EQ-5D as a Generic Measure of Health-Related Quality of Life in Israel: Reliability, Validity and Responsiveness

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ABSTRACT: **Background:** The European Quality of Life 5-Dimensions questionnaire is one of the most commonly used measures of health-related quality of life.

Objectives: To present the feasibility, reliability and validity of the Hebrew version of the EQ-5D.

Methods: We conducted face-to-face interviews with a representative sample (n=1666) of the Israeli Jewish population. The data collected included demographic and medical information, and self-valuation of health using the EQ-5D descriptive system, Visual Analogue Scale and Time Trade-Off. Construct validity was assessed by assuming that older individuals, those with a greater burden of diseases, and those reporting experience with their own severe illness would have lower EQ-5D indexes, VAS and TTO values. Test-retest reliability was assessed in a small sample (n=50) that was reevaluated after a 3 week interval.

Results: Test-retest reliability of the EQ-5D and VAS was very high ($r \geq 0.85$). Reliability of the TTO was moderate ($r = 0.48$). There were significant differences in the EQ-5D index, profiles, VAS and TTO between healthy and sick respondents and younger and older respondents, indicating good validity of the instrument.

Conclusions: The Hebrew translation of the EQ-5D is a practical, reliable and valid instrument for assessing the health-related quality of life of the general Israeli Jewish population.

IMAJ 2010; 12: 715–720

KEY WORDS: European Quality of Life 5-Dimensions, Visual Analogue Scale, time trade-off, translation, construct validity, test-retest reliability

Improving the health of a population is the major aim of health systems, and improving the quality of life is often the major goal in the provision of health care. In public health and in medicine, the concept of health-related quality of life refers to a person's perceived physical and mental health over time [1]. The measurement of HRQoL is a prerequisite for making fully informed decisions with regard to individual patient treatment options, benchmarking the morbidity of entire populations, or even determining the value of a new treatment [2,3].

One of the most commonly used measures of HRQoL is the European Quality of Life 5-Dimensions questionnaire, a standardized generic instrument. The EQ-5D is designed for describing and valuing health by providing a single summary index value (utility) representing the overall HRQoL of an individual by quantifying a preference for his or her health state. The EQ-5D instrument consists of a self-classifier/descriptive system to describe the respondent's own health in five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Respondents can value their health in each dimension at three ordinal levels: no problems, some or moderate problems, and severe or extreme problems. The second measurement component of the EQ-5D is a 20 cm vertical Visual Analogue Scale (EQ VAS) to rate the respondent's own health. The third component of the EQ-5D is a questionnaire on the respondent's background including medical history [4,5].

Recently, the EQ-5D was administered to a nationally representative sample in a large-scale study aiming to describe the current health status and the values of different health states of the Israeli population. The present article analyzes the feasibility, reliability and validity of the Hebrew version of the EQ-5D.

The criterion of practicality implies that the instrument is acceptable to the respondent. Consideration is given to the length of time taken to administer the instrument, as well as its feasibility and cost and the quality of the data. Response rates and completion rates are good indicators of the length, difficulty and acceptability of the instrument. Reliability is determined by the extent to which repeat administration of an instrument to a stable population yields the same results. In order to measure reliability we used the test-retest method. Validity refers to the

EQ-5D = European Quality of Life 5-Dimensions
VAS = Visual Analogue Scale
TTO = Time Trade-Off

HRQoL = health-related quality of life

truthfulness of the findings; i.e., did you really measure what you think you measured? There are several types of validity. Content validity establishes the extent to which the items of an instrument are appropriate for the dimensions being measured, and face validity identifies whether the items of each dimension are sensible and appropriate. These types of validity are not generally measured quantitatively but are an integral part of the construction of the questionnaire. Since this article deals with translation of an established questionnaire, assessing the content and face validity is irrelevant. Criterion validity measures the validity of the questionnaire as compared to a gold standard. As there is no external standard measure of quality of life, criterion validity is not applicable. Another aspect of validity is internal consistency: to what degree do items that are meant to measure the same general construct produce consistent results? This is usually expressed by Cronbach's alpha. Since the dimensions in the EQ-5D represent discrete items that may or may not be related, measuring the internal consistency is extraneous. Therefore, this article focuses on construct validity (or empiric validity), which is the extent to which the measure correlates with other hypothesized indicators of health-related quality of life, such as age and sickness [6].

