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EuroQol-5 Dimension에서 시각아날로그척도 점수에 대한 각 영역들의 영향요인 평가

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Effect of EuroQol-5 Dimension on Visual Analogue Scale in Korean Population

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Background: The EuroQol-5 Dimension (EQ-5D) is the most frequently used questionnaire in cost-utility studies such as the quality-adjusted life year measure. Nevertheless, little attention has been paid to the relationship between an individual's visual analogue scale (VAS) score and EQ-5D dimensions. The objective of this study was to assess the relationship between the EQ-5D and VAS quality of life measures after adjusting for socio-demographic factors in the Korean general population.

Methods: The Fourth Korea National Health and Nutrition Examination Survey, which is a national representative sample, was used to analyze the impact of the EQ-5D dimensions on the VAS. The known-group construct validity of the VAS was assessed by factors that included age, income and comorbidities. The ordinary linear regression models were applied to test for the effect of the EQ-5D dimensions after adjusting for socio-demographic and clinical factors.

Results: We found that the VAS showed good construct validity. The VAS significantly declined as age increased, and as education and income levels decreased. VAS scores decreased for all EQ-5D dimensions as the response level rose. The explanatory power of the VAS increased from 23.0% in the first model, which included only the EQ-5D dimensions and levels, to 25.0% in the full model, which included socio-demographic and clinical factors.

Conclusions: While the EQ-5D dimensions were significant factors in determining the VAS, they did not, however, explain a sufficient amount of variance in the VAS. Further research is required on adding more dimensions to the EQ-5D preference-based instrument.

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Keywords: EQ-5D, Visual analogue scale, Quality of life

INTRODUCTION

Heath-related quality of life (HRQOL) means the physical, psychological, and social domains of health, seen as distinct areas that are influenced by a person's experiences, beliefs, expectations, and perceptions.[1)] As one of the instruments measuring HRQOL, EuroQol-5 Dimension (EQ-5D) is well-established and world widely used generic preference based instrument for assessing HRQOL. The validity and reliability of EQ-5D has been demonstrated in a variety of health conditions as well as general population.[2-6)] There is an evidence on validity and reliability of Korean EQ-5D in general population.[7)]

The EQ-5D was the most frequently used questionnaire

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in cost–utility studies including quality-adjusted life year.[8] Rating scale such as visual analogue scale (VAS) is one of direct health state valuation methods. Preference weight could be derived from both measures. Nevertheless, little attention has been paid to the relationship between the individual's VAS and EQ-5D dimensions. TOMBOLA group reported there were other variables which contribute systematically towards determining VAS score independently of EQ-5D health state classification.[9] Jelsma & Ferguson investigated the predictors including EQ-5D dimension of VAS scores.[10] However, TOMBOLA group's study has a limitation that subject did not include male and co-morbidity was not adjusted. Jelsma & Ferguson's study have relatively small sample size. In addition, there was evidence on substantial cultural differences in preference scores.[11,12]

Therefore, this study primarily aimed to examine the correspondence between EQ-5D and VAS after adjusting socio-demographic variables and clinical conditions using Korean national survey data. Additionally, we assessed the known-group construct validity of VAS.

METHODS

1. Data

We utilized the Forth Korea National Health and Nutritional Examination Survey (KNHANES) data. The survey is a cross-sectional and national wide survey designed to represent the non-institutionalized Korea population over from 2007 to 2009. Subjects who responded EQ-5D questionnaire including VAS and were ≥30 years of age were included. Out of 24,871 subjects, 14,921 persons were used to analyze.

Information on five EQ-5D dimensions, VAS, socio-demographic factors, and clinical characteristics was used. Socio-demographic factors included age, gender, the level of education (6 years and less, 7 to 9 years, 10 to 12 years, 13 years and more) and the quartile of household income. Clinical characteristics included 37 prevalent diseases such as hyperlipidemia, stroke, myocardial infarction, depression, arthritis, subjective health perception and the level of stress. Subjective health perception were measured 5 ordinal scale from 'very good' (1) to 'very bad' (5) and stress was measured using 4 ordinal responses (i.e., 1: Very much, 2: Much, 3: Little, 4: Very little).

