

Depression in Patients with Subacute Myelo-Optico-Neuropathy (SMON)

Tetsuro Konishi¹, Kaori Hayashi¹, Michiyuki Hayashi², Satoshi Ueno³, Souhei Yoshida⁴, Harutoshi Fujimura⁵, Itaru Funakawa⁶ and Misako Kaido⁷

Abstract

Objective We investigated the psychiatric disorders in subacute myelo-optico-neuropathy (SMON) patients by structured interview. The prevalence of major depressive disorder in SMON patients was estimated by structured interview and using Beck's depression inventory (BDI) questionnaires.

Materials and Methods Psychiatric conditions were evaluated in 26 SMON patients (9 males, 17 females, mean age 70.7 years) living in Kyoto prefecture through a structured interview given by psychiatrists. BDI questionnaires and clinical symptoms of SMON were investigated in 106 patients, ranging from 51 to 91 years in age (mean, 73.5) with SMON patients living in Kinki area. BDI questionnaires were obtained from 92 age-matched aged healthy people, ranging from 57 to 91 years in age (mean, 75.8), living in Kyoto city.

Results Among the psychiatric disorders in SMON patients, the prevalence of major depressive disorder and suicidal ideation significantly increased during the period of clioquinol intake and four patients (15.4%) out of 26 SMON patients still suffer from major depressive disorder. The prevalence of major depressive disorder in SMON patients was estimated at 15.1% (16/106) and this percentage was about seven times as frequent as in the age-matched aged healthy people (2.2%; 2/92). In female SMON patients, the degree of the depressive states was significantly correlated with the severe degree of dysesthesia of the lower extremities, and it was inversely correlated with the duration of SMON disease and the total scores of the Barthel index.

Conclusion This is the first report that shows the prevalence of major depressive disorder in SMON patients at present, which was seven times more frequent than age-matched aged healthy persons.

Key words: clinical study, major depressive disorder, clioquinol, SMON, Beck's depression inventory, psychiatric disorders, dysesthesia

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Introduction

Subacute myelo-optico-neuropathy (SMON) is a disease caused by clioquinol intoxication, characterized by subacute onset of sensory and motor disturbance in the lower extremities with visual impairment following abdominal symptoms, which mainly occurred during 1950-60's in Japan (1-3). After the ban of the sale of drugs containing clioquinol in September 1970, a sharp decrease in the number of

SMON patients was observed in Japan. It is estimated that the number of SMON patients only slightly exceeded three thousand in 2002, and the mean age of 1,031 SMON patients exceeded 70 years old (mean age \pm SD, 72.9 \pm 9.6) with female predominance (males: females; 1: 2.75) (4). According to the nation-wide survey of 1031 SMON patients by SMON Research Committee, the prevalence of psychological complications was 51.8% and the depressive state was observed in 19.8% of SMON patients (4).

As the prevalence of major depressive disorder in SMON

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Table 1. Prevalence of Psychological Symptoms Before, During and After the Period of Cloiquinol Intake (6)

	Before	During	At present
Major depression	3.8%	38.4%*	15.4%
Delirium	0%	7.7%	0%
Panic disorder	0%	0%	11.5%
Hypochondriasis	0%	0%	3.8%
Conversion disorder	0%	0%	3.8%
Alcohol abuse	3.8%	0%	3.8%
Sleep disorder	0%	0%	7.7%
Suicidal ideation	0%	23.1%*	0%
Committing suicide	0%	11.5%	0%

Before: before the cloiquinol intake period

During: during the cloiquinol intake period

★: $p < 0.01$ by χ square test between before and during cloiquinol intake period

patients in Japan has not been studied, we estimated the prevalence of major depressive disorder by structured interview by psychiatrists using Beck's depression inventory (BDI) questionnaires. We also compared the depressive states of SMON patients with age-matched healthy persons using BDI questionnaires. At the same time, we tried to clarify the factors causing deterioration of the depressive states in SMON patients associated with their clinical symptoms.

Materials and Methods

Psychiatric conditions were evaluated in 26 SMON patients (9 males, 17 females, mean age 70.7 years) living in Kyoto prefecture through a structured interview given by psychiatrists using BDI questionnaires. BDI questionnaire and clinical symptoms of SMON were investigated in 106 patients (28 males, 78 females), ranging from 51 to 91 years in age (mean, 73.5), living in the Kinki area. Before the entry of this study, we explained to each patient the aim of this study, and promised to keep the results private. Only patients who understood and agreed with the aim of this study were entered. BDI questionnaire was mailed to 300 aged people at random belonging to the golden age club at Ukyo area in Kyoto city, and had reply from 92 old people (41 males, 51 females), ranging from 57 to 91 years in age (mean, 75.8). Thus, the response of the BDI questionnaire was 30.7% (92/300). The clinical symptoms of SMON were evaluated using medical check-up records established by the SMON Research Committee. The degree of the peculiar dysesthesia in SMON patients (2), which includes adherent sensation to sole and sensation of scrubbing, tingling, stabbing or coldness, was classified into four groups; none, mild, moderate and severe. Visual impairments were classified into seven groups; normal, nearly normal, mild, moder-

ate and severely impaired, only perceiving blight sensation and total blind. The gait scores were obtained from condition of gait, which was classified into nine grades as follows: unable to walk, able to move by using a wheelchair, able to walk with aid, walk by holding walls, walk on crutches, walk with a stick, moderately unstable gait, mild unstable gait, normal gait. In each patient, total scores of Barthel index were calculated as the sum of ten questionnaires (total score; 100) (5). Mini-mental state examination (MMSE) was done in all SMON patients and the patients whose scores were less than 23 points were excluded. The study was approved by the ethics committee of Utano National Hospital.

Statistical analysis was made using Spearman's rank correlation, Wilcoxon's rank-sum test, or χ square test. A level of $p < 0.05$ was considered to be statistically significant.

Results

Psychiatric disorders in SMON patients

Structured interview by psychiatrists toward 26 patients with SMON who live in Kyoto area disclosed an increase in the prevalence of major depressive disorder, delirium, suicidal ideation and commitment of suicide during the cloiquinol intake period (*during* in the Table 1). The increase was significant in major depressive disorder and in the suicidal ideation during the cloiquinol intake period (6). Four patients (15.4%) out of 26 SMON patients suffered from major depressive disorder at present (*present* in the Table 1). Significant changes of the prevalence of psychiatric disorders, such as panic disorders, hypochondriasis, conversion disorder, alcohol addict and insomnia, were not observed during the periods of medication of cloiquinol and present (6). The suicidal ideation and commitment of suicide during

the cloquinol intake period were observed with the patients, only who were diagnosed as having major depressive disorder at the same time.

Total BDI scores of SMON patients and aged people

The total scores of BDI questionnaire of these four SMON patients with major depressive disorder in Kyoto prefecture exceeded 25 points, and the score of the other SMON patients without major depressive disorder was under 24 points. It is consistent that 24/25 of the total scores of BDI questionnaire is considered for tentative cut-off point

for suffering from major depressive disorder or severe depressive mood in this study. The number of SMON patients with a total BDI score exceeding 25 points was sixteen (15%) out of 106. On the other hand, the score in 2 (2%) out of 92 aged people exceeded 25 points. The difference of these two groups was significant by χ square test ($p < 0.01$).

Correlation between total BDI scores and clinical characteristics of SMON patients

In order to clarify factors which might influence the scores of BDI questionnaire, Spearman's rank correlation were examined among total BDI scores and the scored clinical characteristics of SMON patients analyzed in each gender groups (Table 2). In each gender, the total BDI scores did not correlate with age nor with the MMSE scores. In female SMON patients, the BDI scores were significantly correlated with the severe degree of dysesthesia of the lower extremities and were inversely correlated with the duration of SMON disease and the total scores of the Barthel index. In contrast, the BDI scores of male SMON patients did not show a significant correlation with any clinical characteristics.