SUBJECTS AND METHODS

From a highly detailed information system, two representative samples of 10,000 Israeli households were drawn covering six different socioeconomic and demographic areas according to socioeconomic and demographic characteristics of the Israeli population. Respondents were selected to match the Israeli general population according to the 2002 census.

Data regarding the acceptability of the questionnaire are presented for the entire sample. Data regarding the validity and reliability of the Hebrew version of the EQ-5D questionnaire were analyzed for the Israeli Jewish subpopulation of the sample, as Arab respondents completed an Arabic version of the EQ-5D.

DATA COLLECTION

A face-to-face household interview-based study was conducted during January-March 2006; data were collected using the EQ-5D instrument. Respondents were given a copy of the questionnaire which was simultaneously read out to them by the interviewer, who then completed the questionnaire for the respondents.

OUTCOME MEASURES

Data collection was done using the following instruments for each respondent:

- *Background information*: This section contains a series of questions designed to elicit background information on age, gender, education, occupation, smoking history, etc.
- *EQ-5D descriptive system*: Respondents were asked to describe their own health state using the EQ-5D descriptive system, resulting in health state that can be defined by a five-digit number, called profile. For example, profile 21132 indicates level 2 on mobility (some problems), level 1 (no problems) for self-care and usual activities, level 3 for extreme pain or discomfort, and level 2 for moderate anxiety or depression [7].
- *EQ VAS method*: Respondents were asked to indicate their own current health state, as well as "dead," on a 20 cm vertical VAS calibrated from zero ("worst imaginable health state") to 100 ("best imaginable health state").
- *Time Trade-Off scaling method*: The TTO exercise was run with the aid of a specially designed set of TTO cards. Respondents were asked to trade off 10 years in their own health with x years (less than 10 years) in the "best imaginable health state," yielding utility values that range from 0 to 1. Respondents also had the option not to trade off any time.

DATA ANALYSIS

- *EQ-5D Index values*: Each EQ-5D profile was converted to utility based on the Danish VAS tariff in order to represent the health status as a continuous variable [8].
- *Rescaling of VAS health states.* It is necessary to rescale the VAS values so that the value for death is set at 0 and the health state 11111 as 1, thus values are all truncated to (–1)/(+1). In order to rescale the mean VAS values for each of the directly valued health states that the respondents valued, the following formula was applied: $VAS_{rescaled} = (VAS_{self} - VAS_{death})/(100 - VAS_{death})$.
- *Calculating TTO values*: TTO values were calculated by converting the number of months into years (dividing by 12) and adding to the number of years. Perfect health is represented by unwillingness to trade off any time, i.e., a value of 10 years, and death is represented by 0 years.

INSTRUMENT EVALUATION

- *Reliability:* Test-retest reliability of the EQ-5D instrument was assessed for 50 of the interviewees who agreed in advance to participate in the test-retest survey. Participants were interviewed again during the 3 weeks after the first interview. The interviewers were assigned randomly and not sent to the previous interviewee in order to test for inter-reviewer consistency. Correlation was assessed for EQ-5D index, VAS score and TTO values for the respondent's self-reported health status. For the measurement of correlation in the VAS scale, the original VAS score was used.
- *Validity:* Construct validity was assessed by correlating the EQ-5D index, the level of impairment in each dimension [categorized as "no problems" (level 1) or "some problems (levels 2 and 3 combined)], normalized VAS and TTO scores that respondents gave to their own HRQoL with

their medical history, as determined by their response to the question regarding:

