

Evaluation of health-related quality of life using EQ-5D in Takamatsu, Japan

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Abstract

Objectives Healthy Japan 21 (Japanese National Health Promotion in the 21st Century) was started in 2000 to promote extension of healthy life expectancy and improve health-related quality of life (HRQOL). The present study aims to describe HRQOL of Japanese subjects using the EuroQol questionnaire (EQ-5D) and investigate the influence of social background, health-related behaviors, and chronic conditions on HRQOL using representatives in Takamatsu, Japan.

Methods Data were obtained from a 2005 Takamatsu City health survey mailed to 2,500 randomly selected Japanese individuals in Takamatsu, a medium-sized city. We examined data from 915 Japanese adults. The questionnaire addressed social background, health-related behaviors, chronic conditions, EQ-5D items, and self-rated health. The impact of social background, health-related behaviors, and chronic conditions on Japanese HRQOL was examined through multivariate regression, adjusting for age and sex.

Results EQ-5D scores decreased with age, particularly for respondents who were unemployed or retired. Adjusting for sex and age, the results showed that age, unemployment/retirement, feeling severe stress, and musculoskeletal and

gastrointestinal diseases were significantly associated with decreased HRQOL. Conversely, sufficient sleep (7–8 h/day) and having a hobby were significantly associated with increased HRQOL.

Conclusions Information is lacking regarding HRQOL in Japanese populations. This study furthers our understanding of some important determinants influencing Japanese HRQOL, using the EQ-5D in Takamatsu, Japan. Our results also resembled some findings from similar studies in other countries. We hope to use the EQ-5D with other health survey questionnaires to gather more data about HRQOL of Japanese people.

Keywords HRQOL · Healthy Japan 21 · EQ-5D · Health-related behaviors · Chronic conditions

Introduction

In recent years, health-related quality of life (HRQOL) has received much worldwide attention, and several multi-attribute health status classifications have increasingly been used to describe and evaluate HRQOL in Japan. Healthy Japan 21 (Japanese National Health Promotion in the 21st Century), a Japanese health policy introduced in 2000 [1], aims to promote extension of life expectancy and improve HRQOL in all Japanese people.

Internationally, studies using the EuroQol (EQ-5D) survey have demonstrated lower scores in older individuals compared with younger individuals [2–5], lower scores in women than in men [2, 3], lower scores in individuals of lower socioeconomic status compared with individuals of higher socioeconomic status [2, 3, 6, 8], and lower scores in individuals with lower educational attainment than in those with higher educational attainment [2, 4, 6, 7].

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EQ-5D [9–12] has been translated into Japanese, and the official Japanese version was developed in May 1998 [12–14]. In a past study in a Japanese population, moderate problems in at least one dimension were reported by a quarter of 621 interview respondents, while only 2.1% of respondents reported extreme problems [13]. Respondents who were elderly, had experiences of serious illness, had lower educational background, were retired or were engaged in housewife were more likely to report problems [13]. However, few studies have evaluated the relationships between EQ-5D index and social background, health-related behaviors, and chronic conditions in the Japanese general population. According to common health surveys in Japan (e.g., the Comprehensive Survey of Living Conditions of the People by the Ministry of Health, Labor, and Welfare), self-rated health (SRH) has mainly been used to investigate subjective HRQOL in the general Japanese population [1, 23, 24, 33–37]. However, it is difficult to describe Japanese HRQOL as a multidimensional concept using only a SRH questionnaire. The present study aims to describe HRQOL of Japanese people using EQ-5D and investigate the influence of social background, health-related behaviors, and chronic conditions on HRQOL. We investigated responses from 915 Japanese individuals in Takamatsu City, Japan.

Methods

Data in this study were obtained from a 2005 Takamatsu City health survey. Takamatsu is a medium-sized city located in Kagawa Prefecture in western Japan [15]. Takamatsu City covers an area of 375.09 km², with a population of 418,125 people. The residential density is 1,795 people/km² (2008). The aim of this survey is to investigate the health state of Japanese general people in Takamatsu City; 2,500 surveys were mailed to randomly selected residents in October 2005. A statement about informed consent was included with the questionnaire, and returning the questionnaire was considered to constitute provision of informed consent. Of these 2,500 surveys, 1,196 were returned by respondents. Of these, 281 were deemed unusable due to missing data. This left 915 surveys, for a usable response rate of 36.6%.