Comparison of the total BDI scores among SMON patients and aged people

The distribution of BDI scores from 92 aged people living in Kyoto city and 106 SMON patients in Kinki area is shown in Fig. 1. Although the mean age of aged people was 2.3 years older than that of SMON patients, the Wilcoxon's

Table 2. Spearman's Rank Correlation Coefficient between Total BDI Scores and Age, Scores of Barthel Index, in Each Gender

	Males (28)	Females (78)
Age	-0.246	0.034
MMSE scores	-0.198	-0.128
Dysesthesia	-0.099	0.292*
Duration of disease	-0.361	-0.270*
Visual impairment	0.164	0.008
Gait disturbance	-0.021	-0.216
Barthel index scores	-0.064	-0.299**

★: $p < 0.05$, ★★: $p < 0.01$

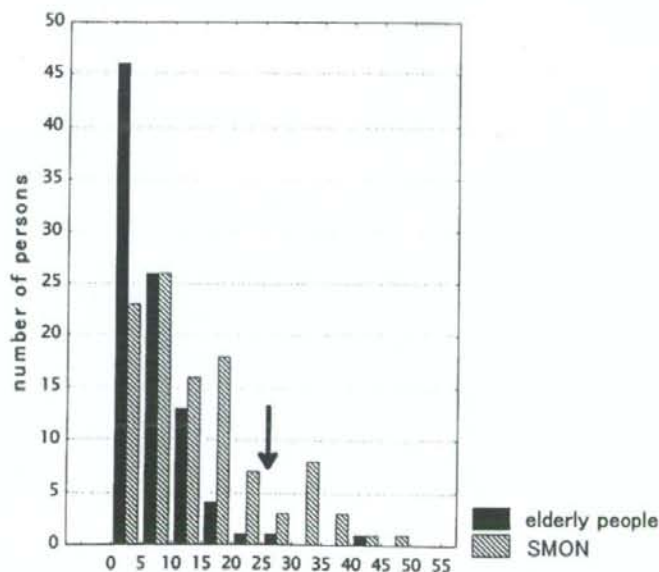


Figure 1. Distribution histogram of BDI scores of SMON patients and aged people. An arrow indicates cut-off point of 25 score.

rank-sum test of BDI scores showed that SMON patients had significantly high scores compared to age-matched aged people ($p < 0.0001$). Using tentative criterion of having major depressive disorder estimated from the high points of BDI scores exceeding 25 (arrow in Fig. 1), two (2.2%) out of 92 aged people and 16 (15.1%) out of 106 SMON patients were suggested to suffer from major depression. The percentage of the patients having estimated major depressive disorder in SMON patients was significantly high compared with those of aged people by χ^2 square test ($p < 0.01$). There was no difference in percentage exceed 25 points among male patients [14.8% (4/27)] and female patients [15.2% (12/79)]. The SMON patients were suggested to be suffering from major depressive disorder seven times more frequently compared with the age-matched aged people.

Discussion

A nation-wide survey of SMON patients showed more than a half SMON patients were suffering from various kinds of psychological complications, such as depressive mood and hypochondriasis (4). The mean age of these SMON patients was over 70 years old.

Here, we disclosed two significant points. First, the prevalence of major depressive disorder and delirium increased during the clioquinol intake period suggesting that these psychiatric disorders were due to the reactions of acute phase of SMON. Secondly, the prevalence of major depressive disorder in SMON patients at present was about 15% of SMON patients, estimated by two different ways, which percentage of major depressive disorder in SMON patients was seven times more frequent than age-matched aged people. One way of estimation of the prevalence of major depressive disorder among SMON patients was done from structured interview of 26 SMON patients by psychiatrists and four (15.4%) out of 26 patients was diagnosed as having major depressive disorder. The other estimation was obtained using BDI questionnaire from 106 SMON patients, in which 24/25 points of BDI scores was arbitrary used as the cut-off point

for the estimation of the prevalence of major depressive disorder. This cut-off point of 25 scores was considered as having moderately to severely depressed patients in the hospitalized medically ill patients (7). Using our tentative cut-off point, 16 (15.1%) out of 106 SMON patients were estimated to be suffering from major depressive disorder which coincided with the results obtained by the structured interview by psychiatrists.

The prevalence of major depressive disorder in aged people was 2.2% (2/92), estimated by the percentage of people, which BDI scores exceeding 25. This estimated prevalence in this study is compatible with other studies of aged people. The six-month prevalence of major depression in three different communities showed 2.2-3.5% with less frequency in aged people over 65 years old (8). The prevalence of major depressive disorder in aged people over 65 years old was reported as 3.7% (9). In Japan, there were two studies on the prevalence of major depressive disorder in elderly people over 65 years old, in which the prevalence was 1.1% (10) and 5.6% (11).

From the correlation study between severity of clinical parameters of SMON patients and BDI scores, the worsening factors for depressive state in female SMON patients closely related with the severity of the degree of dysesthesia of the lower extremities and the degree of disability of ADL. These findings suggest that improvement of the level of ADL and a reduction of dysesthesia of the lower extremities are important factors for the treatment of depressive state in SMON patients. We expect that the alleviation of these factors in the near future by the application of new medications or rehabilitation in SMON patients with a high BDI score will reduce the degree of the depressive mood associated with the reduction of BDI scores.

Abbreviation: ADL: activities of daily living

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Original Article

Activities of Daily Living, Functional Capacity, and Life Satisfaction of Subacute Myelo-Optico-Neuropathy Patients in Japan

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ABSTRACT

Background: Patients with subacute myelo-optico-neuropathy (SMON) suffer from a number of serious neurological symptoms that adversely affect their activities of daily living (ADL). However, the effects of these neurological symptoms on functional capacity and life satisfaction have not been reported.

Methods: We analyzed data from 1,300 SMON patients aged 55–94 years that was obtained at medical check-ups carried out by the SMON Research Committee in 2004–2006 in Japan. The neurological symptoms investigated were visual impairment, dysbasia, symptoms of the lower extremities, and sensory symptoms. Neurological symptoms were classified by severity. The Barthel Index, the Tokyo Metropolitan Institute of Gerontology Index of Competence, and the participant's response to the question "Are you satisfied with life?" were used to evaluate ADL, functional capacity, and life satisfaction, respectively. Data were analyzed using a proportional odds model with the scores for these items as ordinal dependent variables.

Results: For most neurological symptoms, scores for ADL, functional capacity, and life satisfaction were significantly lower in participants with severe or moderate neurological symptoms than in those with nearly normal results upon examination. The odds ratio for life satisfaction due to superior functional capacity was significant after adjustment for sex, age, and ADL score.

Conclusion: The presence of neurological symptoms in SMON patients was associated with low functional capacity, life satisfaction, and ADL. Our results suggest that the life satisfaction of SMON patients can be increased by improving their functional capacity.

Key words: subacute myelo-optico-neuropathy; SMON; activities of daily living; functional capacity; life satisfaction

INTRODUCTION

Subacute myelo-optico-neuropathy (SMON) is a disease caused by clioquinol intoxication, and is characterized by subacute onset of sensory and motor disorders in the lower half of the body and visual impairment.^{1,2} In Japan, there are a large number of SMON patients.³ The incidence of SMON rapidly diminished after clioquinol was banned in 1970. In 2005, approximately 2,600 people with SMON were still receiving health management allowances as relief for an adverse drug reaction.⁴

Some studies have reported that a number of serious

neurological symptoms have remained as sequelae of clioquinol intoxication among SMON patients, and that these symptoms are strongly associated with limited activities of daily living (ADL).⁴⁻⁶ However, both life satisfaction and functional capacity—which includes instrumental self-maintenance, intellectual activities, and social role—play an important role in the life of older SMON patients, and these are yet to be reported.⁷ In the present study, we examine the associations between neurological symptoms, ADL, functional capacity, and life satisfaction in SMON patients.