- Age – categorized into two groups (below median age/ equal or above median age)
- Personal experience of severe illness (yes/no)
- Burden of disease – number of medical conditions they report to be suffering from (none/one or more)

STATISTICAL ANALYSIS

Descriptive statistics were used to describe the demographic details, the background information and the health status of the respondents. Test-retest agreement was measured by the Pearson inter-class correlation coefficient. Comparison among quantitative parameters (EQ-5D index, VAS and TTO) was made using the two-sample *t*-test. Categorical parameters were compared using the Pearson chi-square test. The *t*-tests applied were one-tailed, designed to test the assumption that older age and more severe illness lead to lower values. A P value ≤ 0.05 was considered statistically significant.

RESULTS

DEMOGRAPHIC AND MEDICAL BACKGROUND

Of the 6109 households contacted, 3354 were eligible to participate (no one was at home in 1186 households and 1569 did not qualify with respect to age group). Of the 3354 that were eligible, 754 households refused to participate, 250 started the interview but refused to continue, and 200 did not complete the interview for other reasons. In addition, 150 households were unable to understand the exercise, yielding 2000 completed and usable questionnaires (59.63% of those that were eligible). Including those whose interview was cut short for other reasons and those who did not understand the exercise, the response rate was 70%.

The Jewish subpopulation comprised 1666 respondents (83.3% of the sample). It was similar in its characteristics to the total sample, except for the experience of severe disease in the family [Table 1]. The samples were similar to the adult Israeli population, according to the Israel Central Bureau of Statistics report, with respect to gender distribution and age but with a higher percentage of married individuals and lower percentage of single ones [9,10].

The reliability sample consisted of 50 subjects but one was excluded because of considerable inconsistencies in the responses, leaving 49 subjects. A comparison of the Jewish sample and the reliability sample showed that they were similar in demographic characteristics. There was a higher percentage of females in the reliability sample, but the difference was not statistically significant. The reliability sample reported less experience of the respondents with severe illness of their own or of others. Despite the significant difference in experience with severe disease, there was no difference in the burden of diseases between the reliability sample and the entire Jewish sample [Table 1]. Regarding specific conditions, the most common condition in both the entire sample and the reliability sample was hypertension. There was no significant difference in the prevalence of other conditions (data not shown).

Table 1. Demographic characteristics and medical history of respondents in the general sample, the Israeli Jewish group (Jewish sample) and the subgroup for the test-retest reliability assessment (reliability sample)