The survey addressed social background, health-related behaviors, 11 chronic conditions, EQ-5D items, and SRH.

Regarding social background, we surveyed age, sex, family, living status, marital status, and employment status. Respondents were classified by age as 18–29, 30–39, 40–49, 50–59, 60–69, 70–79, and ≥80 years. From self-reported height and weight, we calculated body mass index

(BMI) and created the following three categories: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), and obese (≥25 kg/m²). Contents of health-related behaviors were: (1) current smoking, (2) excessive alcohol intake (≥44 g/day), (3) regular exercise (moderate or vigorous exercise for >30 min, ≥3 times/week), (4) sufficient sleep (7–8 h/day), (5) having a hobby, and (6) feeling severe stress. We also surveyed family, living status, and other health-related behaviors (e.g., eating breakfast every day, eating lots of vegetables, going out well, and joining social activity); however, these data did not correlate significantly with HRQOL data, therefore corresponding results are not reported herein. Regarding severe stress, participants were asked if they had felt severe stress over the past month. Chronic conditions covered 11 major medical chronic conditions: hyperlipidemia, hypertension, heart disease (including coronary heart disease and any other heart condition), stroke, liver disease, diabetes mellitus, respiratory disease, renal disease, musculoskeletal disease, gastrointestinal (GI) disease, and dental caries or other dental diseases. Respondents answered “yes” if they had each chronic condition and were taking pharmacotherapy prescribed by or were currently under the treatment of a doctor. All respondents were asked both EQ-5D items and to provide a 5-point self-rating of health (very good, good, neither good nor bad, poor, or very poor).

All information on the characteristics of the sample was based on questions from this Takamatsu City health survey. Data were based on unidentified information from individuals who agreed to participate, and data collection was performed within the scope of city council activity.

We obtained permission to publish this study from the Medical Ethics Committee of Kagawa University on 28 April 2010 (permission no. 22-8).

EQ-5D score

EQ-5D is a brief, self-completed instrument for describing and valuing quality of health states defined by the EQ-5D index. This descriptive system classifies respondents into one of 243 distinct health states. The descriptive system consists of five dimensions: (1) mobility, (2) self-care, (3) usual activities, (4) pain/discomfort, and (5) anxiety/depression. Each dimension has three levels, allowing for 3⁵ (i.e., 243) possible health combinations. In addition, for completeness, the states “dead” and “unconscious” were also incorporated in the framework [9–14]. The unique EQ-5D health state is defined by combining one level from each of the five dimensions and producing a set of utility values for 245 health states (EuroQol Group, <http://www.euroqol.org>). We used the Japanese EQ-5D instrument to assess the QOL of participants [14].

Data analyses

Because we supposed that age, health-related behaviors, and chronic conditions were likely to exert some influence on Japanese HRQOL, we analyzed these relationships. Bivariate analyses, such as two-way analysis of frequency with the χ^2 test and nonparametric statistics (Mann–Whitney *U* test or Kruskal–Wallis test), were used to examine relationships between EQ-5D indicators and other data from respondents (statistical tests were performed using a 5% significance level). Using multiple linear regression analyses, HRQOL scores were modeled using social background, health-related behaviors, and chronic conditions as independent variables. Impact on HRQOL scores, adjusted by other covariates, was evaluated using values of the regression coefficient. Calculations of the percentage of respondents reporting problems in different EQ-5D dimensions, mean EQ-5D index values, standard error of the mean (SEM), calculation of *p* values, and multiple regression analyses were performed using SPSS version 14.0 software (SPSS Japan Inc., Tokyo, Japan) for Windows.

Results

Respondent sample

The distribution of respondents according to age and sex, and that of 2005 Takamatsu City population, is shown in Table 1. The ratio of respondents aged 40–69 years was slightly higher than that in the general population of Takamatsu City.

