How Valid Is the Self-Administered Visual Analogue Scale for Assessing the Health Status of Elderly People?

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ABSTRACT

The population of Japan is aging rapidly, and maintaining the quality of life of elderly people has become an important issue in contemporary Japan. This study was conducted to verify the validity of the self-administered visual analogue scale (VAS) for assessing the health status of elderly people. A survey was conducted in two villages in western Japan in 2003. A total of 2040 participants, aged between 60 and 75 years, completed questionnaires comprising the VAS and six Likert-type items for health status, physical strength, life enjoyment, appetite, sleep, and life satisfaction. Data of the valid participants who properly completed both the VAS and the Likert-type item on health status were analyzed (n=1579, 77.4%). Among the Likert-type items, the VAS score was the most associated with health status (r = 0.532), followed by physical strength (r = 0.509). The VAS score showed a weak negative correlation with age (r = -0.130), but no association with socioeconomic factors such as the number of family members or annual income. The correlations between the VAS and the Likert-type item on health status varied between categories in some attributes. Since the VAS score was moderately correlated with similar questions about health status in the Likert-type health questionnaire, it was considered that the VAS is a valid self-administered instrument for collecting data on the health status of elderly people. However, further investigations need to be conducted to improve the VAS and to establish better explanations for aged respondents.

Key words: Health for the elderly, Quality of life, Questionnaire, Visual analogue scale

The population of Japan is rapidly aging, and elderly single people, as well as families consisting solely of elderly couples, are increasing. Health promotion for the elderly should be conducted with consideration for the quality of life[9]. Maintaining the quality of life is essential for the self-reliance of elderly people. In the broad sense of the term, quality of life includes all areas of life such as environment, finance, personal relations and health. Health-related quality of life, with its focus on public health and medical outcome research, is considered to be a sub-category of quality of life[13].

Quality of life is usually measured using questionnaires with Likert-type response formats and verbal categories. Examples of such scales are the WHO-QOL[15] and the 36-Item Short Form Health Survey (SF-36)[16]. In addition to these instruments, visual analogue scales (VAS), originally developed in the Scott Co. Laboratory in 1920[4,5], are occasionally used for the assessment of health status. Traditionally, the VAS, which is known as a graphic rating scale, has been used for measuring feelings such as mood and pain. The original scale combined a sentence and a straight line. Using this scale, the respondents, or raters, could make very fine discriminations. Hayes et al[5] have demonstrated the test-retest reliability of the scale. It is also considered to have statistical advantages over Likert-type questionnaires with a 4-point scale[6]. Since VAS scores have an interval scale, parametric statistical techniques such as analysis of variance and linear regression analysis can be used for the analysis of data. Moreover, if the fre-

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quency distribution of VAS scores is skewed, it can be improved toward normality by arcsin transformation[2]. VAS has also been integrated into the EuroQol, a health utility measure[14].

If specialists use VAS as raters, the scores can be accurate and reliable, as has been demonstrated for parent behavior[3] and behavior of the elderly[11]. However, the elderly are unfamiliar with the VAS and its validity has not been established with them. Some elderly persons may misunderstand the meaning of the questions, and how to respond to them. The validity of VAS can vary between genders and age groups, but despite its importance, very few investigations have been conducted on this issue. The objective of this study is to verify the validity of self-administered VAS for assessing the health status of elderly people in Japan.

METHODS

We reevaluated the results of a health survey of an aging community conducted from July to November 2003 at two rural villages located in Yamaguchi (Y) and Hiroshima (H) Prefectures in western Japan8). The average age of residents in these villages has been increasing, because the major industry is agriculture and few large companies or factories are located nearby, which has resulted in the movement of younger people to urban or industrial areas. The survey was conducted to identify health status and physical strength for longevity, health practices, and the need for health policies for elderly people. We used and analyzed a part of the survey to verify the validity of self-administered VAS.

Subjects

Participants of this survey were insured under the national health insurance and aged from 60 to 75 years. At Y-area, questionnaires were handed to all subjects and returned, whereas, at H-area, they were handed to half of subjects, selected at random. The number of initial subjects was 2571, and the number of questionnaires returned was 2328. After excluding invalid questionnaires (blank, lack of gender or age data), the number of valid participants was 2040, which was 79.3% of the initial subjects (see Fig. 1).