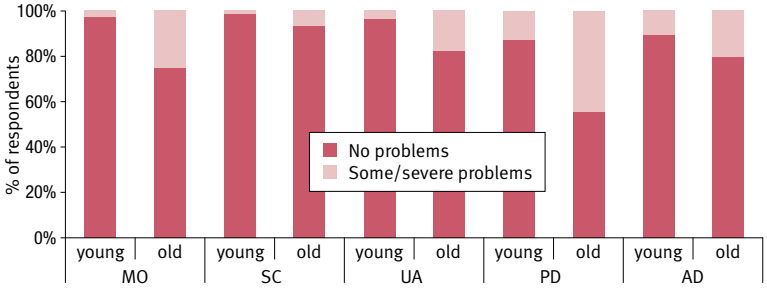
		General sample (N=2000)	Jewish sample (N=1666)	*P* value*	Reliability sample (N=49)	*P* value**
Age (mean ± SD)		42.8±16.3	43.3±16.4	0.33	43.3±16.7	0.99
Gender N (%)	Male	954 (47.7%)	783 (47.0%)	0.57	19 (38.8%)	0.25
	Female	1046 (52.3%)	883 (53.0%)		30 (61.2%)	
Marital status N (%)	Married/Partnership	1199 (60.0%)	983 (59.0%)	0.59	28 (57.1%)	0.85
	Divorced/Widowed	287 (14.3%)	263 (15.8%)		9 (18.4%)	
	Single	495 (24.7%)	401 (24.1%)		12 (24.5%)	
	Other/Refused	19 (1.0%)	19 (1.1%)		0 (0%)	
Income N (%)	Lower than average	873 (43.7%)	680 (40.8%)	0.10	22 (44.9%)	0.14
	Average	460 (23.0%)	405 (24.3%)		17 (34.7%)	
	Higher than average	550 (27.5%)	487 (29.2%)		9 (18.4%)	
	Refused	117 (5.8%)	94 (5.7%)		1 (2.0%)	
Employment status N (%)	Employed	1270 (63.5%)	1091 (65.5%)	0.09	30 (61.2%)	0.72
	Retired/Unemployed	315 (15.8%)	277 (16.6%)		11 (22.5%)	
	Keeping house	212 (10.6%)	146 (8.8%)		5 (10.2%)	
	Student	170 (8.5%)	125 (7.5%)		2 (4.1%)	
	Other/Refused	33 (1.6%)	27 (1.6%)		1 (2.0%)	
Education N (%)	Less than high school	396 (19.8%)	290 (17.4%)	0.33	14 (28.6%)	0.08
	High school	933 (46.6%)	801 (40.1 %)		21 (42.8%)	
	Academic/Rabbinical	556 (27.8%)	476 (28.6%)		9 (18.4%)	
	Other/Refused	115 (5.8%)	99 (5.9%)		5 (10.2%)	
Smoking N (%)	Current	592 (29.6%)	501 (30.1%)	0.30	16 (32.6%)	0.73
	Former	349 (17.4%)	311 (18.7%)		7 (14.3%)	
	Never smoked	1059 (53.0%)	854 (51.2%)		26 (53.1%)	
Severe disease, self	Yes	184 (9.2%)	164 (9.8%)	0.36	0 (0%)	0.02
	No	1816 (90.8%)	1502 (90.2%)		49 (100%)	
Severe disease, family	Yes	751 (37.5%)	676 (40.6%)	0.01	2 (4.1%)	< 0.001
	No	1249 (62.4%)	990 (59.4%)		47 (95.9%)	
Severe disease, treating others	Yes	399 (20.0%)	360 (21.6%)	0.09	1 (2.0%)	< 0.001
	No	1601 (80.0%)	1306 (78.4%)		48 (98.0%)	
No. of conditions	0	1203 (60.2%)	1007 (60.4%)	0.67	33 (67.3%)	0.19
	1	444 (22.2%)	356 (21.4%)		12 (24.5%)	
	≥ 2	353 (17.6%)	303 (18.2%)		4 (8.2%)	

* General sample vs. Jewish sample
** Jewish sample vs. Reliability sample
N = number, SD = standard deviation

RELIABILITY

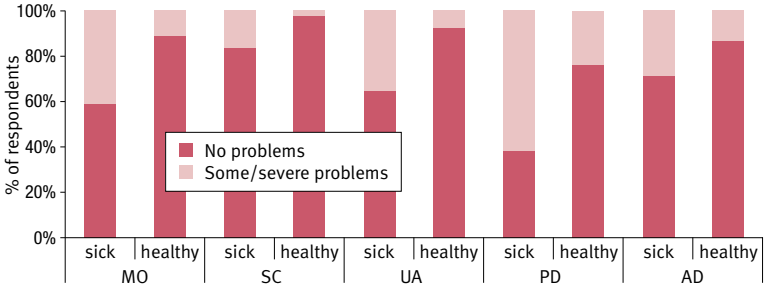
The Pearson correlation between the EQ-5D index utilities for the respondents' health status in the two surveys was very high (r = 0.85), indicating the high test-retest reliability of the EQ-5D descriptive system. The correlation between the VAS scores was also very high (r = 0.87 for both the crude and rescaled VAS scores). The correlation between the TTO values was much lower, with r = 0.48.