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Table 1. Number of participants included in analysis, by sex and age

Age (years)	Men		Women		Total	
	No.	%	No.	%	No.	%
55-64	39	11.9	138	14.2	177	13.6
65-74	152	46.2	318	32.7	470	36.2
75-84	115	35.0	366	37.7	481	37.0
85-94	23	7.0	149	15.3	172	13.2
Total	329	100.0	971	100.0	1,300	100.0

PARTICIPANTS AND METHODS

Participants

We analyzed data from medical check-ups performed by the SMON Research Committee with the support of the Ministry of Health, Labour and Welfare of Japan.^{5,6} Our study participants were SMON patients aged 55 to 94 years who underwent medical check-ups in the years 2004 to 2006. Of 1,326 participants, we excluded 11 who did not consent to the use of their medical check-up data for analysis, and 15 with missing data on ADL, functional capacity, or life satisfaction. Table 1 shows the number of participants eligible for analysis by sex and age. Of a total of 1,300 SMON patients (329 males and 971 females), 73% were between 65-84 years old.

Neurological symptoms

A standardized record was used in the medical check-ups for SMON patients.^{5,6} The record included visual impairment (completely blind, visual acuity insufficient to count fingers, mildly impaired, or nearly normal), dysbasia (abasia, clinging while walking, walking with a cane, or independent walking), symptoms of the lower extremities (severe, moderate, mild, or nearly normal), and sensory symptoms (severely diminished, moderately diminished, mildly diminished, or nearly normal). These levels were recorded as "severe," "moderate," "mild," and "nearly normal," respectively. Symptoms of the lower extremities were weakness, spasticity, and amyotrophy. Sensory symptoms were tactile sensation, algesthesia, vibratory sensation, and dysesthesia. Tactile sensation and algesthesia were divided into the 4 abovementioned levels plus "hypersensitive."

ADL, functional capacity, and life satisfaction

The Barthel Index was used to measure ADL.⁸ Scores ranged from 0 to 100, with a higher score denoting higher ADL. The Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG Index) was used to measure functional capacity^{9,10} and ranged from 0 to 13, with a higher score indicating higher capacity. Life satisfaction was evaluated using the response to the question, "Are you satisfied with life?" Participant responses were grouped into 5 categories:

"dissatisfied," "slightly dissatisfied," "slightly satisfied," "satisfied," and "other." We assigned scores of 1, 2, 4, 5 and 3, respectively, to these categories.

Statistical analyses

ADL, functional capacity, and life satisfaction were compared among the severity groups for neurological symptoms by using a proportional odds model, which is a logistic model for ordinal dependent variables which assumes that the odds ratios for falling above a category versus those for falling within, or below, a category of ordinal dependent variables for independent variables are common across those categories.^{11,12} ADL, functional capacity, and life satisfaction were ordinal dependent variables. The model included sex, age, and one of the neurological symptoms (a dummy variable) as independent variables. The associations between ADL, functional capacity, and life satisfaction were examined using the proportional odds model with life satisfaction as an ordinal dependent variable and sex, age, ADL, and functional capacity as independent variables. Statistical analyses were conducted using SAS software, version 9.1 (SAS Institute, Inc., Cary, NC, USA).

Ethical review

This study was approved in December 2005 by the Ethical Review Board for Epidemiological and Clinical Studies of the Fujita Health University School of Medicine.

RESULTS

Table 2 shows the distributions of neurological symptoms. The proportions of participants with severe symptoms were 1.5% for visual impairment, 16.4% for dysbasia, 5.4-14.0% for symptoms of the lower extremities, and 10.1-35.3% for sensory symptoms. The proportions of participants with nearly normal results were 59.3%, 48.8%, 19.2-49.7%, and 3.0-4.3%, respectively.

Figures 1, 2, and 3 show the distributions of the scores for ADL, functional capacity, and life satisfaction, respectively. The scores for ADL and functional capacity were widely distributed. For ADL, the proportion of participants scoring 70 or less was 22.1%. A functional capacity of 11 or less was noted in 71.8% of participants. With respect to life satisfaction, 23.2% of participants were "dissatisfied" or "slightly dissatisfied" and 49.1% were "slightly satisfied" or "satisfied".

Tables 3, 4, and 5 show the respective mean scores and odds ratios for ADL, functional capacity, and life satisfaction for the groups of neurological symptoms. For all neurological symptoms, mean scores were lower in the severe and moderate groups than in the nearly normal group. For most neurological symptoms, after adjustment for sex and age, the differences in scores between the groups were statistically significant in analysis using the proportional odds model. The

Table 2. Distribution of neurological symptoms

Neurological symptoms	No.	Proportion (%)				
		Severe	Moderate	Mild	Hyper-sensitive	Nearly normal
Visual impairment	1247	1.5	6.8	32.4	-	59.3
Dysbasia	1249	16.4	9.7	25.1	-	48.8
Symptoms of lower extremities						
Weakness	1215	14.0	28.1	38.8	-	19.2
Spasticity	1212	7.1	16.9	26.3	-	49.7
Amyotrophy	1212	5.4	13.6	32.4	-	48.5
Sensory symptoms						
Tactile sensation	1211	10.2	41.5	34.5	9.4	4.3
Algesia	1211	10.1	34.3	28.3	23.1	4.2
Vibratory sensation	1205	35.3	35.4	24.9	-	4.4
Dysesthesia	1207	20.3	57.5	19.2	-	3.0

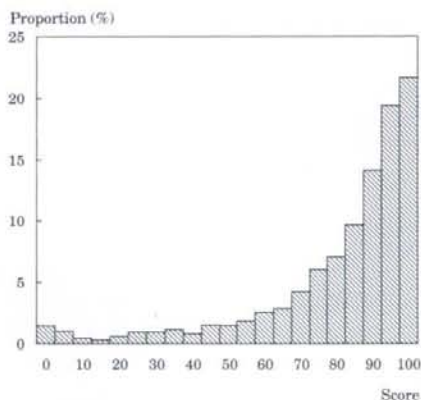


Figure 1. Distribution of activities of daily living scores

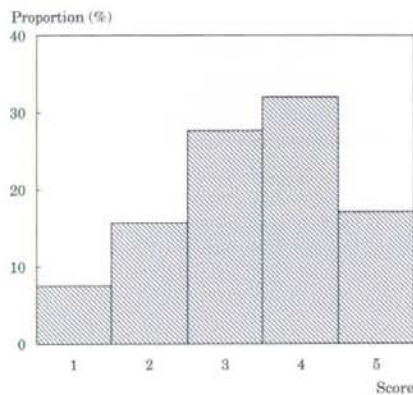


Figure 3. Distribution of life satisfaction scores

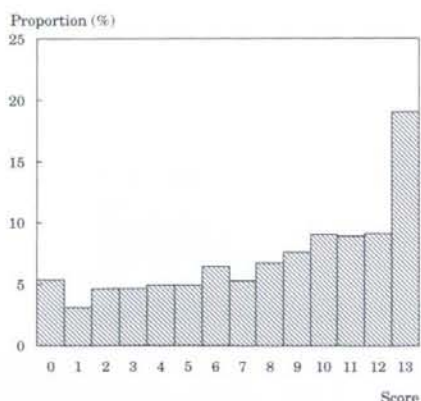


Figure 2. Distribution of functional capacity scores

odds ratios for participants in the severe groups, as compared with the respective nearly normal group, were between 0.00 and 0.49.