2. EuroQol-5 Dimension (EQ-5D)

EQ-5D is composed of two parts; the EQ-5D descriptive system and the EQ VAS. The EQ-5D descriptive system describes general health in terms of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has three levels, indicating no problems, some or moderate problems, and extreme problems, resulting in a total of 243 unique health states.[13] The VAS records the respondent's self-rated health on a vertical scale where the endpoints are labelled 'Best imaginable health state' and 'Worst imaginable health state' scoring from 0 to 100, respectively.[13]

3. Analysis

To assess known-group construct validity, VAS scores were calculated in terms of sex, age group, level of education, the level of income, diseases which were over prevalence of 5%, the number of comorbidity, subjective health perception and the level of stress. VAS scores by EQ-5D dimension and by level were also examined. We assumed that the VAS scores would be lower in females, older person, poorly educated persons, those suffering from any disease, those reporting themselves as poor condition or very stressed based on previous publications.[2,14,15] We also assumed that those reporting problem in any EQ-5D dimension showed lower VAS scores than who did not report problem. Differences in scores between groups are analyzed using the independent *t*-test or analysis of variance with post hoc Tukey test.

Multiple ordinary least square (OLS) regression was performed to identify the relationship between EQ-5D dimensions and VAS. We defined dependent variables as VAS score. The basic independent variables were the 5 dimensions of the EQ-5D, which were treated as 9 dummy variables, indicating the presence of a level 2 or 3 in each dimension except self-care (Model 1). Because of the small numbers of subjects reporting extreme problem in self-care dimension (n=86, 0.58%), those with problems at level 2 or 3 were merged for self-care dimension. In addition, we explored Model 2 and Model 3. Model 2 added socio-demographic variables to Model 1 and Model 3 added clinical

characteristic variables to Model 2. Age was grouped into 3 categories, i.e, less than 60, 60 to 69, and 70 and more, because VAS scores in among 30's, 40's and 50's were not significantly different in univariate analysis. Survey year

Table 1. Distribution of socio-demographic and clinical characteristics and VAS scores (N=14,921)

Characteristics	N (%)	VAS, mean±SD	P^a	Group[b]
Survey year				
2007	2,632 (17.6)	70.0±18.4	<0.001	A
2008	5,892 (39.5)	72.8±18.8		B
2009	6,397 (42.9)	73.7±18.1		C
Age group				
≤59	9,731 (65.2)	75.4±15.6	<0.001	A
60-69	2,767 (18.5)	70.0±20.1		B
≥70	2,423 (16.2)	64.9±23.7		C
Gender				
Male	6,300 (42.2)	74.6±16.6	<0.001	
Female	8,621 (57.8)	71.3±19.6		
Educational level, y				
≤6	4,980 (33.4)	67.3±22.5	<0.001	A
7-9	1,884 (12.6)	72.4±17.5		B
10-12	4,584 (30.8)	75.0±15.6		C
≥13	3,455 (23.2)	77.5±13.5		D
Household income quartile				
1st	3,298 (22.7)	66.0±22.5	<0.001	A
2nd	3,623 (24.9)	72.4±17.9		B
3rd	3,814 (26.2)	75.1±16.2		C
4th	3,813 (26.2)	76.9±14.7		D
Subjective health perception				
Very good	607 (4.1)	88.9±11.5	<0.001	A
Good	5,083 (34.1)	81.0±13.3		B
Fair	5,280 (35.4)	71.9±15.0		C
Poor	3,256 (21.8)	62.8±20.0		D
Very poor	693 (4.6)	50.5±25.4		E
Level of stress				
Very much	783 (5.3)	62.5±22.8	<0.001	A
Much	3,340 (22.4)	68.2±19.4		B
A little	8,012 (53.7)	74.8±16.4		C
Very little	2,771 (18.6)	75.1±19.7		C
Hypertension				
Yes	3,257 (21.8)	68.4±20.8	<0.001	
No	11,664 (78.2)	73.9±17.6		
Diabetes mellitus				
Yes	1,198 (8.0)	65.5±22.0	<0.001	
No	13,723 (92.0)	73.3±18.0		
Depression				
Yes	812 (5.4)	59.4±22.7	<0.001	
No	14,109 (94.6)	73.5±17.9		
Arthritis				
Yes	2,638 (17.7)	65.0±21.9	<0.001	
No	12,283 (82.3)	74.3±17.2		
Number of co-morbidities				
0	5,388 (36.1)	77.7±14.7	<0.001	A
1	4,029 (27.0)	74.1±17.0		B
2	2,507 (16.8)	70.6±19.0		C
3	1,477 (9.9)	66.6±20.8		D
≥4	1,520 (10.2)	60.8±72.7		E

Abbreviations: VAS, visual analogue scale; SD, standard deviation.