Questionnaires

The participants completed questionnaires comprising both the VAS for the assessment of health status and six Likert-type items for health status, physical strength, life enjoyment, appetite, sleep, and life satisfaction. Since elderly people were considered to be familiar with the traditional Likert-type questionnaire, the VAS was compared with this reliable measure. When the VAS is valid, the correlation between the VAS and the Likert-

type questionnaire, measuring the same concept of health status, is predicted to be stronger than that between the VAS and other associated items. If not, a negative result would imply that a valid assessment of health status could not be performed by the VAS.

The direction for the VAS was "please make an X mark on the line below for your health status at present." The length of the VAS was 10 cm, and it was divided at 1 cm intervals into an 11-point scale. The range of the scores was from 0 to 10. The left end of the line indicated the poorest health; the right end the best health; with the mid-point also indicated (see Appendix 1). Respondents could mark the level of their health status either on the scale divisions or between them. The score was measured by the distance from the left end of the scale to one decimal place.

The Likert-type items related to the self-assessments of the participants were: (1) health status; (2) physical strength; (3) life enjoyment; (4) appetite; (5) sleep; (6) life satisfaction (see Appendix 2). Each of these items offered four choices, and the participants had to choose one only. The correlation between the VAS and the Likert-type item on health status was examined to verify the construct validity of the VAS. The other five Likert-
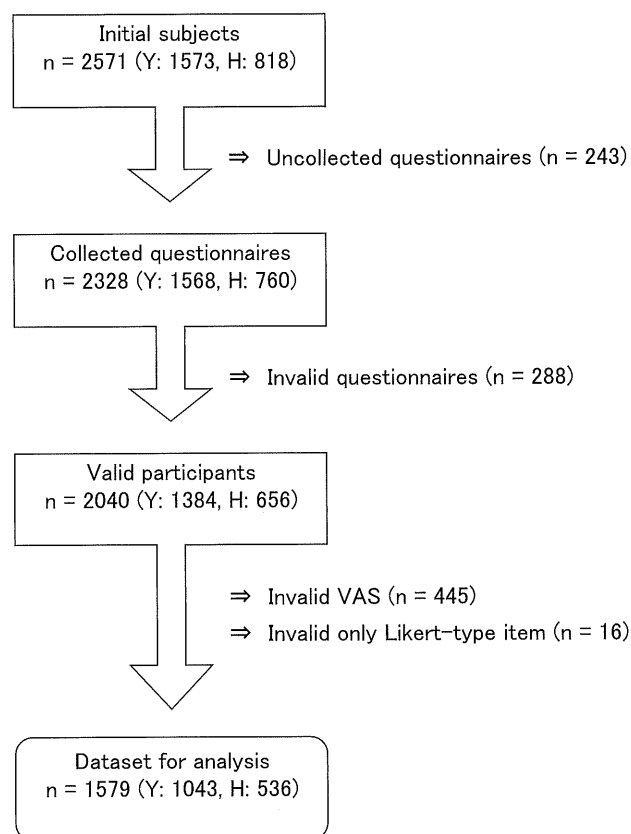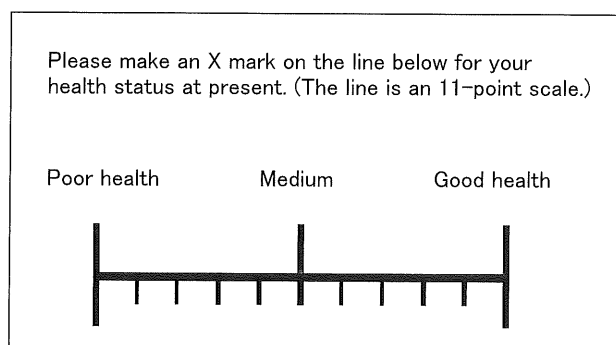

Fig. 1. Diagram indicating the formation of the dataset for analysis from the initial subjects.
(Y: Yamaguchi Prefecture, H: Hiroshima Prefecture)

Please make an X mark on the line below for your
health status at present. (The line is an 11-point scale.)

Poor health　　　　　　Medium　　　　　　Good health

Appendix 1. Visual analogue scale for health status
used in this study

1. health status

　　　　How do you feel about your health status?

2. physical strength

　　　　How do you feel about your physical strength?

3. life enjoyment

　　　　Are you enjoying your life?

4. appetite

　　　　Do you enjoy your meals?

5. sleep

　　　　Do you get enough sleep every day?

6. life satisfaction

　　　　Are you satisfied with your daily life?

