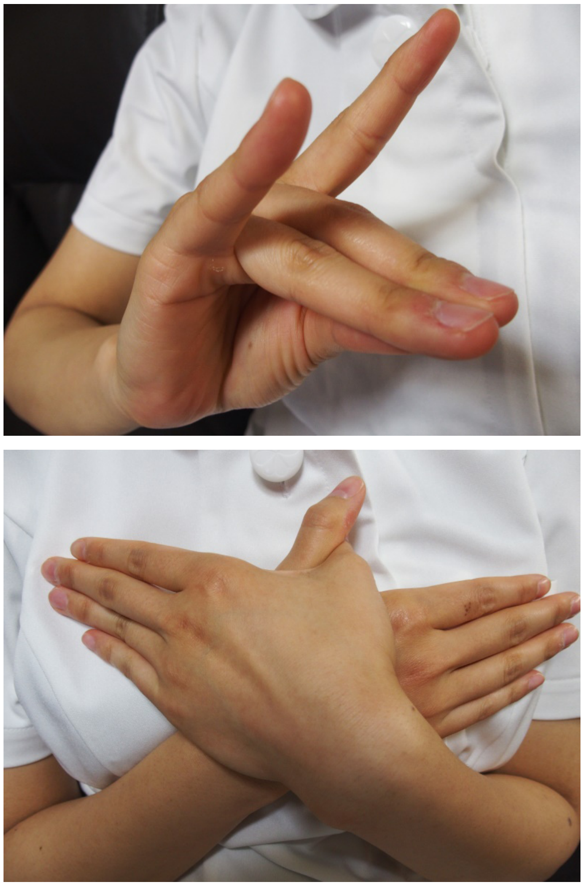

Figure 1 Fox (upper) and pigeon (lower) hand gestures.

individuals who scored 24 points or more on the MMSE as the normal group and individuals who scored 23 points or less as the cognitive impairment (CI) group (n=16, Table 1). The presence of subjective memory impairment was analyzed elsewhere. The group with subjective memory impairment consisted of 103 individuals (28 men, 75 women).

The outcome of subjective memory impairment was assessed with a single question about the presence of perceived memory problems: "Do you have any problems with your memory"? This question selected for analysis was based on the variables identified.[16]

Statistical analysis

Data are presented as means ± standard deviation. Descriptive statistics, the χ^2 test, one-way analysis of variance (ANOVA), and Student's *t*-test were used to compare the differences between the normal group and the CI group. The χ^2 test was used to explore the difference in the success rate of the imitation test between sexes. ANOVA was used to compare MMSE scores among error-pattern types. The *t*-test was performed to examine differences in MMSE scores between sexes and between the normal and CI groups. A *P*-value of less than 0.05 denoted statistical significance. All analyses were performed using SPSS 21.0J for Windows (IBM Japan, Tokyo, Japan).

Results

Most subjects succeeded in imitating the fox gesture, regardless of impairment in cognitive function (Table 2); the success rates for the pigeon gesture – 75.3% in the normal group and 56.3% in the CI group – were not significantly different. The sensitivity, specificity, positive predictive value (PV^+; positive diagnosis/test), and negative predictive value (PV^-; negative diagnosis/test) were 43.8%, 75.3%, 7.0%, and 97.0%, respectively.

There were no differences in the success rate of imitation of the fox gesture or in CI between males and females. A significant difference between the success rate of imitation of the pigeon gesture and the presence of CI was not found in males but was found in females (*P*=0.016). The sensitivity, specificity, PV^+, and PV^- were 28.6%, 68.9%, 4.7%, and 97.9%, respectively, in males (Table 3), and 55.6%, 78.7%, 8.8%, and 98.0%, respectively, in females (Table 3). The greatest significant difference between the success rate of imitation of the pigeon gesture and the

Table 1 Demographic characteristics of subjects

	Total n=392	Normal n=376	CI n=16	
Age	68.8±6.4	68.7±6.3	71.4±7.0	ns
Amount of education	10.6±2.0	8.7±0.8	10.7±2.0	$P<0.001$
MMSE score	28.2±2.3	28.4±1.9	21.8±1.4	$P<0.001$
CES-D score	10.7±2.0	11.8±2.2	10.9±2.2	ns
Subjective memory impairment	103 (26.3%)	97 (25.8%)	6 (37.5%)	ns
Error of fox	13 (3.3%)	12 (3.2%)	1 (6.2%)	ns
Error of pigeon	100 (25.5%)	93 (24.3%)	7 (43.8%)	ns

Abbreviations: MMSE, Mini-Mental State Examination; CES-D, Center for Epidemiologic Studies Depression scale; ns, not significant.

Table 2 Demographic characteristics of subjects with regard to sex

	Males		Females	
	Normal n=132	CI n=7	Normal n=244	CI n=9
Age	68.7±6.7	69.4±7.0	68.7±6.1	72.9±6.9
Amount of education	11.1±2.1	8.4±1.1	10.5±1.9	8.9±0.3
MMSE score	28.0±2.1	21.9±1.2	28.7±1.8	21.8±1.6
CES-D score	10.4±4.8	12.4±6.4	10.7±5.7	11.3±7.6
Error of fox	6	1	6	0
Error of pigeon	41	2	52	5

Abbreviations: MMSE, Mini-Mental State Examination; CES-D, Center for Epidemiologic Studies Depression scale; CI, cognitive impairment.