Figure 1. Percentage of "young" and "old" respondents (younger or older than median) reporting problems in each EQ-5D dimension



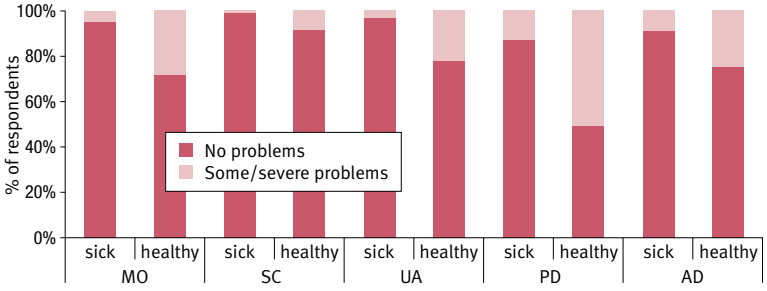
MO = mobility, SC = self-care, UA = usual activities, PD = pain/discomfort, AD = anxiety/depression. No problems = level 1, Some/severe problems = levels 2 and 3

Figure 2. Percentage of "sick" and "healthy" respondents (based on answer to question regarding self-experience of severe disease) reporting problems in each EQ-5D dimension



MO = mobility, SC = self-care, UA = usual activities, PD = pain/discomfort, AD = anxiety/depression. No problems = level 1, Some/severe problems = levels 2 and 3

Figure 3. Percentage of "sick" and "healthy" respondents (based on having no medical conditions vs. having one or more) reporting problems in each EQ-5D dimension



MO = mobility, SC = self-care, UA = usual activities, PD = pain/discomfort, AD = anxiety/depression. No problems = level 1, Some/severe problems = levels 2 and 3

VALIDITY

In comparing the respondents' HRQoL, the rescaled VAS scores of three respondents were excluded since they rated "death" as 100 in relation to their own quality of life. No TTO value was excluded.

- *HRQoL and age:* Seven respondents were excluded from evaluation because data on age were not available. The median age was 41. The HRQoL of respondents aged 41 years and older was lower than that of younger respondents. The EQ-5D index was 0.77 (SD 0.24) and 0.93 (SD 0.14), the rescaled VAS scores were 0.75 (SD 0.20) and 0.88 (SD 0.14), and the TTO values were 0.9 (SD 0.17) and 0.96 (SD 0.10) for the older and younger respondents respectively (P < 0.001 for all comparisons). There was no difference in the VAS score assigned to death; the younger respondents valued death as 0.06 (SD 0.13) and the older as 0.07 (SD 0.2). The two groups were also significantly different in the distribution of the levels in each EQ5D dimension (P < 0.001 for each dimension) [Figure 1].
- *HRQoL and experience of disease:* The HRQoL of respondents who reported experiencing severe disease themselves was lower than that of those who did not, and the difference was statistically significant. The EQ-5D index was 0.66 (SD 0.26) and 0.87 (SD 0.19), the rescaled VAS scores were 0.62 (SD 0.22) and 0.84 (SD 0.17), and the TTO values were 0.82 (SD 0.21) and 0.94 (SD 0.13) for those with and without personal experience with disease, respectively (P < 0.001 for all). Those with experience of disease valued death slightly higher than those without – 0.095 (SD 0.18) and 0.061 (SD 0.12) respectively (P = 0.01). The two groups were also significantly different in the distribution of the levels in the EQ5D dimensions (P < 0.01 for each) [Figure 2].
- *HRQoL and burden of disease:* The HRQoL of respondents who reported having one or more medical condition was lower than that of those who had none, and the difference was statistically significant. The EQ-5D index was 0.74 (SD 0.24) and 0.93 (SD 0.15), the rescaled VAS scores were 0.70 (SD 0.20) and 0.89 (SD 0.13), and the TTO values were 0.88 (SD 0.18) and 0.96 (SD 0.10) for the respondents with one or more medical condition and those who had none, respectively (P < 0.001 for all comparisons). The sick respondents valued death slightly higher than the healthy ones did – 0.074 (SD 0.14) and 0.058 (SD 0.11) respectively (P < 0.01). The two groups were also significantly different in the distribution of the levels in each EQ5D dimension (P < 0.001 for each dimension) [Figure 3].