[a]Calculated by independent *t*-test or analysis of variance.

[b]Grouping by post hoc Tukey analysis. Different alphabets indicate statistically significant differences between groups.

was treated as covariate using dummy variable because of difference of VAS scale in each year.

All statistical analyses were performed using SAS (version 9.1, Cary, North Carolina, USA).

RESULTS

A total of 14,921 subjects were included in modeling. The mean age of the participants was 52.9 years (SD=14.5), and 57.8% of the participants were women. Sixty four percent of participants reported at least one co-morbidity; hypertension was the most prevalent condition, which was reported by 3,257 (21.8%) participants and followed by arthritis (17.2%) (Table 1).

1. Known group validity

Aspects of the known-group construct validity of VAS by socio-demographic factors, the number of comorbidity, and self-perceived health condition are shown in Table 1. As hypothesized, the VAS scores of females significantly lower than those of males. VAS significantly declined as age increased, education level decreased, income level decreased in univariate analysis. Mean scores on the VAS score corresponding subjective health perception were 88.9 in 'very good', 81.0 in 'good', 71.9 in 'fair', 62.8 in 'poor' and 50.5 in 'very poor'. Less stressed people tended to report higher values than more stressed group on VAS score. VAS score in subject with depression was lower at 59.4 compared to 73.5 in subjects without depression. VAS was significantly declined as the number of co-morbidity increased (Table 1). In post hoc analysis, there are significant differences for all pairwise comparison after correction for p-value except between 'little stressed group' and 'very little stressed group'.

Table 2 showed proportions of response level by each dimension of EQ-5D and the corresponding mean VAS scores. VAS scores decreased for all dimensions as the response level rise. In self-care dimension, 'some problem' group and 'severe problem' group are not significantly different, whereas there is significant differences all pairwise comparison in other remaining dimensions.

2. Ordinary least square regression

The results of the OLS regression analysis of each of the three models are shown in Table 3. The sign of coefficients associated with EQ-5D are logically consistent for all models. More severe health problems in any dimension markedly yielded a lower VAS value in all models. Pain/dis-

Table 2. VAS scores by the levels and dimensions of EQ-5D

	N (%)	VAS, mean±SD	P^a
Mobility			
No problem	11,724 (78.6)	76.1±15.5	<0.001
Some problem	3,073 (20.6)	60.9±22.1	
Severe problem	124 (0.8)	42.4±26.1	
Self-care[b]			
No problem	14,045 (94.1)	73.9±17.2	<0.001
Some problem	790 (5.3)	53.1±25.9	
Severe problem	86 (0.6)	48.7±25.8	
Usual activities			
No problem	12,773 (85.6)	75.5±15.9	<0.001
Some problem	1,891 (12.7)	56.9±22.7	
Severe problem	257 (1.7)	47.9±26.0	
Pain/discomfort			
No problem	10,345 (69.3)	77.2±15.2	<0.001
Some problem	3,883 (26.0)	65.0±19.1	
Severe problem	693 (4.6)	49.1±26.2	
Anxiety/depression			
No problem	12,651 (84.8)	75.1±16.8	<0.001
Some problem	2,056 (13.8)	65.0±19.1	
Severe problem	214 (1.4)	49.1±26.2	

Abbreviations: VAS, visual analogue scale; EQ-5D, EuroQol-5 Dimension; SD, standard deviation.
[a]Calculated by analysis of variance.
[b]There was no significant difference between 'some problem' and 'severe problem' group when post hoc Tukey analysis was applied.