Table 6 shows the odds ratios for independent variables in the proportional odds model with life satisfaction as the ordinal dependent variable. The odds ratio for functional capacity—after adjustment for sex, age, and ADL—was significantly higher than 1.

DISCUSSION

We observed that the scores for ADL, functional capacity, and life satisfaction among SMON patients were strongly associated with the severity of neurological symptoms. The odds ratios of the severe group were much lower than those of the nearly normal group. These associations are not surprising, given that the neurological symptoms included visual impairment, dysbasia, symptoms of the lower extremities, and sensory symptoms. Some previous studies on ADL in SMON patients reported results similar to ours.^{5,6} We found that more than 70% of SMON patients had limited functional capacity (a score of ≤ 11 on the TMIG Index).¹³ Functional capacity includes instrumental self-maintenance, intellectual activities, and social role, and is likely to be an accurate

Table 3. Mean scores and odds ratios for activities of daily living by severity of neurological symptoms

Neurological symptoms	Severe		Moderate		Mild		Hypersensitive		Nearly normal		P value†
	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	
Visual impairment	40.0	0.02	63.5	0.12	75.6	0.37	-	-	87.7	1.00	<0.001
Dysbasia	44.1	0.00	73.9	0.05	85.5	0.22	-	-	93.4	1.00	<0.001
Symptoms of lower extremities											
Weakness	49.2	0.01	77.6	0.13	89.5	0.45	-	-	94.5	1.00	<0.001
Spasticity	66.5	0.14	73.0	0.25	83.1	0.65	-	-	85.7	1.00	<0.001
Amyotrophy	38.9	0.02	65.4	0.09	81.9	0.39	-	-	90.6	1.00	<0.001
Sensory symptoms											
Tactile sensation	67.9	0.15	78.7	0.38	88.5	0.93	83.6	0.52	84.5	1.00	<0.001
Algesthesia	69.8	0.17	77.5	0.35	87.8	0.81	85.1	0.58	84.7	1.00	<0.001
Vibratory sensation	75.4	0.22	82.3	0.42	88.9	0.74	-	-	89.3	1.00	<0.001
Dysesthesia	72.6	0.24	82.6	0.57	88.8	1.18	-	-	81.7	1.00	<0.001

* Mean activities of daily living score.

† Odds ratio and P value from the proportional odds model with activities of daily living as an ordinal dependent variable and sex, age, and a neurological symptom as independent variables.

Table 4. Mean scores and odds ratios for functional capacity by severity of neurological symptoms

Neurological symptoms	Severe		Moderate		Mild		Hypersensitive		Nearly normal		P value†
	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	
Visual impairment	1.6	0.01	4.2	0.06	6.7	0.28	-	-	9.7	1.00	<0.001
Dysbasia	3.4	0.03	5.3	0.08	8.0	0.25	-	-	10.5	1.00	<0.001
Symptoms of lower extremities											
Weakness	3.8	0.04	7.2	0.17	9.3	0.48	-	-	10.9	1.00	<0.001
Spasticity	6.8	0.31	7.1	0.36	8.3	0.72	-	-	8.8	1.00	<0.001
Amyotrophy	2.7	0.03	5.5	0.13	7.8	0.38	-	-	9.9	1.00	<0.001
Sensory symptoms											
Tactile sensation	5.9	0.25	7.8	0.59	9.5	1.17	8.3	0.69	8.5	1.00	<0.001
Algesthesia	6.0	0.26	7.6	0.54	9.4	1.10	8.7	0.78	8.7	1.00	<0.001
Vibratory sensation	7.2	0.47	8.3	0.69	9.6	1.11	-	-	9.7	1.00	<0.001
Dysesthesia	7.0	0.35	8.3	0.60	9.4	0.95	-	-	8.7	1.00	<0.001

* Mean functional capacity score.

† Odds ratio and P value from the proportional odds model with functional capacity as an ordinal dependent variable and sex, age, and a neurological symptom as independent variables.

Table 5. Mean scores and odds ratios for life satisfaction by severity of neurological symptoms

Neurological symptoms	Severe		Moderate		Mild		Hypersensitive		Nearly normal		P value†
	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	Mean score*	Odds ratio†	
Visual impairment	2.2	0.16	3.0	0.46	3.2	0.66	-	-	3.5	1.00	<0.001
Dysbasia	3.1	0.42	3.2	0.47	3.2	0.56	-	-	3.5	1.00	<0.001
Symptoms of lower extremities											
Weakness	2.9	0.27	3.3	0.47	3.4	0.61	-	-	3.6	1.00	<0.001
Spasticity	3.1	0.63	3.2	0.68	3.2	0.67	-	-	3.5	1.00	0.002
Amyotrophy	2.9	0.33	3.1	0.53	3.3	0.67	-	-	3.5	1.00	<0.001
Sensory symptoms											
Tactile sensation	3.2	0.42	3.3	0.48	3.5	0.73	3.3	0.55	3.7	1.00	<0.001
Algesthesia	3.2	0.55	3.3	0.59	3.4	0.79	3.3	0.66	3.6	1.00	0.067
Vibratory sensation	3.3	0.47	3.3	0.45	3.4	0.53	-	-	3.8	1.00	0.021
Dysesthesia	3.2	0.49	3.3	0.54	3.6	0.89	-	-	3.7	1.00	<0.001

* Mean life satisfaction score.

† Odds ratio and P value from the proportional odds model with life satisfaction as an ordinal dependent variable and sex, age, and a neurological symptom as independent variables.

Table 6. Odds ratios for life satisfaction with respect to sex, age, activities of daily living, and functional capacity

Independent variables	Odds ratio*	P value*
Sex (male/female)	1.51	<0.001
Age (years)	1.05	<0.001
Activities of daily living	1.01	0.109
Functional capacity	1.16	<0.001

* Odds ratio and P value from the proportional odds model, with life satisfaction as an ordinal dependent variable.

indicator of the quality of life of older SMON patients.^{10,13} Our findings suggest that measures that can remedy the limited functional capacity of SMON patients are of great importance.^{4,6}

When asked "Are you satisfied with life?" almost half of participants answered "slightly satisfied" or "satisfied." Although interpreting these responses is difficult, the level of life satisfaction in SMON patients appears relatively low. A national survey in Japan reported that in the general elderly population the proportion of individuals who responded similarly to the same question was over 90%.¹⁴

In the present study, the level of life satisfaction was significantly associated with functional capacity after adjustment for sex, age, and ADL score, which suggests that life satisfaction among SMON patients might be increased by obtaining a higher level of functional capacity.^{15,16} Unfortunately, there are no effective medical treatments to relieve the remaining neurological symptoms in SMON patients.^{4,5} Although we did not investigate the factors associated with high functional capacity, our results offer information that should be useful in offering specific and effective assistance to those patients.

There are several limitations and problems in the present study. The participants were examined at medical check-ups carried out by the SMON Research Committee; approximately half of the participants were SMON patients receiving health management allowances for the relief of adverse drug reactions.^{4,5} Although the proportions SMON patients with limited ADL, functional capacity, and life satisfaction might be higher in the entire SMON population than in the subset of patients we analyzed, we believe that the associations between neurological symptoms and those indices would not be radically changed. The Barthel Index and TMIG Index used in this study are common tools for measuring ADL and functional capacity, respectively.⁷⁻⁹ We used the question "Are you satisfied with life?" to measure life satisfaction. Although other indices to measure life satisfaction have been proposed,^{17,18} questions similar to ours have been used in several previous studies.^{14,19} We used a proportional odds model for ordinal dependent variables of ADL, functional capacity, and life satisfaction, rather than binary logistic models that reduce those variables to just two categories. In proportional odds models, as we describe above, it is assumed that the odds of falling above a category versus those of falling

with, or below, the category of ordinal dependent variables for independent variables are common across all categories.^{11,12} To take one example from the present study, the odds ratio for participants with severe visual impairment, as compared with those in the nearly normal group, was 0.49 for the dependent variable of ADL. This can be interpreted to mean that SMON patients with severe visual impairment had 0.49 times the odds of a higher, versus a lower, ADL score than those with nearly normal visual impairment. The results obtained from such models lead to important findings regarding the factors related to the distributions of ADL, functional capacity, and life satisfaction. However, their interpretation requires careful analysis and debate.

