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BRIEF COMMUNICATION

A comparison of self-rated health using EQ-5D VAS in the United States in 2002 and 2017

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Abstract

Purpose To compare self-rated health among the United States general population in 2002 and 2017.

Methods Secondary data were analyzed from two EQ-5D valuation studies conducted in 2002 and 2017. Both studies included the EQ-5D-3L self-classifier and visual analog scale (VAS), where health is rated from 0 (worst imaginable health) to 100 (best imaginable health). VAS scores were compared between time points using regression models, adjusting for sociodemographic factors (Model 1), plus illness (Model 2), and health problems according to the EQ-5D classifier (Model 3).

Results Mean VAS scores in 2002 [84.4 (SD = 16.1)] were not different from 2017 [84.6 (SD = 14.5)] ($p = 0.63$), nor different after adjusting for demographics (Model 1) or illness (Model 2). However, 2017 VAS mean scores were significantly higher than 2002 [2.2 (95% CI 1.36–3.10)] upon adjusting for the presence of dimension-specific health problems.

Conclusions Self-rated health of the general US adult population in 2017 was similar to 2002, but after adjusting for health problems, scores were slightly higher in 2017. Sociodemographic shifts in age and education explain some of the differences in scores, and by removing health and sociodemographic factors, we found the VAS reveals self-rated health is slightly better in 2017 than 2002.

Keywords Self-rated health · Health-related quality of life · VAS · Valuation · EQ-5D-3L

Background

Self-rated measures of health-related quality of life (HRQOL) are useful for understanding perceptions of subjective well-being and burden of disease at the population level, and complement metrics such as mortality as indicators of population health [1]. While trends in mortality are widely reported in studies and the mass media, longitudinal measurement of the well-being of a population is much less frequently reported. Trends in mortality rates are maintained in established databases by federal agencies [2] and is an objective dichotomous measure of population health—alive or dead. In contrast, HRQL is a more elusive concept typically rated on scales using various profile or summary measures [1, 3] that may or may not be routinely collected from the population using the same measure, and is influenced by various demographic factors that change in the population over time, such as the distribution of age, sex, level of education, and comorbidities [4–6]. One of the challenges of determining whether societal values assigned to health have changed is that there is a dearth of valuation studies that ask the general population to value health using the same metric and methodologies at different point in time [7], thereby precluding the ability to compare changes in perceptions of health over time.

Studies examining health status of the general US public using the same HRQL measures over time are scarce. The Center for Disease Control (CDC) routinely administers a 5-point general health question (health rated as excellent, very good, good, fair, or poor) [2], and publicly available data show that between 2000 and 2015, the proportion of age-adjusted, respondent-assessed fair-poor health status among US adults increased from 9.0 [standard error (SE) = 0.1] to 9.2% (SE = 0.1) [8], which suggests that general health has declined very slightly. Other countries have employed general measures of health such as the Health Utilities Index [5] and EQ-5D [9], where the latter includes

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a visual analog scale (EQ-VAS), where health is self-rated on a 100-point scale, which may provide further insight into trends in health perceptions among the US population. Notably, the EQ-VAS was employed in two prominent studies that may provide insight into the subjective well-being of the US population: in 2002, the US EQ-5D-3L valuation study was conducted by Shaw et al. [10], and recently, the EQ-5D-5L valuation study was completed in 2017 [11], where the EQ-VAS was completed in both studies. The aim of this study was to compare self-rated health based on the EQ-VAS in the US over a 15-year span, adjusting for demographic factors that may account for differences in the overall rating of population health over time.