DISCUSSION

The EQ-5D is one of the most widely used health-related quality of life questionnaires. It has been translated into over 60 languages and tested in numerous different population groups – both patients and the general population [5,7,11,12]. This study analyzed the feasibility, validity and reliability of the Hebrew version of the EQ-5D.

FEASIBILITY

One of the major advantages of the EQ-5D is that it is user-friendly; both the five-dimension three-level format and the VAS rating scale require little time and cognitive effort on the respondent's part. The response rate in this study was high, almost 60%. Similar response rates were noted in the creation of the Japanese and Spanish tariffs (63.9% and 51.8%, respectively), both of which used face-to-face interviews [13,14]. Higher response rates were attained in cases where the EQ-5D was administered for validation purposes or for assessing the health of the population. In those cases, respondents were asked to value only their own health state, which is both an easier and shorter task and thus the response rate is higher: 70–90% [15-17]. The simplicity of the EQ-5D questionnaire was also exemplified in a survey of the Catalan population: of the 12,245 questionnaires completed only 10 (0.08%) had a missing item in the EQ-5D descriptive system, as compared to 182 VAS scores (1.5%) [17].

VALIDITY

Assessing the EQ-5D descriptive system, VAS and TTO in relation to factors known to impact HRQoL demonstrated their construct validity; that is, older age and illness were correlated with lower scores and higher levels of disability (as indicated by the level in each dimension), as expected. In fact, stratification of respondents by age group and by the number of medical conditions reported revealed a gradual and almost completely linear ($r > 0.8$) decrease in HRQoL as respondents were older and sicker (data not shown). A similar relationship was noted in other studies, indicating that the EQ-5D is indeed sensitive to variations in health [18-20].

RELIABILITY

The correlation coefficient of the EQ-5D descriptive system and the VAS were very high, indicating a high degree of reliability. The reliability of the VAS and the EQ-5D in this study is comparable to that found elsewhere [2,12,16]. The correlation between the responses using the TTO was considerably lower – less than 0.5. This may be due to difficulties that respondents may have had in understanding the task, as TTO is known to be cognitively challenging. However, other studies found the test-retest reliability of the TTO to be higher, 0.63–0.85 [19]. One explanation for the lower level of correlation in this study may be a learning effect regarding the method: the self-TTO was one of the first questions in the questionnaire, so that in the first survey the self-TTO was the respondent's first encounter with the method, whereas in the second survey the respondent was more familiar and possibly more comfortable with the method.

Another element that may affect the test-retest reliability is the stability of the stimulus that is measured. The idea behind test-retest reliability is that the respondent, when asked to assess the same stimulus twice, would give the same answer. In our case, the stimulus is the respondent's own health. Therefore, the interval between the two tests must be long enough that the respondent does not remember the response given previously, but not too long as to minimize the chance that the respondent's health may significantly change. In this study, one respondent gave widely discrepant responses for the TTO in the two surveys: 0.11 in the first and 0.81 in the second. This may be due to confusion on the respondent's part regarding what is traded off and what remains, as the complement of 0.11, 0.89, is very close to the value given in the second survey. Alternatively, there may have been a change in the respondent's health in the interval between the two surveys, since this increase in the TTO was accompanied by an increase (though smaller) in VAS score and improvement in the EQ-5D profile and index. Eliminating this respondent from the calculation raised the correlation between the TTO values to 0.6.

CONCLUSIONS

This study has demonstrated that the EQ-5D, translated to Hebrew, is a practical, reliable and valid instrument for assessing the HRQoL of the general Israeli Jewish population. The usefulness of the TTO method is uncertain as it may be too complex a task for some respondents, leading to erroneous results.

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