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EQ-5D-5L population norms and health inequality for Trinidad and Tobago in 2022– 2023 and comparison with 2012

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Abstract

Background The use of EQ-5D instruments in clinical, policy and economic applications continues to grow internationally. Population norms studies provide baseline values against which demographic and patient groups are compared and inequality is assessed. This study presents updated EQ-5D-5L population norms for 2022–2023, evaluates inequality and compares the results with those of 2012.

Methods Demographic and EQ-5D-5L data were obtained from mutually exclusive, representative samples of adults in three studies conducted from July 2022 through May 2023. EQ-5D-5L index values, EQ VAS scores, and ceilings (all dimensions at level 1) were calculated for age-sex groups and stratifiers including education, income, ethnicity, marital status, and employment status. For inequality, the Kakwani index was calculated for the EQ VAS scores and index values, and ordered logit models were used to obtain odds ratios for reporting higher levels of problems on each dimension for demographic groups. The results were compared with those from 2012 which included applying the value set that had been used for the 2022–2023 population norms to the 2012 states.

Results Data were obtained form 2,989 respondents. The mean index value was 0.921, EQ VAS was 79.6 and the ceiling was 31.5%. The dimensions with the highest rates of reported problems at any level (2–5) were pain/discomfort (43%) and anxiety/depression (39%). The Kakwani index was 0.113 for EQ VAS and 0.058 for index values, with sex accounting for the largest relative contribution. Mean index values, EQ VAS scores, and ceilings were lower across all demographic groups in 2022–2023 compared to 2012.

Conclusions This is the first study to investigate how EQ-5D-5L population norms have changed within a country over time. Significant changes were observed in the EQ-5D-5L measures and the relative frequencies of reported problems on the dimensions. Inequality increased, and there were changes in the levels of reported problems on the dimensions for demographic groups. Such changes suggest that national population norms should be updated periodically to capture changes in health status, perceptions of health, and health inequality.

Keywords EQ-5D-5L, Trinidad and Tobago, Inequality, Population norms

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Introduction

Health related quality of life (HRQoL) is playing an increasingly important role in clinical research and practice, health technology assessment (HTA) and health policy [1, 2]. EQ-5D is the most commonly used generic HRQoL instrument that is accompanied by preference-based value sets and is recommended as a health outcomes measure in the HTA guidelines of many countries [3, 4].

Population norms studies for EQ-5D instruments are used to provide baseline values for population health and to quantify health inequalities using EQ-5D measures [5]. In 2012, a population norms study was conducted for Trinidad and Tobago using the EQ-5D-5L instrument with a representative sample (age, sex, region) of 2,036 respondents [6]. These values provided the comparators for several studies that used EQ-5D-5L in Trinidad and Tobago [7–9] along with baseline values that were used in conjunction with EQ-5D-5L data from other Caribbean countries to evaluate health inequality and to develop a set of Caribbean region population norms [10, 11].

Over time changes in lifestyle, diet, health services, demographics and other factors may lead to changes in population health status [12]. In 2022–2023 a second EQ-5D-5L population norms study was conducted for Trinidad and Tobago. The purpose of this study was to update the population norms for Trinidad and Tobago and to examine how health status and health inequality had changed over the 10-year period 2012 to 2022–2023.

Methods

The instrument

The EQ-5D-5L's descriptive system comprises 5 dimensions in the following order: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression [13]. Each respondent selects one of five levels of problems that they are experiencing for each dimension. The levels are: no problems (level 1), mild-, moderate-, severe- or extreme problems/unable to (level 5). Each respondent will then have an EQ-5D-5L state which takes the form of the 5 levels in the order of the dimensions. A respondent who reports no problems walking about, mild problems with self-care, unable to do usual activities, severe pain/discomfort and moderate anxiety/depression would be in EQ-5D-5L state 12543. With 5 dimensions and 5 levels, there are $5^5 = 3,125$ possible health states. The original EQ-5D instrument (EQ-5D-3 L) had 3 levels: it excluded levels 2 and 4 and had the highest level for mobility as 'confined to bed' which was changed to 'unable to walk about' for the 5L [14]. EQ-5D-5L valuation studies have been conducted in many countries [15]. A valuation study produces a value for each EQ-5D-5L state that expresses the preference of citizens of a specific country, relative to all other EQ-5D-5L states. These preference values are known as EQ-5D-5L index values. Because the index values are based on the preferences of the general population, the index value for a respondent represents the societal value of the individual respondent's health state. The EQ-5D-5L instrument also includes a visual analogue scale (EQ VAS) in which a respondent indicates their subjective scoring of their state of health on a scale of 0 (worst health imaginable) to 100 (best health imaginable). The EQ-5D-5L instrument therefore provides three things: a state of health in 5 dimensions, an index value and an EQ VAS score.