Methods

Data from two, independent EQ-5D valuation studies conducted in the US among the adult general population were combined and analyzed [10, 12]. Self-reported health was captured by asking respondents to report the presence of any common chronic conditions and to report their health today using the EQ-5D health classifier, a more acute indicator. The EQ-5D is a widely used generic, multi-attribute health status measure composed of a descriptive, 5-dimension health classifier system (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) and a visual analog scale (VAS) [13]. All respondents reported their health status by completing the EQ-5D-3L health descriptor with three levels of severity (no problems, some problems, extreme problems) and VAS self-rating of health anchored at 0 (the worst health you can imagine) and 100 (the best health you can imagine). Both studies shared a very similar protocol. In both studies, trained interviewers conducted face-to-face interviews targeting English and Spanish-speaking, non-institutionalized adults (≥ 18 years old) living in the US. The two studies were conducted as a basis for a valuation of the EQ-5D-3L in 2002 [10] and EQ-5D-5L in 2017, which also included a sub-study valuing the EQ-5D-3L [11]. They differed in mode of administration and VAS presentation; the 2002 study was administered using pen and paper and the 2017 study was administered via computer [14]. The two studies also differed in sampling strategy; the 2002 study utilized a multistage sampling strategy based on residential mailing lists and systematically oversampled Black and Hispanic populations, whereas the 2017 study utilized a quota sampling strategy based on age, gender, race, and ethnicity using estimates from 2015 census data.

The independent variable of interest was the time-period in which the EQ-5D health valuation interview was completed (referent category: 2002). Differences in self-rated health between 2002 and 2017 were investigated using three ordinary least squares (OLS) regression models fitting respondent VAS scores.

Model 1 estimates the mean difference in health state valuation between time periods, adjusting for differences sociodemographic characteristics. Covariates included age (18–34, 35–54, and ≥ 55 years old), sex (male/female/other), race (White/Black/Other), ethnicity (Hispanic/non-Hispanic), and education (high school or less/greater than high school completed). *Model 2* included an additional variable for history of illness (any/none reported), thereby effectively removing the effect of illness (and differences in the presence of illness as reported in 2002 and 2017) on VAS-based self-rated health. *Model 3* further adjusted for self-reported EQ-5D-3L health state descriptors. Due to the low prevalence of health states containing health dimensions with extreme problems (i.e., level 3), each descriptor was operationalized as a dichotomous variable (any/no problems). In addition, a fourth model tested whether an interaction occurs when the independent variable of time has a different effect on self-rated health depending on another independent variable, the presence of any problems in the EQ-5D health dimensions, while adjusting for respondent characteristics.

All models were tested for normality, linearity, independence, homoscedasticity, and collinearity. The normality assumption via the Kolmogorov–Smirnov test was violated ($p < 0.05$); however, assuming VAS scores are bounded and not censored, assumptions of normality can be relaxed in sufficiently large samples [15]. Model performance statistics were reported for each model by unadjusted and adjusted R-squared and mean square error. Given the distribution of VAS scores observed in the sample, a sensitivity analysis was performed using a generalized linear model (GLM) using a beta distribution to examine the robustness of the base-case. All analyses were conducted using SAS 9.4 (Chapel Hill, NC).

Results

Sample demographics from a total of 4775 respondents ($n = 3728$ in 2002; $n = 1047$ in 2017) were analyzed. Compared to 2002, respondents in 2017 were more likely to be older, Hispanic, and more educated. Problems in the mobility, self-care, and usual activities EQ-5D were reported more frequently in the 2017 group compared to 2002 (Table 1).

There was no difference in unadjusted mean (SD) VAS scores between 2017 and 2002 [84.6 (14.5) vs. 84.4 (16.1); $p = 0.63$] (Table 2). No differences in mean VAS scores were observed after adjusting for sociodemographic factors (*Model 1*: $ß_{2017–2002} = 0.7$; $p = 0.17$) or with further adjustments for history of illness (*Model 2*: $ß_{2017–2002} = 0.9$;

Table 1 Sample demographics, by year (2017 vs. 2002)