In conclusion, the neurological symptoms of SMON patients are associated with low levels of functional capacity, life satisfaction, and ADL. Our results indicate that life satisfaction of SMON patients might be increased by improving functional capacity.

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RESEARCH PAPER

Factors associated with life satisfaction in Japanese stroke outpatients

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Abstract

Purpose. To measure life satisfaction in Japanese stroke outpatients and randomly-sampled community residents and to investigate variables influencing their life satisfaction.

Method. Data on the demographic and clinical profiles, Satisfaction in Daily Life (SDL), other measurements, were obtained from 869 stroke outpatients (552 males, 317 females) and 748 community-dwelling elderly (360 males, 388 females), aged 55 years and older. Differences in categorical variables and continuous variables were tested by chi-square test and ANCOVA with age as the covariate, respectively.

Results. The 11 SDL items were subjected to a factor analysis, which extracted two factors. Factor 1 (F1), labeled as 'satisfaction with one's own abilities', included satisfaction with housework, self-care, gait, physical health, hobby and leisure, social intercourse and mental health. Factor 2 (F2), 'satisfaction with external factors', included satisfaction with partner/family relationship, economic state and social security, and house facilities. Both F1 and F2 scores were significantly lower for stroke outpatients ($M=19.7$ and 10.9 , respectively) than for community-dwelling elderly ($M=28.2$ and 12.0 , respectively) ($p < 0.001$). Living conditions were significantly associated with F2, but not with F1. Males living alone scored lowest on F2 than the others for both groups. Among stroke outpatients, both F1 and F2 scores differed significantly by the type of hemiparesis and the severity of aphasia.

Conclusions. SDL of stroke outpatients, which was lower than community-dwelling elderly, differed by the type of hemiparesis, the severity of aphasia, and living conditions. The effects of living conditions might vary with gender.

Keywords: Stroke, life satisfaction, satisfaction in daily life, principal component analysis

Introduction

Although medical treatments for stroke have been progressing, stroke is still one of the major causes of death in most industrialized countries [1–3] and impairments and disabilities after stroke persist in many cases. After acute medical and/or neurosurgical treatments for stroke, rehabilitative treatments play a major role at the subacute and chronic stages, including improvement in hemiplegia, independence in activities of daily living (ADL), encouragement to participate in social activities, and improvement in quality of life (QOL). Activity limitations and participation restrictions, as well as life satisfaction, which constitute a subjective perception of the individual and is a subjective domain of QOL, are very important in community rehabilitation programs and home-care and home-help services.

Previous studies have revealed that life satisfaction of post-stroke patients was influenced by race [4,5], gender [6,7], marital status [1,7], living conditions [8], aphasia [4,9,10], social support [3,11,12], and returning to work [14]. However, the influence of these factors on patients' satisfaction remains controversial due to inconsistent findings.

As to the effect of aphasia, for example, Christensen and Anderson [9] reported that patients with aphasia showed lower satisfaction than those without aphasia in the central region of the USA, whereas Ross and Wertz [10] showed that life satisfaction might be independent of aphasia in the southwestern region of the USA. As to gender, marital status, and living arrangements, Jaracz [6] observed that life satisfaction of stroke patients was not significantly correlated with their gender, marital status, or living arrangements in Poland, whereas

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Kauhanen [7] found that various aspects of QOL, including life satisfaction, were associated with marital status in Finland. Thus, it seems reasonable to hypothesize that the association of these factors with life satisfaction may differ across nationality and race/ethnicity or culture.

On the other hand, the sample sizes of the previous studies were relatively small, i.e., mostly less than 100 patients. Because life satisfaction is a subjective perception of the individual, it may fluctuate easily. Thus, a larger number of subjects are needed to obtain a stable result concerning life satisfaction. As far as we know, however, only one previous report has demonstrated the life satisfaction and its related factors among post-stroke outpatients with more than 800 subjects. Wyller et al. [12] reported that the subjective well-being (SWB) of 1,417 post-stroke patients in Norway, which may be regarded as interchangeable with life satisfaction mentioned here, was considerably lower than that of the counter-age community residents. They also described its relationship with female gender, older age, good general and mental health, and a firm social network. A body of large-scale investigations is necessary to obtain a consensus about life satisfaction of patients living at home with disabilities, such as stroke, subacute myelo-optico-neuropathy [13] and others.

The aims of the present study are to measure the life satisfaction of a large number of stroke patients living at home and community-dwelling elderly in Japan, and to disclose the features and influencing factors of their life satisfaction. We paid particular attention to the influence of living condition, which might play a supportive role for the outpatients after stroke, and to the influence of the time duration after onset of stroke as well. In the future, we intend to investigate the SDL of patients with subacute myelo-optico-neuropathy.

Methods

Stroke outpatients

All of Japan was divided into 10 regions, and one to three hospitals were selected from each region based on the following criteria: (i) the hospital has first-grade rehabilitative facilities in the legal medical insurance system, (ii) a board-certified doctor of rehabilitation medicine organizes the department of rehabilitation medicine, and (iii) the hospital serves the region. Finally, 16 hospitals were chosen from all over the country, and were asked to join the collaborative study. The board-certified doctor in each hospital was asked to select a maximum of 80 consecutive stroke outpatients according to our common inclusion criteria: patients (i) are 55 years of age or older, (ii) have a history of stroke confirmed

with computed tomography or magnetic resonance image, (iii) have already received stroke rehabilitation in the hospital, (iv) have no dementia or extremely severe aphasia, or who could not understand the questionnaire, (v) are able to respond to a self-rating questionnaire, and (vi) agree to join this study.

The SDL and other questionnaires were administered to stroke outpatients by these doctors. The doctors evaluated the severity of aphasia into 4 degrees: no aphasia, mild aphasia, moderate aphasia and severe aphasia. Stroke outpatients with aphasia were interviewed by trained speech therapists who were allowed to be proxy for patients with aphasia who were unable to complete the questionnaires by themselves, while the other outpatients and community residents responded to each item by themselves.

Although the doctors sent us anonymous data on 1,070 stroke outpatients from 16 hospitals nationwide, only 869 participated in the study (Table I), as the remaining 201 patients were in long-term hospital or nursing home care, or had missing values. Of the 869 patients, 59.0% had cerebral infarction, 35.1% had cerebral hemorrhage, 4.3% subarachnoid hemorrhage (SAH), 0.9% others, and 0.7% unknown; and the duration from onset was 5.3 ± 4.8 years (mean \pm standard deviation).

Community-dwelling elderly

One thousand community-dwelling elderly were randomly selected from the register of electors of Yahatanishi Ward, Kitakyushu City, Japan. Kitakyushu City, a large city located in a rural province of Japan, was designated by the national government as a model city for treating the elderly. Yahatanishi Ward is a residential area of the city, and its elderly residents were regarded as representative of aged persons in Japan. First, we sent a letter of request and questionnaires to 1,000 elderly people, asking them to participate in the survey; 780 agreed to take part in it. One hundred forty-nine did not respond, 46 refused to join the survey, and 25 had died or moved. Members of our survey team then called at the subjects' homes, and collected 748 questionnaires (Table I), as 32 of the 780 were excluded because they were in a hospital or nursing home, or less than 55 years old. Details regarding the data collection have been described elsewhere [15]. Of the 748 community-dwelling elderly, 451 (205 males, 246 females) received some medical treatments and rehabilitation services.