The demographic details of respondents are presented in Table 2. Mean age was 51.4 years [standard deviation (SD) 16.8 years; range 18–95 years]. Mean EQ-5D index was 0.877 (SD 0.157) and declined with age. Respondents were predominantly female and married, with 36.4%

employed full time, 21.5% engaged in housewife, and 16.9% unemployed or retired. Mean BMI was 22.4 kg/m², with 18.8% of respondents having BMI ≥ 25 kg/m². Regular exercise (>30 min, ≥ 3 times/week) was performed by about a quarter of respondents (24%), and 72.3% did not get 7–8 h/day of sleep. Almost a quarter of respondents were smokers (23.8%), and 5.0% reported excessive alcohol intake (≥ 44 g/day). Over four-fifths (82.8%) reported having a hobby. Feelings of severe stress in the past month were reported by about a quarter of respondents (27.2%), and almost half (47.7%) had at least one chronic condition. Percentages of respondents reporting problems on each EQ-5D dimensions were higher in older respondents.

The age gradient was significant across all dimensions except for anxiety/depression. Employment status and reporting a problem on the EQ-5D were also significantly related, with respondents who were unemployed or retired being more likely to report some problem on all dimensions. According to health-related behaviors, respondents without a hobby and those who had experienced severe stress within the past month were more likely to report some problem across all dimensions except for self-care.

Chronic conditions

As shown in Tables 2 and 3, almost half of respondents reported at least one chronic condition, with hypertension in 15.8%, heart disease in 3.9%, diabetes mellitus in 6.8%, musculoskeletal disease in 6.1%, and GI disease in 4.7%. Respondents with a chronic condition were more likely to report some problem on all EQ-5D dimensions and showed lower mean EQ-5D index (Table 2). When specific chronic conditions were considered (Table 3), significant differences in the percentage of respondents reporting a problem were observed in at least three dimensions (mobility, usual activity, and pain/discomfort) for those with and without the specific chronic conditions identified.

Table 1 Distribution of respondents according to age and sex

Age (years)	Respondents (2005)						Population of Takamatsu City (2005)					
	Male		Female		Total		Male		Female		Total	
18–29	42	10.6%	68	13.2%	110	12.0%	24,421	18.1%	24,398	16.4%	48,819	17.2%
30–39	56	14.1%	73	14.1%	129	14.1%	26,155	19.4%	26,190	17.6%	52,345	18.5%
40–49	70	17.6%	97	18.8%	167	18.3%	21,064	15.6%	21,235	14.3%	42,299	14.9%
50–59	101	25.4%	109	21.1%	210	23.0%	25,480	18.9%	25,730	17.3%	51,210	18.1%
60–69	74	18.6%	87	16.8%	161	17.6%	18,395	13.6%	20,765	14.0%	39,160	13.8%
70–79	44	11.1%	58	11.2%	102	11.1%	13,800	10.2%	18,450	12.4%	32,250	11.4%
≥ 80	11	2.8%	25	4.8%	36	3.9%	5,551	4.1%	11,788	7.9%	17,339	6.1%
Total	398	100.0%	517	100.0%	915	100.0%	134,866	100.0%	148,556	100.0%	283,422	100.0%