Appendix 2. Likert-type items of health-related ques-
tionnaire†
† All items have four choices. The original question-
naire was written in Japanese. This English version
was prepared for this manuscript and the accuracy of
the translation has not been validated.

type items related to health status were assumed
to correlate with the VAS for health status.
Socioeconomic data including family members,
occupation, education and annual income were
also collected for this study, as potential confound-
ing factors.

Statistical analysis

Data of the participants who properly com-
pleted both the VAS and the Likert-type item
on health status were analyzed (n=1579, 77.4%
of the valid participants; see Fig. 1). Among the
valid participants, 445 people did not respond to
the VAS. The dataset consisted of 701 men and
878 women. Mean age of all subjects was 67.5
(standard deviation: 4.2). Frequencies of the VAS
scores and other items were examined. The VAS
scores were also arcsin transformed to confirm the
previous study[2], mentioned in the introduction.
In the present study, however, raw scores of the
VAS were used for the subsequent non-paramet-
ric analysis, because the VAS data were compared
with ordinal data. We examined the associations

between the VAS score and responses to each
Likert-type question related to health status. The
associations between the VAS score and socio-
economic factors were also analyzed. Spearman's
correlation coefficients were used for the analysis
of these associations. The coefficients were com-
pared between genders, between age groups, and
between categories in other attributes. Statistical
significance was set at p < 0.05. The strength of
correlation was defined as follows: (1) coefficient ≧
0.6 is strong; (2) ≧ 0.4 is moderate; (3) ≧ 0.2 is
weak; (4) < 0.2 is very weak or none. These analy-
ses were conducted using SPSS for Windows, ver-
sion 13.0.

RESULTS

Basic attributes of the participants for analysis
are shown in Table 1. There was no statistically
significant difference between the two villages
in gender or age, but in the socioeconomic data,
including family members, occupation, education
and annual income, significant differences were
found. This study was not aimed to compare the
two villages. A larger sample size provides a more
reliable result for statistical analysis. Therefore,
the subsequent analyses were conducted as a
single sample. Single elderly people constituted
8.8% and people living only with their spouses
50.6%. Almost half of the participants (48.1%)
were unemployed, and the majority of people
with an occupation were employed in agriculture
and forestry (n=522, 36.0%). People with a 9-year
education constituted 40.8%, and those with a 12-
year education 49.1%. Of the participants, 84.2%
earned an annual income below 3 million yen
(about $25,000).

The distribution of the VAS scores is shown
in Fig. 2. The mean VAS score was 6.4 (standard
deviation: 2.4). The mode was 5.0, and 90.9% of
the data were integers. The frequency distribution
of the scores was skewed and they were improved
toward an almost normal distribution by using
arcsin transformation. There was a very weak
negative correlation between the VAS score and
age (r = -0.130), but no significant differences in
the VAS score were found between the two vil-
lages.

Correlations between the VAS score and Likert-
type questionnaire items are shown in Table 2.
This table includes the correlations between the
Likert-type item on health status and other items.
It can be seen that the VAS score was the most
closely associated with health status (r = 0.532),
followed by physical strength (r = 0.509) among
the Likert-type items. Fig. 3 shows the distribu-
tion histograms of VAS scores by response to the
Likert-type item on health status. The VAS scores
in the third category 'poor for health status' as
the response to the Likert-type item were almost

Table 1. Basic attributes of the participants for analysis by area†

Item	Category	Y-area (n=1043)	H-area (n=536)	Total (n=1579)	%	p value‡
Gender	Male	452	249	701	44.4	0.238
	Female	591	287	878	55.6	
Age group	60 - 64	263	149	412	26.1	0.113
	65 - 69	376	208	584	37.0	
	70 - 75	404	179	583	36.9	
Family	Single	99	37	136	8.8	< 0.001
	Couple	556	225	781	50.6	
	Other	361	267	628	40.6	
	Missing	27	7	34	–	
Occupation	With	552	201	753	51.9	< 0.001
	Without	417	281	698	48.1	
	Missing	74	54	128	–	
Education	≦ 9 years	440	147	587	40.9	< 0.001
	≦ 12 years	440	266	706	49.1	
	> 12 years	80	64	144	10.0	
	Missing	83	29	142	–	
Annual income	< 1 million yen	341	128	469	34.4	0.001
	< 3 million yen	439	240	679	49.8	
	≧ 3 million yen	130	86	216	15.8	
	Missing	133	82	215	–	

† The percentage of each category was calculated without missing data (invalid or unknown).