Instruments

The questionnaires consisted of a subject's profile sheet, the Satisfaction in Daily Life (SDL) [16],

Table 1. Characteristics of stroke outpatients and community-dwelling elderly.

	Stroke outpatients (n = 869)				Community-dwelling elderly (n = 748)			
	Male		Female		Male		Female	
	n	(%)	n	(%)	n	(%)	n	(%)
Subjects	552	(63.5)	317	(36.5)	360	(48.1)	388	(51.9)
Age (years old)								
mean (SD)	67.3	(7.5)	69.2	(8.6)	66.5	(7.6)	67.7	(7.8)
range	55-91		55-96		55-89		55-90	
Living conditions								
Alone	23	(4.2)	27	(8.5)	16	(4.4)	69	(17.8)
With spouse	261	(47.3)	103	(32.5)	213	(59.2)	148	(38.1)
Spouse and/or other family members	266	(48.2)	185	(58.4)	131	(36.4)	170	(43.8)
Type of hemiparesis								
Without hemiparesis	57	(10.3)	42	(13.2)				
Right hemiparesis	222	(40.2)	129	(40.7)				
Left hemiparesis	248	(44.9)	135	(42.6)				
Bilateral hemiparesis	25	(4.5)	11	(3.4)				
Severity of aphasia								
Without aphasia	252	(45.7)	194	(61.2)				
Mild aphasia	199	(36.1)	89	(28.1)				
Moderate-severe aphasia	100	(18.1)	34	(10.7)				

other measurements, such as the Short Form-36 (SF-36) [21,22], the Self-Rating Barthel Index [15], and the Self-Rating Frenchay Activity Index [23]. Details regarding these measurements without SDL have been described elsewhere [15].

The SDL, a simple measurement of subjective QOL referring to the Life Satisfaction Measure by Viitanen et al. [16], was used to assess the life satisfaction of stroke outpatients. The SDL was initially developed to evaluate the life satisfaction of sub-acute myelo-optico-neuropathy [17], and has been widely applied to stroke patients [18] and hemiplegics [19]. The SDL consisted of 11 items, i.e., physical health, mental health, self-care, gait, housework, house facilities, partner and family relationships, hobby and leisure activities, social intercourse, economic state and social security, and having a job [20]. Each item was rated along a 5-point rating scale from 'dissatisfied' (rated as 1) through to 'satisfied' (rated as 5); thus, giving a possible range of SDL scores from 11 (the lowest state of satisfaction) to 55 (the highest state of satisfaction).

Living conditions were asked by a single item with 5 response alternatives: 'living alone', 'living with spouse', 'living with spouse and other family member(s)', 'living with child (daughter or son), their spouses, and grandchild(ren) etc.', and 'others'.

Data analysis

A principal component analysis was performed to: (i) clarify the dimensionality of the SDL which might cover various aspects of the life satisfaction, and (ii)

construct some summary variables rather than individual items. The latter might prevent increased possibilities of type I error due to repeat comparisons using 11 items. After the promax rotation, items showing loadings exceeding 0.50 were regarded as salient on a component. Differences in categorical variables and continuous variables were tested by a chi-square test and ANCOVA with age as the covariate. Statistical analyses were conducted using the SPSS 11.0 J.

Results

Dimensionality of the SDL scale

A total of 1,617 data responses on individual SDL items were factor analyzed. According to an initial unrotated solution, the eigenvalues of the first two factors exceeded 1.0. These factors were then subjected to the promax rotation. Table II shows the factor loadings of individual SDL items.

The SDL consisted of two factors, and one item was quite independent of other items. Factor 1 (F1) included satisfaction with housework, self-care, gait, physical health, hobby and leisure, social intercourse, and mental health. These seven items seemed to represent several aspects of 'one's own abilities'. Factor 2 (F2) included satisfaction with partner/family relationship, economic state and social security, and house facilities. These three items were related to the satisfaction with 'external factors' of the respondents. One item, satisfaction with having a job, showed extremely lower communality estimate (0.16) as compared to any other items' counterpart

Table II. Promax rotated factor loadings of 11 items of satisfaction in daily life.

Items of satisfaction	Factor 1: Satisfaction with One's Own Abilities	Factor 2: Satisfaction with External Factors
Housework	0.97	-0.16
Self-care	0.95	-0.12
Gait	0.89	-0.07
Physical health	0.70	0.13
Hobby/leisure	0.67	0.15
Social intercourse	0.62	0.18
Mental health	0.57	0.30
Partner/family relationship	-0.14	0.85
Economic state and social security	-0.05	0.75
House facilities	0.20	0.65
Having a job	0.16	0.28
Interfactor correlation	.55	

Bold-faced values: factor loadings ≥ 0.50 .

(>0.53), and had no salient loadings on either factor. Two scale scores were calculated based on the factor structure, excluding that item. Cronbach's α 's were 0.91 and 0.66 for F1 and F2, respectively.

Differences in life satisfaction according to the history of stroke and gender

Total SDL scores were significantly lower for stroke outpatients (entire 33.3; males 32.7, females 34.2) than for community-dwelling elderly (entire 43.3; males 43.7, females 42.9) ($p < 0.01$). However, the SDL involved two components (Table II), and one relatively independent item as mentioned above. Therefore, we decided to use these two factors separately in the subsequent analyses rather than the total SDL score.

Figure 1a depicts the mean scores of F1, 'satisfaction with one's own abilities' by gender and subject characteristics (stroke outpatients vs community-dwelling elderly). F1 scores were significantly lower for the stroke outpatients ($M = 19.7$, $SE = 0.23$) than for the community-dwelling elderly ($M = 28.2$, $SE = 0.24$) ($F = 644.7$, $p < 0.001$). Also, a significant interaction with gender was observed ($F = 6.7$, $p < 0.01$). Among the stroke outpatients, males ($M = 19.1$, $SE = 0.28$) showed lower scores than females ($M = 20.2$, $SE = 0.37$), but among the community-dwelling elderly, females ($M = 27.9$, $SE = 0.33$) showed lower scores than males ($M = 28.4$, $SE = 0.35$).

As displayed in Figure 1b, the mean scores of F2, 'satisfaction with external factors', were also significantly lower for the stroke outpatients ($M = 10.9$, $SE = 0.09$) than for the community-dwelling elderly ($M = 12.0$, $SE = 0.14$) ($F = 66.6$, $p < 0.001$), while

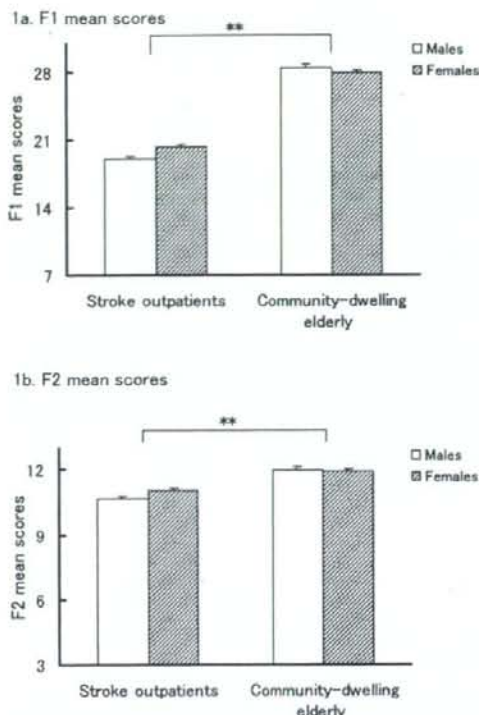


Figure 1. Comparison of F1 and F2 mean scores with stroke outpatients and community-dwelling elderly. Both scores (Figure 1a and 1b) were significantly lower for stroke outpatients than for community-dwelling elderly ($F = 644.7$ for F1, $F = 66.6$ for F2, both $p < 0.001$). ** $p < 0.01$, by ANCOVA.

the interaction with gender was marginal ($F = 2.9$, $p < 0.09$). Gender difference was not observed in F1 and F2 scores.