An EQ-5D-5L value set was published for Trinidad and Tobago in 2024 [16]. When the 2012 population norms were published, EQ-5D-5L index values were not available for Trinidad and Tobago, so EQ-5D-5L values were developed by applying a crosswalk algorithm [17] to the existing Trinidad and Tobago EQ-5D-3L values [18]. The crosswalk values ranged from −0.163 to 1.000 and the 2024 EQ-5D-5L index values ranged from −0.563 to 1.000.

Data collection

The 2022–2023 population norms data that are reported in this study were obtained from two studies that were conducted in Trinidad and Tobago in which self-reported health and demographic data for mutually exclusive, nationally representative samples (age, sex, region) were collected. This included EQ-5D-5L and EQ VAS data from each respondent.

Data for the Trinidad and Tobago EQ-5D-5L valuation study [16] were collected from July to September 2022 by a survey company that provided 11 trained interviewers who conducted face-to-face computer-assisted interviews (survey 1 of the 2022–2023 population norms). The target was a representative sample (age, sex, region) of 1,000 people aged 18 and over. The most recent census data was the 2011 Population and Housing Census of the Central Statistical Office (CSO) of Trinidad and Tobago. Streets were randomly selected from CSO maps and 1 in every 4 houses visited. Respondents were selected based on the most recent birthday method. Each respondent chose a gift valued at TT$60 (approximately US$9) for participating in the valuation study.

The second study was the Discrete Choice Experiment (DCE) with Duration study [19] (survey 2 of the population norms study). Data were collected in November 2022 to February 2023. Respondents belonging to a survey company's panel were given links to an on-line survey in which they performed a series of DCE tasks and provided their demographic and EQ-5D-5L data. Because of the initial slow uptake, recruiters were sent out to public places to have respondents complete the tasks on laptop computers and tablets. Quality issues relating to the length of time that respondent spent on the DCE

tasks resulted in the data from 611 respondents eventually being excluded (further details are discussed elsewhere [19]). The data from these respondents were also removed from the population norms data set.

A target of 3000 respondents was set for the population norms study. Internationally, most EQ-5D-5L population norms studies have been based on smaller samples [5], however this target was set as it would allow at least 300 respondents in each age group. In an effort to reach a target of 3,000 respondents, another survey was undertaken on-line from March to August 2023 (survey 3 of the population norms study). In this on-line survey, only EQ-5D-5L and demographic data were collected from members of a survey company's panel who were recruited by sending survey links via e-mail. Data for 940 respondents were collected. Respondents in surveys 2 and 3 received a gift valued at TT\$20 (approximately US\$3). All three surveys were conducted by the same survey provider.

The data that were used for the population norms were collected using the self-complete computer/tablet-based EQ-5D-5L English-language questionnaire that had been linguistically adapted and validated for Trinidad and Tobago. Several categorical demographic variables were included. Age was collected in groups: 18–24, 25–34, 35–44, 45–54, 55–64, and 65+. Sex was grouped into male and female. Marital status was recorded as single, married/cohabiting, separated/divorced. Ethnicity was grouped into afro-, indo-, and mixed/other. Geography was captured using the 15 administrative regions of the country. Monthly income bands were TT\$2,500 or less, \$2,501-5,000, \$5,001–12,000, \$12,001–20,000 and over \$20,000. Education was grouped into incomplete secondary or less, complete secondary, vocational, and university. Employment status was added in survey 3. This was grouped into employed, choose not to work, retired, on disability, student, and unemployed. A binary question was also included for whether the respondent was covered under private health insurance. Another binary question was included for whether an employed person was self-employed or worked for others.