Table 3. Association of VAS scores with EQ-5D dimensions and other variables[a]

Variables	Model 1		Model 2		Model 3	
	Beta (SE)	*P*	Beta (SE)	*P*	Beta (SE)	*P*
Constant	76.84 (0.34)	<0.0001	78.58 (0.45)	<.0001	80.00 (0.47)	<0.0001
Survey year						
2007	0.00		0.00		0.00	
2008	1.97 (0.38)	<0.0001	1.99 (0.38)	<.0001	2.37 (0.38)	<0.0001
2009	1.62 (0.38)	<0.0001	1.71 (0.38)	<.0001	2.34 (0.38)	<0.0001
EQ-5D domain and level						
Mobility 2	-4.91 (0.43)	<0.0001	-4.14 (0.45)	<.0001	-3.73 (0.45)	<0.0001
Mobility 3	-11.22 (1.71)	<0.0001	-10.33 (1.72)	<.0001	-9.89 (1.70)	<0.0001
Self-care 2/3	-2.90 (0.69)	<0.0001	-2.74 (0.69)	<.0001	-2.85 (0.69)	<0.0001
Usual activity 2	-6.43 (0.54)	<0.0001	-6.06 (0.54)	<.0001	-5.72 (0.54)	<0.0001
Usual activity 3	-7.93 (1.27)	<0.0001	-7.52 (1.27)	<.0001	-7.05 (1.25)	<0.0001
Pain/discomfort 2	-5.94 (0.36)	<0.0001	-5.76 (0.36)	<.0001	-5.06 (0.36)	<0.0001
Pain/discomfort 3	-13.50 (0.77)	<0.0001	-13.14 (0.77)	<.0001	-12.11 (0.77)	<0.0001
Anxiety/depression 2	-7.56 (0.41)	<0.0001	-7.46 (0.41)	<.0001	-5.91 (0.42)	<0.0001
Anxiety/depression 3	-11.94 (1.20)	<0.0001	-11.68 (1.19)	<.0001	-9.09 (1.20)	<0.0001
Age group						
≤59			0.00			
60-69			0.35 (0.40)	0.378	0.45 (0.41)	0.266
≥70			-0.53 (0.47)	0.262	-0.61 (0.47)	0.199
Gender						
Male			0.00			
Female			-0.27 (0.28)	0.330	0.03 (0.28)	0.905
Educational level, y						
≤6			-0.87 (0.46)	0.059	-0.80 (0.46)	0.079
7 - 9			-1.12 (0.48)	0.021	-1.27 (0.48)	0.008
10 -12			-1.08 (0.37)	0.004	-1.29 (0.37)	0.001
≥13			0.00			
Household income quartile						
1st			-3.06 (0.44)	<.0001	-2.79 (0.43)	0.079
2nd			-1.27 (0.38)	0.001	-1.10 (0.38)	0.008
3rd			-0.68 (0.37)	0.065	-0.58 (0.36)	0.001
4th			0.00			
Level of stress						
Very much					-5.74 (0.61)	<0.0001
Much					-4.28 (0.33)	<0.0001
A little or very little					0.00	
Number of co-morbidities						
0					0.00	
1					-1.51 (0.34)	<0.0001
2					-2.12 (0.41)	<0.0001
3					-3.31 (0.51)	<0.0001
≥4					-3.37 (0.55)	<0.0001
R^2	0.230		0.235		0.250	

Abbreviations: VAS, visual analogue scale; EQ-5D, EuroQol-5 Dimension.; SE, standard error.
[a]Assessed by ordinary least square regression analysis.

comfort dimension was the most influential factors to self-reported VAS score, while self-care dimension was the least influential factors to the VAS score in all models. VAS score was influenced by the subject's educational achievement, the wealth of household, although the absolute magnitude was not so much. Level of distress considerably impacted on VAS scores. 'Very much stress' and 'Much stress' group showed a decrease of 5.69 and 4.22 in VAS scores compared to 'Very little or little stress' group. Explanatory power on VAS increased from 23.0% in Model 1 to 25.0% in Model 3.