Table 2 Responses to EQ-5D by demographic variables

Indicating a (moderate or extreme) problem (%)															
	<i>n</i>	%	Mobility	<i>p</i>	Self-care	<i>p</i>	Usual activities	<i>p</i>	Pain/discomfort	<i>p</i>	Anxiety/depression	<i>p</i>	EQ-5D index	SD	<i>p</i>
Total	915	100	13.6		3.9		10.1		30.4		22.8		0.877	0.157	
Sex															
Female	517	56.5	14.1	0.662	4.4	0.396	12.4	0.008**	32.7	0.095	25.1	0.068	0.888	0.150	0.067
Male	398	43.5	12.8		3.3		7.0		27.4		19.8		0.868	0.161	
Age group (years)															
18–29	110	12.0	1.8	0.000**	0.0	0.000**	1.8	0.000**	14.5	0.000**	20.0	0.047*	0.932	0.127	0.000 ^b
30–39	129	14.1	7.0		2.3		6.2		17.1		23.3		0.902	0.148	
40–49	167	18.3	5.4		1.8		3.6		25.7		22.2		0.900	0.139	
50–59	210	23.0	6.2		1.0		3.3		28.6		19.0		0.900	0.133	
60–69	161	17.6	14.3		2.5		8.7		37.9		20.5		0.868	0.155	
70–79	102	11.1	41.2		12.7		36.3		48.0		33.3		0.780	0.182	
≥80	36	3.9	72.2		30.6		50		75.0		36.1		0.684	0.158	
Marital status															
Single	309	33.8	11.9	0.041*	2.6	0.007**	7.9	0.004**	28.9	0.172	21.0	0.067	0.885	0.148	0.073
Married	606	66.2	16.8		6.5		14.2		33.3		26.5		0.861	0.173	
Employment status															
Employed	333	36.4	7.2	0.000**	1.2	0.000**	3.9	0.000**	24.0	0.000**	15.9	0.000**	0.910	0.135	0.000 ^b
Self-employed	83	9.1	13.3		3.6		7.2		28.9		26.5		0.871	0.149	
Housewife	197	21.5	8.6		2.5		9.6		29.9		24.4		0.882	0.150	
Part-time job	100	10.9	5.0		0.0		2.0		22.0		23.0		0.909	0.126	
Student	24	2.6	4.2		0.0		4.2		8.3		8.3		0.956	0.103	
Unemployed/retired	155	16.9	40.6		14.8		30.3		51.6		35.5		0.774	0.191	
Other status	23	2.5	13.0		4.3		17.4		47.8		26.1		0.833	0.147	
BMI															
<18.5 kg/m ²	94	10.3	16.0	0.755	6.4	0.415	13.8	0.189	30.9	0.342	24.5	0.552	0.869	0.165	0.774
18.5–24.9 kg/m ²	649	70.9	13.4		3.5		10.3		29.1		23.4		0.879	0.155	
≥25 kg/m ²	172	18.8	12.8		4.1		7.0		34.9		19.8		0.872	0.161	
Current smoking															
Yes	218	23.8	14.1	0.496	3.6	0.323	10.6	0.367	31.7	0.129	23.1	0.782	0.873	0.158	0.217
No	697	76.2	11.9		5.0		8.3		26.1		22.0		0.887	0.154	
Alcohol intake															
<44 g/day	869	95.0	13.7	0.824	3.9	0.701	10.5	0.077	30.4	1.000	22.8	0.858	0.877	0.158	0.941
≥44 g/day	46	5.0	10.9		4.3		2.2		30.4		23.9		0.877	0.144	

Table 2 continued

		Indicating a (moderate or extreme) problem (%)													
	<i>n</i>	%	Mobility	<i>p</i>	Self-care	<i>p</i>	Usual activities	<i>p</i>	Pain/discomfort	<i>p</i>	Anxiety/depression	<i>p</i>	EQ-5D index	SD	<i>p</i>
Sufficient sleep (7–8 h/day)															
Yes	253	27.7	13.3	0.746	3.6	0.449	9.7	0.540	27.5	0.003**	19.9	0.001**	0.886	0.155	0.001 ^a
No	662	72.3	14.2		4.7		11.1		37.9		30.4		0.851	0.160	
Exercise (>30 min, ≥3 times/week)															
Yes	220	24.0	9.5	0.054	1.8	0.073	8.2	0.368	27.3	0.274	16.8	0.016*	0.895	0.135	0.115
No	685	74.9	14.8		4.6		10.6		31.5		24.7		0.871	0.163	
Having a hobby															
Yes	758	82.8	11.7	0.001**	2.4	0.000**	7.9	0.000**	27.6	0.000**	19.3	0.000**	0.891	0.148	0.000 ^a
No	157	17.2	22.3		11.5		20.4		43.9		40.1		0.806	0.180	
Severe stress within past month															
No	666	72.8	11.6	0.006**	3.3	0.126	8.1	0.002**	26.9	0.000**	15.5	0.000**	0.897	0.144	0.000 ^a
Yes	249	27.2	18.9		5.6		15.3		39.8		42.6		0.822	0.175	
Chronic condition															
No	479	52.3	3.8	0.000**	1.5	0.000**	2.1	0.000**	18.8	0.000**	16.7	0.000**	0.925	0.122	0.000 ^a
Yes	436	47.7	24.3		6.7		18.8		43.1		29.6		0.824	0.173	