Characteristic	2017 ($n=1047$)	2002, Unweighted ($n=3728$)	2002, Weighted ($n=3728$)
Age, n (%)			
Mean/SD	48.2/17.9	42.9/0.3	44.5/0.3
18–34	289 (27.6)	1328 (35.6)	1328 (31.7)
35–54	373 (35.6)	1556 (41.7)	1556 (42.4)
55+	385 (35.6)	844 (22.6)	844 (26.0)
Range	18–99	18–99	18–99
Gender, n (%)			
Male	532 (50.8)	1571 (42.1)	1571 (47.9)
Female	510 (48.7)	2157 (57.9)	2157 (52.1)
Race, n (%)			
White	762 (72.8)	1444 (38.7)	1444 (72.0)
Black	135 (12.9)	1045 (28.0)	2045 (11.0)
Other	150 (14.3)	1239 (33.2)	1239 (17.0)
Ethnicity, n (%)			
Hispanic	199 (19.0)	1095 (29.4)	1095 (11.8)
Non-Hispanic	848 (81.0)	2633 (70.6)	2633 (88.2)
Education, n (%)			
High school or less	395 (37.7)	2125 (57.3)	2125 (52.5)
Greater than high school	652 (62.3)	1581 (42.7)	1581 (47.5)
History of illness, n (%)			
Any	732 (69.9)	2386 (64.0)	2386 (68.4)
None	315 (30.1)	1342 (36.0)	1342 (31.6)
EQ-5D dimensions, n (%)			
MO, any problems	264 (25.2)	646 (17.4)	646 (18.2)
SC, any problems	72 (6.9)	155 (4.2)	155 (3.7)
UA, any problems	228 (21.8)	549 (14.8)	549 (15.0)
PD, any problems	420 (40.1)	1439 (38.8)	1439 (40.8)
AD, any problems	310 (29.6)	976 (26.3)	976 (26.4)
VAS responses, n (%)			
Mean/SD	84.6/14.5	84.4/16.1	84.3

AD anxiety/depression, *MO* mobility, *PD* pain/discomfort, *SD* standard deviation, *SC* self-care, *UA* usual activities

$p=0.10$) (Table 2). After adjustments for any problems in EQ-5D-3L dimensions, mean VAS scores were higher in 2017 compared to 2002 (*Model 3*: $ß_{2017–2002}=2.2$; $p=0.10$) (Table 2). Model 3 demonstrated a notable increase in explained variance compared to the previous model specifications (*Model 3:* adjusted $R^2=0.36$). "On average, a smaller decrease in VAS was observed for any problems in usual activities (Model 4: mean difference = 5.9, 95% CI 2.6–9.2) and Pain/Discomfort (Model 4: mean difference = 4.6, 95% CI 1.6–7.6) among respondents in 2017 compared to the observed decrease in VAS among respondents in 2002." GLM models utilizing a beta distribution produced only marginal differences from the OLS base-case analysis (not reported).

Discussion

Overall self-rated health was found to be higher among the adult general population in 2017 than 2002 after accounting for sociodemographic, health-related factors, and self-reported EQ-5D-3L health status. Sociodemographic factors did not explain self-rated health in the general population (Model 1). After removing the effect of differences in health between the two populations, Model 2 showed no difference in health between healthy persons. Model 3 describes a significant difference in the residual effects of what people feel about their health after considering different levels of health, not just medical conditions. These results suggest the "average" adult American has slightly

Table 2 Full model results for self-rated health (VAS)

Parameter	Model 1			Model 2			Model 3		
	β	SE	*p*-value	β	SE	*p*-value	β	SE	*p*-value
Intercept	86.7	0.57	< 0.001	82.9	0.60	< 0.001	89.8	0.53	< 0.001
2017	0.74	0.54	0.17	0.86	0.53	0.10	2.22	0.44	< 0.001
Age (18–34)	Ref			Ref			Ref		
Age (35–54)	−3.71	0.47	< 0.001	−2.16	0.46	< 0.001	−0.38	0.39	0.33
Age (55+)	−9.19	0.63	< 0.001	−6.86	0.62	< 0.001	−2.81	0.51	< 0.001
Female gender	−0.70	0.45	0.12	−0.15	0.44	0.74	0.22	0.36	0.55
Greater than high school	3.35	0.46	< 0.001	3.21	0.45	< 0.001	1.21	0.37	< 0.001
White	Ref			Ref			Ref		
Black	−0.32	0.59	0.59	−0.48	0.57	0.40	0.09	0.47	0.85
Other	−0.46	0.87	0.60	−0.83	0.85	0.33	−0.38	0.68	0.57
Hispanic	1.95	0.87	0.024	1.29	0.85	0.13	0.69	0.69	0.31
No history of illness	–	–	–	7.54	0.41	< 0.001	2.53	0.37	< 0.001
MO, any problems	–	–	–	–	–	–	−6.01	0.75	< 0.001
SC, any problems	–	–	–	–	–	–	−9.96	1.51	< 0.001
UA, any problems	–	–	–	–	–	–	−9.13	0.85	< 0.001
PD, any problems	–	–	–	–	–	–	−5.01	0.46	< 0.001
AD, any problems	–	–	–	–	–	–	−5.38	0.50	< 0.001
R^2	0.063			0.11			0.39		
Adjusted R^2	0.062			0.11			0.39		
Root MSE	15.29			14.90			12.28		