DISCUSSION

Our study investigated the known group validity of VAS and the relationship between VAS and EQ-5D dimension using a nationally representative sample. Differences in the VAS scores in terms of sex, age, educational level, and health status showed evidence of known-group construct validity, even if the effect of these demographic and clinical variables except the level of distress seems not too high. This trend was similar to previous publication.[14)]

Our main finding is that EQ-5D domains explained a modest degree of variance on VAS and explained variance was slightly improved after adding socio-demographic factor and clinical features from 23.0% to 25.0%. This explained variance was lower than previous research conducted in other countries. The proportion of variance explained in the VAS was 47% for the EQ-5D items in Switzerland population[16)] and that was 32% in UK after adjusting age, the level of education, race, smoking behaviour and perceived locus of control[9)] Jelsma & Ferguson concluded that apart from the EQ-5D descriptors, income, unemployment and age were the major determinants of the VAS for South African using stepwise regression, and the model developed accounted for an adjusted R^2 of 0.234.[10)]

Over seventy percent of the variance in the self-reported VAS is not explained by socio-demographic factors, the number of co-morbidities and level of stress, nor five domains of the EQ-5D in our study. This finding suggests that the limited explanatory power of the EQ-5D instrument could be due to the limited dimension of this tool or cultural difference. Although the EQ-5D classification includes anxiety/depression dimension, the independent measure of distress could be an additional determinant of VAS score in our study. To date, EQ-5D has been the only multi-attribute utility instrument that generated valuation sets for the general population in Korea. The number of domain of EQ-5D was relatively low compared with other multi-attribute health utility instruments. Recently, researches on exploration of health dimension to be included in EQ-5D have been conducted.[16,17)] Further research regarding the addition of appropriate dimension in preference-based HRQOL instrument in Korean population is required

There is a limitation to our study. VAS scale in each year during 4th KNHANES survey was slight different. VAS scale was 20 centimeter horizontal line in 2007, 19 centimeter vertical line in 2008 and 20 centimeter vertical line in 2009. Thus, we adjusted dummy coded survey year variable in each model and impact of survey year was significant but absolute magnitude was not much.

In conclusion, EQ-5D dimensions were significant factor determining VAS after adjustment for socio-demographic factors and clinical characteristics. However, EQ-5D dimensions did not explain a sufficient amount of variance in VAS. Further research is required about adding additional dimensions to EQ-5D as a preference-based instrument.

요 약

배경: EuroQol-5 Dimension (EQ-5D)은 질 보정 수명 측정 같은 비용-효용 분석에서 가장 빈번히 사용되는 도구임에도 개인들의 시각아날로그척도 점수와 EQ-5D 영역들 간의 관계에 대한 연구는 드물었다. 이 연구의 목적은 한국 일반인구집단에서 인구사회학적 정보를 보정한 후에 시각아날로그척도로 측정한 삶의 질 점수와 EQ-5D 영역들 간의 관계를 평가하고자 함이다.

방법: 시각아날로그척도 점수에 대한 EQ-5D 영역들의 영향을 분석하기 위해 국가 대표 표본인 4기 국민건강영양조사 자료를 사용하였다. 시각아날로그척도에 대한 알려진 집단에 따른 구성 타당도는 연령, 수입, 동반질환 같은 요소들로 평가하였다. 시각아날로그척도 점수에 대한 EQ-5D 영역들의 영향을 인구사회학적 요인과 임상적 요인을 보정하여 다중 선형회귀분석으로 분석하였다.

결과: 시각아날로그척도는 좋은 구성 타당도를 보였다. 시각아날로그 척도 점수는 연령이 증가할수록, 교육과 소득 수준이 감소할수록 유의하게 감소하였다. 시각아날로그 척도 점수는 모든 EQ-5D 영역에서 응답 수준이 높아질수록 감소하였다. EQ-5D 영역들과 수준만을 포함한 모델 1에서 시각아날로그척도의 설명력은 22.9%였고, 모델 1에 인구학적 그리고 임상적 요인까지 포함한 모델 2에서는 시각아날로그척도의 설명력이 31.3%로 증가하였다.

결론: EQ-5D 영역들은 시각아날로그척도 점수의 유의한 요인이었지만, 시각아날로그척도 점수의 변이를 충분히 설명하지 못했다. 선호도 기반 삶의 질 측정도구인 EQ-5D에 다른 영역을 더하는 것에 대한 추가 연구가 필요할 것이다.

중심단어: EQ-5D, 시각아날로그척도, 삶의 질

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