* χ^2 , $p < 0.05$; ** χ^2 , $p < 0.01$

^a Mann–Whitney *U* test, $p < 0.01$

^b Kruskal–Wallis test, $p < 0.01$

Table 3 Distribution of EQ-5D responses by chronic condition

		Indicating a (moderate or extreme) problem (%)													
	<i>n</i>	%	Mobility	<i>p</i>	Self-care	<i>p</i>	Usual activities	<i>p</i>	Pain/discomfort	<i>p</i>	Anxiety/depression	<i>p</i>	EQ-5D index	SD	<i>p</i>
Hyperlipidemia	86	9.4	17.4	0.251	5.8	0.374	14	0.255	43	0.009**	26.7	0.348	0.836	0.160	0.008 ^a
Without	829	90.6	13.1		3.7		9.7		29.1		22.4		0.881	0.156	
Hypertension	145	15.8	25.5	0.000**	6.2	0.158	16.6	0.007**	40.7	0.004**	26.2	0.332	0.832	0.170	0.000 ^a
Without	770	84.2	11.3		3.5		8.8		28.4		22.2		0.885	0.153	
Heart disease	36	3.9	33.3	0.002**	13.9	0.011*	30.6	0.000**	61.1	0.000**	36.1	0.067	0.772	0.185	0.000 ^a
Without	879	96.1	12.7		3.5		9.2		29.1		22.3		0.881	0.154	
Stroke	8	0.9	50.0	0.015*	25.0	0.036*	37.5	0.038*	75.0	0.012*	62.5	0.018*	0.720	0.185	0.005 ^a
Without	907	99.1	13.2		3.7		9.8		30.0		22.5		0.878	0.156	
Liver disease	26	2.8	26.9	0.072	3.8	1.000	30.8	0.003**	46.2	0.085	34.6	0.157	0.814	0.178	0.037 ^b
Without	889	97.2	13.2		3.9		9.4		29.9		22.5		0.879	0.156	
Diabetes mellitus	62	6.8	32.3	0.000**	11.3	0.008**	19.4	0.025*	50.0	0.001**	29.0	0.272	0.803	0.195	0.001 ^a
Without	853	93.2	12.2		3.4		9.4		29.0		22.4		0.882	0.152	
Respiratory disease	28	3.1	35.7	0.002**	14.3	0.021*	32.1	0.001**	46.4	0.092	42.9	0.019*	0.772	0.166	0.000 ^a
Without	887	96.9	12.9		3.6		9.4		29.9		22.2		0.880	0.155	
Renal disease	9	1.0	22.2	0.350	11.1	0.304	44.4	0.008**	55.6	0.140	44.4	0.127	0.786	0.220	0.131
Without	906	99.0	13.5		3.9		9.7		30.1		22.6		0.878	0.156	
Musculoskeletal disease	56	6.1	58.9	0.000**	14.3	0.001**	50.0	0.000**	83.9	0.000**	41.1	0.002**	0.682	0.131	0.000 ^a
Without	859	93.9	10.6		3.3		7.5		26.9		21.7		0.889	0.150	
Gastrointestinal disease	43	4.7	51.2	0.000**	9.3	0.083	30.2	0.000**	60.5	0.000**	39.5	0.014*	0.740	0.164	0.000 ^a
Without	872	95.3	11.7		3.7		9.1		28.9		22.0		0.883	0.153	
Dental caries or other dental diseases	88	10.6	15.9	0.512	3.4	1.000	10.2	1.000	36.4	0.223	30.7	0.082	0.862	0.159	0.274
Without	827	89.4	13.3		4.0		10.0		29.7		22.0		0.878	0.157	

* χ^2 , $p < 0.05$; ** χ^2 , $p < 0.01$ ^a Mann–Whitney U test, $p < 0.01$ ^b Mann–Whitney U test, $p < 0.05$

EQ-5D dimensions

From the results of each level of the five dimensions in Table 4, about 30% of respondents reported some pain/discomfort and about 20% had anxiety/depression. A “moderate” problem on at least one dimension was reported by 41.6% of respondents, whereas 4.0% of respondents reported some form of “extreme” problem. Problems on one or more EQ-5D dimensions were reported by 45.6% of respondents.