SE standard error, *REF* reference category, *MO* mobility, *SC* self-care, *UA* usual activities, *PD* pain/discomfort, *AD* anxiety/depression, *MSE* mean squared error

better self-rated health now compared to 15 years ago. Further, a fourth model showed problems with usual activities and pain/discomfort were perceived less negatively when rating one's own health.

We found an absolute difference of 2.2 points in overall self-ratings of health in Model 3. While this difference appears small, our findings suggest that the VAS explains variations in HRQOL beyond the EQ-5D descriptive system. Similar observations were made in a recent Germany population study conducted by Huber and colleagues [16]. Although previous comparisons of population health often focused on life expectancy, the CDC's healthy day equivalence seems to be emerging as an indicator of self-reported health and HRQOL [17]. Our finding that self-rated health of the population slightly improved from 2002 to 2017 contrasts with the CDC study of 2000–2015 that reported a slightly smaller proportion of persons reported their general health as excellent/very good/good (decreasing from 9.2 to 9.0% as noted earlier) [8]. Although one may note that they are slightly different metrics, that there is some margin of error and the differences are very small, it is important to note that we found no difference in self-reported health before adjusting for differences in demographics and health problems, and 2.2 higher score associated with 2017 captures how people feel today after removing the variance across time points attributed to observed differences in select demographics, conditions, and health problems.

The comparability of study designs from which the two data sources were drawn was a strength, however, there is a possibility that there was a learning effect associated with the completion of the EQ-5D-3L in the 2017 study as respondents completed it after valuations tasks associated with the EQ-5D-5L. Second, due to limited shared covariates between data sources, the presence of unmeasured confounders is possible. For example, in the context of the US health care system, it is possible that individuals with higher socioeconomic status may view any health issues more positively. Second, there is a potential for endogeneity in fitting the EQ-5D-3L responses to the VAS, since it is unclear whether rating health problems influences the VAS or whether the global evaluation of health affects the reporting of problems. Third, the generalizability to the US general population extends only to those similar in age, ethnicity, race, and aspects of health as the samples. The self-rating of health today via the VAS may largely represent mental well-being, and one may speculate that a slight but real increase in self-rated health could be attributed to events and policies that positively affect well-being of a populace, such as health policy (e.g., introduction of the Patient Protection and Affordable Care Act in 2010 [18]), improvements in the US

economy [19], as well general views and attitudes on health and end-of-life care [20].

In summary, we found slight improvement in self-rated health by US in 2017 compared to 2002, after taking into account sociodemographic and health-related factors that typically explain self-rated health. This study is an initial examination into trends in self-rated health at a general population level and revealed that average self-rated health is relatively consistent over the past 15 years, but it provides limited insights into specific population subgroups and the complexity of factors that contribute to health perceptions, which is a rich area for future research using datasets such as these. The improvement in self-rated health in 2017 compared to 2002 is contrary to those observed by the CDC; however, both findings are associated with statistical error, suggesting further research is necessary to further elucidate changes in self-rated health over time at an aggregate, population level. While it is speculative to attribute any differences to a specific policy or policies and acknowledging the limitations of the generalizability of the datasets to the general population, it is encouraging to see that the average self-rating of health is similar or better than 2002 in the United States in 2017.

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Compliance with ethical standards

Disclosures EHL has stock or ownership and is an employee of Pfizer Inc. and is an employee of Pfizer Inc. JWS has stock or ownership and is an employee of Bristol-Myers Squibb. ASP has received consulting income from Bristol-Myers Squibb, Merck, Novartis, and Avexis. ASC has nothing to disclose.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The present study was a secondary data analysis and was determined by the UIC IRB approval not to involve human subjects.

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