‡ Significant differences between areas in each category by chi square test.

normally distributed; the frequency distributions in the other categories were skewed. There was no association between the VAS score and socioeconomic factors such as the number of family members and annual income.

The means of the VAS scores and the correlation coefficients between VAS score and Likert-type item on health status are shown in Table 3 to provide a comparison between genders, between age groups, and between categories in other attributes. The coefficients in male (0.569), in age group 65-69 (0.568), and in people with an occupation (0.551) were considerably high. In age group 70-75, the coefficient in male (0.578) was the highest, and that in female (0.443) was the lowest.

DISCUSSION

Elderly people living in two rural villages in Japan completed the VAS and a questionnaire measuring health status through Likert-type responses. The VAS score was moderately correlated with similar questions about the health status measured by the Likert-type items, indicating the validity of data on the health status of elderly people collected through the VAS. However, more than 20% of participants did not respond to the VAS, which may suggest that they could not understand the intention of the investigators, or how to respond to it. There were no significant differences in gender, age group, education and other attributes between respondents and non-respondents to the VAS (data are not shown.). Since a number of missing data could reduce the reliability of the analysis, an adequate explanation for the elderly should be given when the VAS is used.

The VAS has various designs. The simplest one consists of a simple line with marks at both ends. The VAS used in this study was sub-divided by scale marks every 1 cm, with the mid point indicated. Although this design has the advantage of ease of response, it has the disadvantage that
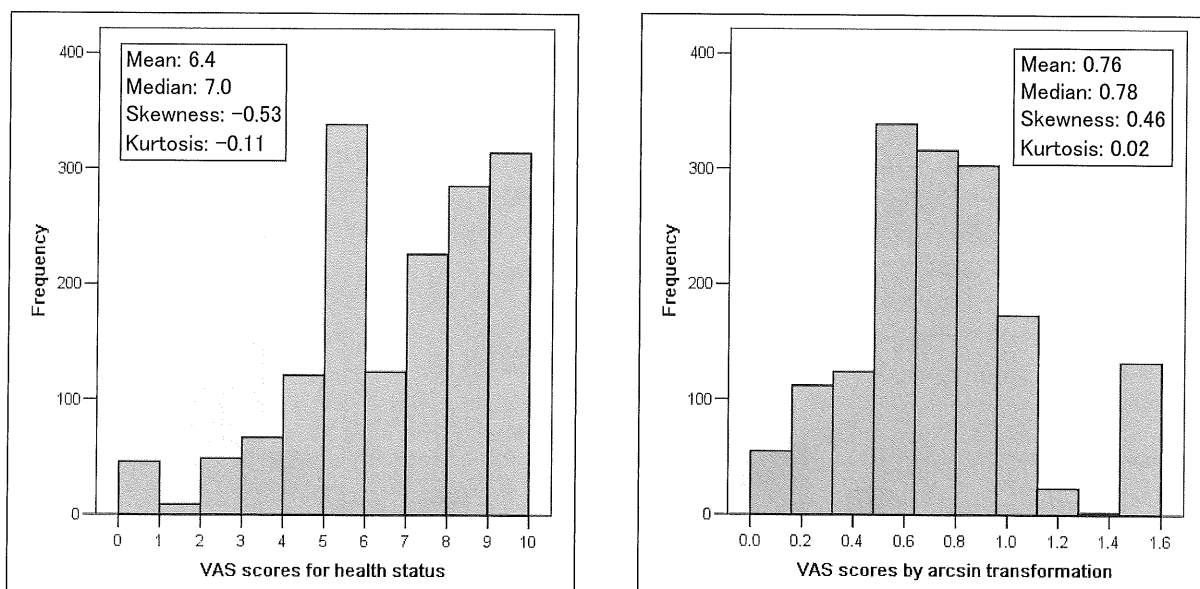
Fig. 2. Distribution histograms of visual analogue scale (VAS) scores for health status (left)† and VAS scores by arcsin transformation (right)‡

† The range of VAS scores is from 0 to 10.

‡ Arcsin transformation improved the distribution of VAS toward almost normal distribution. This histogram shows that the median was close to the mean, the kurtosis was close to 0, but the skewness was relatively high. (In the standard normal distribution, the median should be equal to the mean; the skewness and the kurtosis should be 0.)

responses tend to get centered around the mid point and at scale marks, which is not an optimal condition for parametric statistical analysis. However, by using arcsin transformation, the distribution can be brought close to a normal distribution curve, when parametric statistical analysis needs to be conducted.