EQ-5D health state and SRH

The relationship between EQ-5D dimensions and SRH status is presented in Table 5. These results show that, as SRH decreases from very good to very poor, the percentages of respondents reporting moderate or severe problems increases in each of the five EQ-5D dimensions. In the worst SRH category, over three-quarters of respondents reported problems in each EQ-5D dimension except the self-care dimension, while only 10.3% of respondents reported problems on any of the five EQ-5D dimensions in the best SRH category. Mean EQ-5D indices at each level of SRH were all significantly different from each other and decreased from very good (0.977) to very poor (0.537). The

Pearson correlation coefficient between SRH and the EQ-5D index value was $r = 0.568$ ($p < 0.001$).

Determinants influencing Japanese HRQOL

The results of multiple linear regression analyses for the association between all social determinants and EQ-5D score are shown in Table 6. Explanatory factors of social background, health-related behaviors, and 11 chronic conditions were entered into multiple regression analyses as independent variables. HRQOL decreased with age. Marital status and BMI were not associated with HRQOL. Regarding employment status, unemployment/retirement had a significantly negative impact on HRQOL. Health-related behaviors, sufficient sleep (7–8 h/day), and having a hobby exerted positive impacts, but feelings of severe stress within the past month had a negative impact on HRQOL. In terms of specific chronic conditions, musculoskeletal and GI diseases showed significantly negative impacts on HRQOL.

Discussion

We attempted to describe HRQOL of the general population of Takamatsu City in 2005, expressed in EQ-5D dimensions and health state scores (mean EQ-5D index values). Compared with a previous study in Japan by Ikeda et al. [13], our figures were higher on all EQ-5D dimensions. According to other results from overseas (Table 7) [2–5, 13, 16, 17], our result resembled those from a UK study [2].

As mentioned, SRH is the most commonly used single-dimension measure for HRQOL in Japanese populations. As SRH status decreased from very good to very poor, the percentage of respondents reporting problems on any EQ-5D dimension increased and mean EQ-5D index decreased. This pattern again resembled those of studies in

Table 4 Percentage of responses to each EQ-5D dimension

Dimension	Some problem		Extreme problem		Any problem	
	n	%	n	%	n	%
Mobility	123	13.4	1	0.1	124	13.5
Self-care	32	3.5	4	0.4	36	3.9
Usual activity	80	8.7	12	1.3	92	10.0
Pain/discomfort	267	29.2	11	1.2	278	30.3
Anxiety/depression	190	20.8	19	2.1	209	22.9
Any dimension	381	41.6	37	4.0	418	45.6

Table 5 Percentage of individuals reporting any problem on EQ-5D by SRH

Dimension	Very good (n = 194), %	Good (n = 310), %	Neither good nor bad (n = 313), %	Poor (n = 86), %	Very poor (n = 12), %	p
Mobility	1.0	6.1	16.3	50.0	75.0	0.000**
Self-care	0.5	1.6	3.8	16.3	33.3	0.000**
Usual activities	0.5	2.9	11.2	44.2	75.0	0.000**
Pain/discomfort	4.6	18.1	43.5	76.7	91.7	0.000**
Anxiety/depression	5.2	13.9	31.6	54.7	83.3	0.000**
Any problem	10.3	30.3	60.1	88.4	100.0	0.000**
EQ-5D index (SD)	0.977 (0.072)	0.925 (0.119)	0.832 (0.149)	0.688 (0.160)	0.537 (0.142)	0.000 ^a