Differences in life satisfaction of stroke outpatients and community-dwelling elderly according to living conditions

Of the 5 categories of living condition, the category of 'living with my children (daughters or sons), their spouses, and grandchild(ren) etc.' was combined with another category of 'living with spouse and other family members' because of the fewer number of stroke outpatients in the former category. In addition, 5 subjects who responded to 'others' in their living conditions were omitted in the subsequent analyses. Then the differences in life satisfaction according to living conditions were examined by ANCOVA, with gender and their interaction, controlling for the effect of age. The analysis was conducted separately for stroke outpatients and community-dwelling elderly.

Among the stroke outpatients, although the main effect of living conditions and its interaction with gender were not significant on F1 scores, a significant main effect of living conditions ($F = 3.6$, $p < 0.05$) on F2 scores was observed. As displayed in Figure 2a, F2 scores were comparable between genders living with a spouse, and the scores of females did not differ between those who were living with a spouse and those who were living alone. Thus, the significant difference according to living conditions observed here might be attributable to the lower F2 scores for males who were living alone.

Among the community-dwelling elderly, similar to the stroke outpatients, although living conditions had no significant effects on F1 scores, its main effect on F2 scores was significant ($F = 13.7$, $p < 0.001$) and its interaction with gender was marginal ($F = 2.9$,

$p < 0.06$): i.e., as displayed in Figure 2b, F2 scores were comparable for both genders who were living with a spouse or living with a spouse and other family members, but the scores were lower for those who were living alone, particularly for males.

Differences in life satisfaction of stroke outpatients according to clinical features

F1 scores varied significantly by the type of hemiparesis ($F = 9.4$, $p < 0.001$) and the severity of aphasia ($F = 6.1$, $p < 0.01$), while gender and any other possible interactions were not significant (Figure 3). Further inspection by Bonferroni post-hoc test indicated that F1 scores were significantly higher for the stroke outpatients without hemiparesis ($M = 23.6$, $SE = 0.97$) than for those who had right hemiparesis ($M = 19.1$, $SE = 0.42$), left hemiparesis ($M = 17.4$, $SE = 0.64$), and bilateral hemiparesis ($M = 18.4$, $SE = 1.57$). Also, F1 scores significantly differed between those without aphasia ($M = 21.6$, $SE = 0.58$) and those with moderate-severe aphasia ($M = 17.8$, $SE = 0.94$), while F1 scores of those with mild aphasia ($M = 19.5$, $SE = 1.01$) did not differ among any of these groups.

The similar analysis on F2 scores yielded significant main effects of the types of hemiparesis ($F = 2.95$, $p < 0.05$), the severity of aphasia ($F = 7.5$, $p < 0.01$), and significant gender X aphasia interaction ($F = 3.2$, $p < .05$). Bonferroni post-hoc test indicated that F2 scores differed significantly between those without hemiparesis ($M = 11.4$, $SE = 0.38$) and those with left hemiparesis ($M = 10.1$, $SE = 0.25$), while other comparisons, including those with right hemiparesis ($M = 10.7$, $SE = 0.17$) and bilateral hemiparesis ($M = 10.5$, $SE = 0.62$), was not significant. The significant gender X aphasia interaction indicated that the effect of aphasia on F2 scores differed by gender.

As displayed in Figure 4a and 4b, F2 scores of males seemed comparable across the three levels of aphasia (no, mild, and moderate-severe), while F2 scores of females were slightly higher than those of males at no aphasia and mild aphasia conditions, but considerably lower than males at the moderate-severe aphasia condition. Further analysis by gender provided supportive results that no significant main effect was observed for males, but both types of hemiparesis ($F = 2.8$, $p < 0.05$) and the severity of aphasia ($F = 8.3$, $p < 0.001$) showed significant main effects for females. In particular, the effect of aphasia was crucial for the female outpatients, if they suffered from hemiparesis.

The time after onset of stroke, which might have some influence on life satisfaction for the stroke outpatients, showed no association with either F1 or F2 scores.

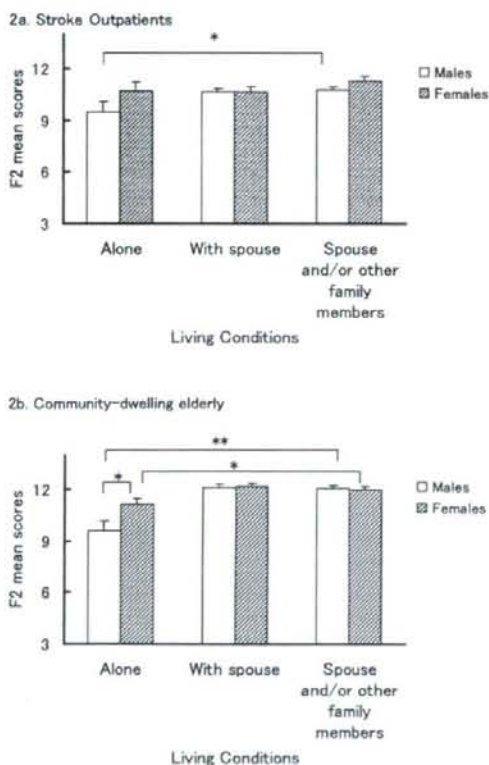


Figure 2. F2 mean scores by living conditions. For stroke outpatients (Figure 2a), living conditions showed a significant main effect on F2 scores ($F = 3.6$, $p < 0.05$). For community-dwelling elderly (Figure 2b), living conditions showed a significant main effect ($F = 13.7$, $p < 0.001$) and a marginal interaction effect with gender ($F = 2.9$, $p < 0.06$) on F2 scores. * $p < 0.05$, by ANCOVA.

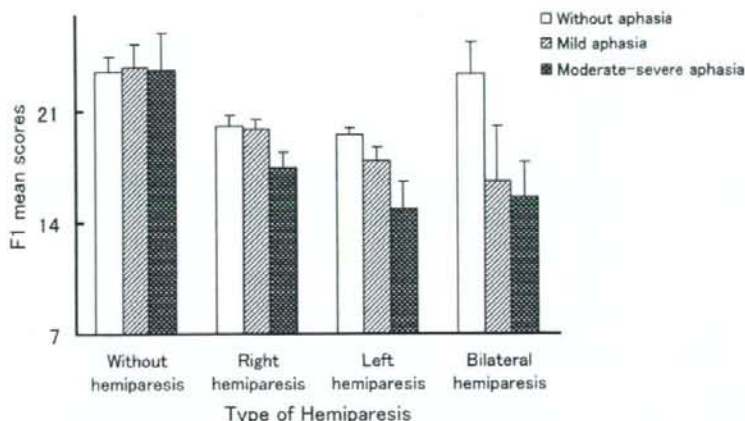


Figure 3. F1 mean scores by type of hemiparesis and severity of aphasia for stroke outpatients. F1 mean scores of types of hemiparesis are shown in without aphasia, mild aphasia and moderate-severe aphasia. F1 mean scores varied significantly by the type of hemiparesis ($F = 9.4$, $p < 0.001$) and the severity of aphasia ($F = 6.1$, $p < 0.01$), while gender and any other possible interactions were not significant.