Table 3 Demographic characteristics of subjects with regard to sex

	Males				Females			
	SMI (+)		SMI (–)		SMI (+)		SMI (–)	
	Normal n=25	CI n=3	Normal n=107	CI n=4	Normal n=72	CI n=3	Normal n=172	CI n=6
Age	71.1±8.2	69.3±9.7	68.2±6.2	69.5±6.1	68.9±6.3	72.7±7.6	68.6±6.1	73.0±7.2
Amount of education	10.6±3.6	8.0±1.7	11.2±2.0	8.6±0.5	10.3±2.0	8.7±0.6	10.5±1.9	9.0±0.0
MMSE score	26.9±2.1	21.3±1.5	28.2±2.0	22.3±1.0	28.6±1.7	20.3±1.5	28.7±1.8	22.5±1.2
CES-D score	10.1±5.4	11.3±10.6	10.5±4.6	10.5±4.6	12.9±7.3	12.3±12.0	9.9±4.7	10.8±5.8
Error of fox	0	0	6	1	3	0	3	0
Error of pigeon	11	0	30	2	13	3	39	2

Abbreviations: MMSE, Mini-Mental State Examination; CES-D, Center for Epidemiologic Studies Depression scale; CI, cognitive impairments; SMI, subjective memory impairment.

presence of CI was found in females with subjective memory impairments (P=0.001). The sensitivity, specificity, PV$^+$, and PV$^-$ for this group were 100%, 81.9%, 18.8%, and 100%, respectively.

In individuals who failed to imitate the sign for pigeon, the rate of each type of error pattern was compared between the normal and CI groups. There was a significant difference in the MMSE scores between the CI and normal groups ($P<0.01$). However, there were no differences in MMSE scores between error-pattern types (Table 4). Participants with cognitive memory impairment were found only in the compulsory education groups. We were not able to analyze the date-divided years of education.

Discussion

The results of our study showed that the sensitivity and specificity of the YFPIT were not high enough to promote this test as a screening tool for CI in a community-dwelling population; however, a significant difference was found in the success rate of producing the pigeon gesture between the normal and subjective memory-impairment groups in females. These findings suggest that the YFPIT is limited in the general population, but is a useful tool for females with subjective memory impairments in a community-dwelling population.

There was a sex difference in the correct-answer rate in this study, in contrast with the results of a previous study.[13] This sex difference may have been influenced by the type of dementia causing the CI. In general, there are higher rates of AD in women.[17] Visual processing abnormalities occur in AD, beginning in the early stage,[8] and may have led to the association between the errors in producing the pigeon gesture and CI as measured by the MMSE in this study. In fact, the success rate for imitating the pigeon gesture in patients with dementia with Lewy bodies was higher than in those with AD rated by the Clinical Dementia Rating scale (51.2% versus 35.4%, respectively).[13]

In addition to the validity of a screening tool, it is important to reduce the refusal ratio for screening examinations in community-dwelling populations. We believe that the usefulness of the YFPIT was high because no subjects refused to participate in this study. Although the PV$^+$ value of the YFPIT was 7%, it required a shorter time to complete than the MMSE.

Table 4 Data on each result of pigeon-test data

	Pigeon test		Significance	Error patterns			
	Correct n=292	Error n=100		F(i) n=57	F(ii) n=8	F(iii) n=24	F(iv) n=11
Age	68.2±6.2	70.8±6.5	ns	69.7±6.1	69.3±7.4	72.4±6.6	74.1±6.6
Sex (M/F)	97/195	42/58	0.004	32/24	2/6	6/18	2/9
Education	10.7±2.0	10.3±2.0	ns	10.6±2.0	10.9±1.6	10.2±2.3	9.1±1.7
MMSE	28.4±2.2	27.5±2.5	0.009	27.7±2.5	28.1±2.0	27.5±2.8	26.5±2.5
Subjective memory impairment (%)	76 (26%)	27 (27%)	ns	17 (30%)	2 (25%)	6 (25%)	2 (18%)
Hypertention (%)	141 (48%)	57 (57%)	ns	32 (57%)	5 (63%)	14 (58%)	6 (54%)
Diabetes (%)	33 (11%)	7 (7%)	ns	4 (7%)	1 (13%)	1 (4%)	1 (9%)
Hyperliminea (%)	70 (24%)	17 (17%)	ns	14 (25%)	2 (25%)	1 (4%)	0 (0%)

Abbreviations: MMSE, Mini-Mental State Examination; F(i), palm–palm; F(ii), palm–dorsum; F(iii), dorsum–dorsum; F(iv), intermediate.

Against the background of rapid growth of the Japanese population, the number of individuals of advanced age has notably increased. Currently, one in 40 individuals in Japan over the age of 65 years has a form of dementia; this rate increases to one in nine individuals among those over the age of 85 years.

There was a difference in the correct-answer rate for the pigeon gesture between a previous report[13] (85.7%) and the present study (75.3%). We cannot clearly explain the reason for this difference, but it may have resulted from the difference in the areas assessed, ie, a farm/village area versus a mid-sized city.

There were several limitations in this study. We did not perform imaging studies, such as magnetic resonance imaging, and the examination of cognitive function was limited to the MMSE. Therefore, the causes of CI were not clearly understood. The analysis of each type of dementia discussed in the previously mentioned article was impossible. In addition, very few subjects had CI. Almost all subjects were cognitively normal, because the recruitment was focused on community-dwelling subjects. Therefore, a larger number of individuals with both mild CI and normal cognition is needed.

Disclosure

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