** χ^2 , $p < 0.01$

^a Kruskal–Wallis test, $p < 0.01$

Table 6 Multiple regression analysis on EQ-5D index value

	<i>B</i>	<i>SEM</i>	<i>p</i>
	0.911	0.021	0.000
Sex			
Male	0.000		
Female	−0.018	0.012	0.131
Age (years)			
18–29	0.000		
30–39	−0.034	0.019	0.073
40–49	−0.039	0.018	0.034
50–59	−0.036	0.018	0.052
60–69	−0.053	0.020	0.008
70–79	−0.110	0.022	0.000
≥80	−0.148	0.031	0.000
Marital status			
Single	0.000		
Married	0.013	0.011	0.219
BMI			
<18.5 kg/m ²	−0.011	0.015	0.466
18.5–24.9 kg/m ²	0.000		
≥25 kg/m ²	0.002	0.012	0.853
Employment status			
Employed	0.000		
Self-employed	−0.029	0.017	0.091
Housewife	−0.005	0.015	0.724
Part-time job	0.008	0.016	0.611
Student	0.019	0.031	0.540
Unemployed/retired	−0.066	0.017	0.000
Other status	−0.041	0.029	0.154
Health-related behavior			
Current smoking	0.008	0.011	0.462
Alcohol intake (>44 g/day)	−0.019	0.021	0.356
Exercise (>30 min, ≥3 times/week)	0.026	0.010	0.012
Sufficient sleep (7–8 h/day)	0.029	0.011	0.008
Having a hobby	0.048	0.012	0.000
Severe stress within the past month			
No	0.000		
Yes	−0.070	0.011	0.000
Chronic condition			
Hyperlipidemia	−0.009	0.016	0.558
Hypertension	0.004	0.013	0.740
Heart disease	−0.029	0.024	0.217
Stroke	−0.059	0.048	0.222
Liver disease	−0.009	0.027	0.736
Diabetes mellitus	−0.022	0.018	0.229
Respiratory disease	−0.044	0.026	0.092
Renal disease	−0.057	0.045	0.203
Musculoskeletal disease	−0.133	0.019	0.000
Gastrointestinal disease	−0.086	0.022	0.000
Dental caries or other dental diseases	0.000	0.015	0.995
<i>R</i> ²	0.324		
Adjusted <i>R</i> ²		0.299	

B *B*-estimate, *SEM* standard error of the mean

other countries [3, 17]. This study is the first to compare SRH and EQ-5D index in Japan. An intermediate correlation was identified between SRH and EQ-5D index ($r = 0.568$; $p < 0.001$).

This study also examined the relationship between various factors and HRQOL using representative Japanese samples. Consistent with past studies [2–5], HRQOL scores decreased with age. Regarding sex differences, HRQOL tended to be lower in females than in males, but not significantly so. In terms of employment status, unemployment/retirement was associated with the lowest scores.

Adjusting scores for age and sex by multiple linear regression, age, unemployment/retirement, feelings of severe stress within the past month, and musculoskeletal and GI diseases were significantly associated with decreased HRQOL score. Conversely, sufficient sleep (7–8 h/day) and having a hobby were associated with increased HRQOL score.

This model in our study successfully explained 30% of the variance in EQ-5D index scores. Conversely, BMI, smoking, and alcohol intake were not associated with HRQOL.

Previous surveys of HRQOL and employment status have reported that respondents who are retired or engaged in housewife are more likely to report problems [2, 13, 18]. We were unable to find any significant association between housewife or part-time employment and HRQOL, but unemployment/retirement was significantly associated with lower HRQOL in the general Japanese population. In Japan, the unemployment rate was 4.4% in 2005 and decreased to 3.9% in 2007. Labor participation rate was almost 70% for working age (18–64 years), but decreased to 19.4% by ≥65 years old [19]. About 90% of companies in Japan adopt the retirement system, with retirement at 60 years old. Recently, participation of seniors in the workforce has been reviewed, and there is strong demand from seniors who want to work, so working expansion and rehiring systems are gradually being introduced [20].

On the other hand, health-related behaviors such as getting sufficient sleep (7–8 h/day) and having a hobby exerted positive effects on HRQOL. According to recent sleep research in Japan, individuals with sleep duration of either <6 or >8 h tend to be more depressed than those with sleep duration of 6–8 h [21, 22]. As subjective sleep sufficiency decreased, symptoms of depression increased, indicating a linear, inverse-proportional relationship [21, 22]. Having a hobby also had a significantly positive impact on HRQOL. We were unable to find any previous studies reporting a positive relationship between having a hobby and HRQOL in a Japanese population. However,

Table 7 Comparison of HRQOL as measured by EQ-5D among different countries

Country	n	Indicating a (moderate or extreme) problem (%)					
		Mobility	Self-care	Usual/activity	Pain/discomfort	Anxiety/depression	Any dimension
Japan (Ikeda) [13]	621	7.2	1.8	5.2	20.0	8.5	25.0
UK [2]	3,395	18.4	4.2	16.3	33.0	20.9	43.1
USA [4]	427	14.0	3.0	14.0	40.0	24.0	–
Canada [5]	1,518	22.2	4.0	19.1	43.6	28.6	53.0
Spain [16]	12,245	11.2	2.0	6.9	26.3	12.5	33.0
China [17]	2,991	4.9	2.0	3.3	18.0	6.1	22.4
Sweden [3]	3,069	11.1	1.9	8.0	44.3	29.1	–