Discussion

In a sample of 869 post-stroke outpatients living at home and 748 community-dwelling elderly randomly sampled in Yahatanishi Ward, Kitakyushu City, Japan, we found that: (i) life satisfaction could be assessed by two different but correlated constructs, (ii) life satisfaction differed significantly between stroke outpatients and community-dwelling elderly, and (iii) life satisfaction among stroke outpatients varied according to their living conditions in general. As far as we know, no previous research, except for one study in Norway [12], has investigated the life satisfaction and/or QOL of hundreds of stroke patients living at home, with simultaneous reference to their clinical diagnoses and assessments.

Exploratory factor analysis revealed that the SDL consisted of two factors (Table II). Factor 1 reflected 'satisfaction with several aspects of one's own abilities'. Factor 2 was related to 'satisfaction with external factors'. These two components regarding life satisfaction were significantly lower for the stroke outpatients than for the community-dwelling elderly (Figures 1a, 1b). In comparison between the stroke outpatients and the community-dwelling elderly, both similarity and dissimilarity were observed in living conditions related to higher or lower 'satisfaction with external factors' (Factor 2) (Figures 2a, 2b), although their 'satisfaction with own ability' (Factor 1) was not associated with living conditions.

The similarity was found for males: (a) males who were 'living alone' showed the lowest 'satisfaction with external factors'; (b) the satisfaction levels were comparable between males who were 'living with

spouse' and males who were living with spouse and/or other family'. On the contrary, females showed a different feature between the two groups: although 'satisfaction with external factors' was independent of living conditions among female stroke outpatients, 'living with spouse and/or other family' might appear the most satisfying condition and 'living alone' was the least satisfying condition (post-hoc test, $p < 0.05$) among female community-dwelling elderly. A Post-hoc test further revealed that male community-dwelling elderly who were 'living alone' showed significantly lower F2 scores than their female counterparts ($p < 0.05$). That is, 'satisfaction with external factors' could be influenced by living conditions for males, but not particularly so for females.

It might be suggested that males who were 'living alone' tended to have less communication with others and thus to be more isolated than males who were living with others. Social support may, therefore, be needed particularly for male post-stroke patients who are living alone. There have been several researches on the effects of social support on post-stroke patients and their caregivers. Wyller et al. [12] found that a firm social network was related to higher life satisfaction in 1,417 stroke patients in Norway. Some other studies, although the sample sizes were not necessarily sufficient, have also demonstrated that social support is an important determinant for life satisfaction of stroke outpatients living in the community [3,11,26-29]. Gottlieb et al. [11] reported the direct effect of social support on QOL in Israel, and Åström et al. [29] found that social disintegration was associated with reduction in life satisfaction in stroke patients in Sweden.

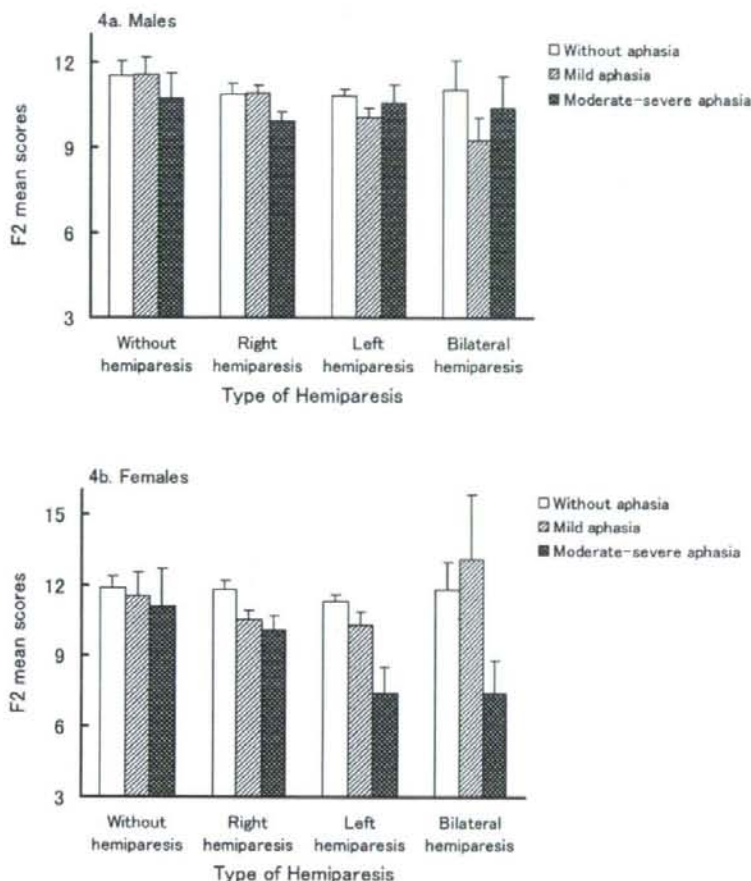


Figure 4. F2 mean scores by type of hemiparesis and severity of aphasia for stroke outpatients. F2 mean scores of males seemed comparable across the three levels of aphasia (no, mild, and moderate-severe) in figure 4a, while F2 scores of females were slightly higher than those of males at no aphasia and mild aphasia conditions in figure 4b, but considerably lower than males at the moderate-severe aphasia condition ($F = 8.3, p < 0.001$).

On the other hand, Clarke et al. [27] noted that social support might act as a moderator of the effects of disability on well-being in Canada. Kauhanen [7], in Finland, found that married patients coped less well in terms of mental health than unmarried patients, because of overprotective and over-caring spouses and noted that the support for caregivers was important for the success of stroke rehabilitation. In the present study, although the direct and indirect effects of social support could not be tested, lower 'satisfaction with external factors' scores for male stroke outpatients who were 'living alone' might suggest the importance of social support for them.

One of the clinical phenomena for post-stroke patients is depression. Post-stroke depression

occurs in about 40% of patients [24], and clinical severity in stroke is related to severe post-stroke depression [25]. Because of such psychological impairment, many patients might be likely to show reduced enthusiasm for continuing rehabilitation treatment. If their spouses and/or family members do not notice this common phenomenon, such patients may be regarded as lazy, and then feel isolated due to the lack of sympathy from family members. Glass et al. [26] and Glass and Maddox [28] demonstrated that a high level of social support was associated with faster and more extensive recovery of functional status after stroke, based on a longitudinal observation of ADL among stroke patients. Social support may have such a desirable influence.

There is no doubt that both types of hemiparesis and the severity of aphasia have a larger impact on 'satisfaction with own ability' (Factor 1) of stroke outpatients (Figure 3). Following the significant gender X aphasia interaction on 'satisfaction with external factors' (Factor 2), detail analyses conducted separately by gender indicated that significant findings on these clinical features were peculiar for females (Figure 4b), but not for males (Figure 4a). Lack of communication might make post-stroke patients feel alone and depressed [9], suggesting that the adverse impact of aphasia might be stronger for females. Although communication is an important factor for males and females, a component of communication influencing life satisfaction might be different between genders. Females may be more likely to seek verbal communication, but males may be more likely to seek any care/help for their daily life.

In conclusion, life satisfaction of Japanese stroke outpatients was influenced not only by clinical features (hemiparesis and aphasia), but also by their living conditions. We discussed several reasons, such as family factors and social support, explaining why 'living alone' was the least satisfactory condition, particularly among male stroke outpatients. We did not, however, research the reason why living conditions influence life satisfaction of stroke outpatients in this study. More details about daily activities, living conditions and the needs of stroke outpatients should be investigated in a future study.

There exist several strategies in rehabilitation medicine for enhancing the life satisfaction of stroke outpatients. It seems desirable that rehabilitation staff should provide general education for family members of stroke patients so that they might understand the physical and mental problems after stroke, and facilitate manifold social support with adequate timing and/or sufficient quantity [28].

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