The VAS was most similar to the health status item in the Likert-type questions, and the two had the strongest correlation. The VAS was also associated with physical strength and other items. This study demonstrated the construct validity of the VAS for assessing health status. Kuroda et al[7] have clarified a close correlation between the VAS score and utility score in the EuroQol. Our results corroborated this finding.

The correlation between the VAS and the Likert-type item in males was higher than that in females, especially in the age group 70-75. This result suggested that aged men maintain the ability to answer correctly. In the youngest age group 60-64, however, there was the lowest correlation, which needs to be interpreted from the viewpoint of generation rather than age. Since there was no difference in the correlations between education levels, individual differences may be larger than differences by factors. A previous study[12] demonstrated that the anxiety and depression scale was associated with VAS in 61% of the subjects. Although our study cannot be compared with this previous study, our results indicate the importance of more detailed and well-designed research

Table 2. Correlations between visual analogue scale (VAS) score and Likert-type items†

Likert-type item	VAS of health status	Likert-type health status
Health status	0.532	-
Physical strength	0.509	0.648
Life enjoyment	0.387	0.403
Appetite	0.354	0.295
Sleep	0.272	0.260
Life satisfaction	0.300	0.263

† Spearman's correlation coefficients are shown. All coefficients were significant. (p < 0.001)

on the validity of VAS.

There are some limitations to this study. First, the sample used was not representative of elderly people in Japan. Second, both the VAS and the Likert-type questions were original, and were not compared with a more valid and frequently-used questionnaire or other forms of the VAS. Third, the leading question occasioned by repeating similar items for health status and the order of the questions may have offered the results of this study. Despite these limitations, the results of this study suggest that the VAS could be a promising self-administered instrument for assessing the subjective health status of the elderly.
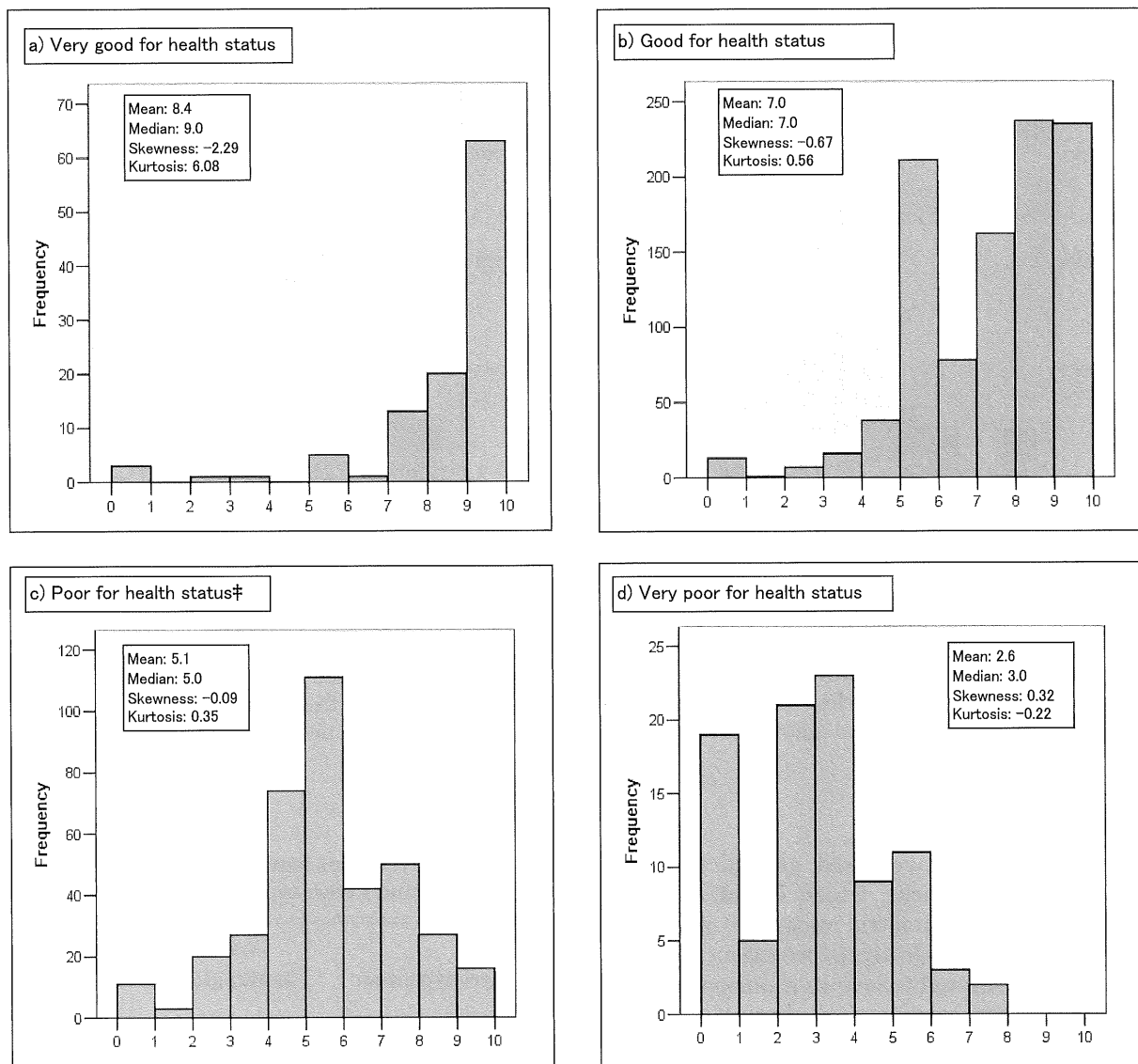
a) Very good for health status