according to past studies of the elderly in Japan, having a hobby improves both care prevention and HRQOL in older individuals [23, 24]. We also found that feelings of severe stress significantly lowered HRQOL. Sources of severe stress might differ for each age group. According to the Comprehensive Survey of Living Conditions of the People by the Ministry of Health, Labor, and Welfare 2004, sources of stress for younger individuals (25–44 years) included “income/family budget/debt” in 32.5%, “income in the future or in old age” in 27.4%, “human relations besides family” in 22.3%, and “work of self and spouse” in 21.9% [25]. The middle-age group (45–64 years) reported stress sources such as “income in the future or in old age” in 39.3%, “own health/disease” in 36.7%, and “income/family budget/debt” in 26.5% [25]. Conversely, “own health/disease” in 60.4% and “self-care in old age” in 36.9% were the main sources of stress for the older age group (≥65 years) (not shown in table, [25]).

Among the investigated chronic conditions, musculoskeletal and GI diseases were significantly associated with reduced HRQOL. In terms of reduced Japanese HRQOL with musculoskeletal disease, 42.2 million (41.2%) Japanese adults reportedly suffer from musculoskeletal pain and 9.1 million (8.8%) might encounter interference with daily activities due to pain [26–28]. Given this high prevalence, musculoskeletal pain is a health problem that warrants high priority in Japan.

In terms of the relationship between GI disease and HRQOL of Japanese population, the Domestic/International Gastroenterology Surveillance Study (DIGEST) surveyed 5,581 respondents from 10 developed countries (including Japan) and evaluated the impact of GI symptoms on QOL [29–31]. This study showed that presence of GI symptoms (especially upper GI symptoms) was closely associated with impaired wellbeing and daily life in Japanese [31].

According to the relation between other specific diseases and HRQOL, a Swedish survey also reported that QOL was lowest among individuals with depression (0.38) or low back pain (0.66) using the EQ-5D [3], while depression and

arthritis showed the greatest decrements using EQ-5D index scores in a US study [32].

Recent investigations have pointed out that Japanese HRQOL might be affected by factors such as age, sex, socioeconomic status, health-related behaviors, some diseases, and social networks [33–41]. A previous study using SRH in Japan revealed that female educational attainment shows significant linear associations with SRH [33]. Adjusted household income was also significantly associated with self-rated physical health among female respondents. While educational attainment was associated with SRH in the young age group, adjusted household income was associated with self-rated physical health in the middle-age and old-age groups [33]. Some previous studies using SRH for elderly individuals in Japan have identified that factors such as years of education, income, depression, stress, sense of coherence, hobby activities, joining in social activities, and getting social support are strongly related to HRQOL [23, 24, 34–37]. More studies are expected to investigate relationships between each factor and Japanese HRQOL.

The present study has a number of limitations. As our data were cross-sectional, no causal relationship may be derived between sociodemographics, chronic conditions, and HRQOL. Due to the limited number of response categories in the EQ-5D for each question, a ceiling effect may occur when measuring the health status of Japanese samples. The data we collected included a slightly higher proportion of data from the middle-age group than that in the general population of Takamatsu City, and the possibility therefore exists that the young age group is not accurately reflected in the results. Our usable response rate was low because we did not accept house-to-house interviews, therefore those who answered this survey may be more health conscious than the average in Takamatsu City. In addition, we did not analyze some aspects of socioeconomic status (education, household income), detailed chronic conditions (e.g., depression), and social support as factors of HRQOL. EQ-5D is a brief questionnaire and is an effective tool to evaluate HRQOL of Japanese people.

Some Japanese surveys for specific diseases using EQ-5D have been reported [38–41]. We hope to use EQ-5D with other health survey questionnaires (e.g., Health Utility Index, SF-12, and Quality of Well-Being) to gather more data about HRQOL in Japanese populations.

Conclusions

Although the available information on HRQOL in Japanese populations remains insufficient, this study furthers our understanding of some important determinants influencing Japanese HRQOL, using the EQ-5D. Our results also resembled some findings from similar studies in other countries. We hope to use EQ-5D with other health survey questionnaires to gather more data about HRQOL of Japanese people.

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Conflict of interest statement None declared.

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