Mean: 8.4
Median: 9.0
Skewness: −2.29
Kurtosis: 6.08

b) Good for health status

Mean: 7.0
Median: 7.0
Skewness: −0.67
Kurtosis: 0.56

c) Poor for health status‡

Mean: 5.1
Median: 5.0
Skewness: −0.09
Kurtosis: 0.35

d) Very poor for health status

Mean: 2.6
Median: 3.0
Skewness: 0.32
Kurtosis: −0.22

Fig. 3. Distribution histograms of visual analogue scale (VAS) scores for health status by response to Likert-type item on health status†
† The range of VAS scores is from 0 to 10.
‡ In this category, data were almost normally distributed among the four categories. This histogram shows that the median was close to the mean, the skewness was close to 0, but the kurtosis was relatively high. (In the standard normal distribution, the median should be equal to the mean; the skewness and the kurtosis should be 0.)

This study was not the first attempt to use the VAS with the elderly. Other studies using the VAS to determine the health status of elderly people have been conducted in clinical settings[1] and in community-based settings[10]. However, in these studies, the VAS was not completely self-administered. Future tasks include comparing various designs of the VAS, improving the VAS to make it more acceptable as an instrument for the assessment of elderly people's health, and combining VAS with other scales. Moreover, better explanations of the use of the VAS for aged respondents and caregivers need to be established.

Table 3. Means of visual analogue scale (VAS) scores and correlations between VAS score and Likert-type item on health status in each category†

Item	Category		Mean (SD)	Coefficient
Whole sample			6.4 (2.4)	0.532
Area	Yamaguchi (Y)		6.4 (2.3)	0.543
	Hiroshima (H)		6.5 (2.5)	0.513
Gender	Male		6.3 (2.4)	0.569
	Female		6.5 (2.3)	0.499
Age group*	60 - 64		6.9 (2.2)	0.484
		Male	*6.9 (2.4)*	*0.514*
		Female	*6.8 (2.1)*	*0.461*
	65 - 69		6.5 (2.4)	0.568
		Male	*6.4 (2.5)*	*0.567*
		Female	*6.5 (2.4)*	*0.569*
	70 - 75		6.0 (2.4)	0.515
		Male	*5.9 (2.4)*	*0.578*
		Female	*6.1 (2.4)*	*0.443*
Occupation**	With		6.6 (2.3)	0.551
	Without		6.2 (2.4)	0.506
Education*	≦ 9 years		6.1 (2.5)	0.510
	≦ 12 years		6.6 (2.3)	0.533
	> 12 years		6.8 (2.2)	0.520

† Spearman's correlation coefficients are shown. All coefficients were significant. ($p < 0.001$)

* The VAS scores were significantly different between categories. ($p < 0.001$; Kruskal-Wallis test)

** The VAS scores were significantly different between categories. ($p < 0.001$; Mann-Whitney test)

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