Analysis

The demographic compositions of the three surveys making up the sample were checked for consistency. Demographics of the whole sample were then compared with CSO data to check for representativeness. Mean EQ-5D-5L index values, EQ VAS scores, and ceilings (the proportion of respondents reporting EQ-5D-5L state 11111) were calculated for each demographic group. For the binary variables (health insurance and sex) t-tests were used to check for statistical significance of differences between means. For the other demographics, ANOVA was used to test for the significance of differences between means. Because the variables all failed

Bartlett's test of equality of variances, Welch's t-test and ANOVA were used. A p-value of less than 0.05 was considered to be significant. The most commonly observed states were recorded along with their index values, EQ VAS scores, and frequencies. Index values, EQ VAS scores and ceilings were calculated for age-sex subgroups along with 95% confidence intervals. For each dimension, the percentage of respondents in each age-sex sub-group reporting each level was calculated.

The EQ-5D measures were compared with the 2012 population norms for all of the demographic sub goups that were common to the 2012 and 2022–2023 studies. The 2012 population norms study was conducted using crosswalk values, hence for comparison the EQ-5D-5L states from 2012 were also valued using the index values from the 2022–2023 Trinidad and Tobago valuation study [16]. The differeces between mean index values in 2012 versus 2022–2023 for each demographic group were tested for significance using t-tests.

Index values, EQ VAS scores and ceilings by various demographic variables including income, education, employment status can be used as indicators of health inequality. Aside from the EQ-5D-5L measures recorded by demographic groups, two approaches were taken to assess inequality. Multivariable ordered logit models were used to obtain odds ratios for reporting higher levels of problems (levels 3 through 5) on the five dimensions associated with demographic variables. The explanatory variables were also dichotomized into being in the reference group or not being in the reference group. This approach was necessary in order to allow comparison with the findings from 2012. The Kakwani inequality index [20] was calculated for the 2022–2023 index values and EQ VAS scores. The Kakwani index provides a measure of inequality in health that can be used to estimate how far the distribution of health deviates from equal distribution- similar to the Gini coefficient for wealth [21]. The Kakwani index ranges from 0 (equality) to 1 (extreme inequality). It is also possible for the Kakwani index to take negative values (discussed elsewhwere [22]). The general formula is:

$$C = \frac{2}{N\mu} \sum {}_{i=1}^{n} h_i R_i - 1 - \frac{1}{N}$$

where h is the EQ-5D variable (EQ VAS score or index value), μ is its mean, R_i is the relative fractional rank of the ith individual based on h and N is the number of observations [22]. In order to maintain comparability with the 2012 data, we used the same modified Kakwani index that was used in the 2012 study:

$$C = \frac{2}{\mu} cov(h, R)$$

in which the covariance is obtained from this ordinary least squares regression model (displayed for EQ VAS):

$$\frac{2\sigma_R^2}{\overline{EQ\,VAS}}EQ\,VAS_i = \alpha_i + \gamma_k R_i + \epsilon_i$$

Here $\overline{EQ\,VAS}$ is the mean EQ VAS score, R_i is the relative fractional rank of the ith individual based on their EQ VAS score, σ_R^2 is the variance of the EQ VAS scores γ_k is the Kakwani index (with k explanatory variables which can be decomposed to provide the shares of overall inequality associated with different demographic groups). Full details of this regression model are discussed elsewhere [20]. The Kakwani index and decompositions for EQ-5D-5L index values were also calculated using the same model.

Results

The sample

The combined sample comprised 2,989 respondents (49.5% male). The response rate for the first survey (face to face) was 34%. Response rates are not available for the other two surveys. The data collection tools ensured that all EQ-5D-5L and EQ VAS data were completely collected for all respondents so that there were no incomplete responses. Table 1 shows the distribution of respondents across the three surveys by age, sex and region). There were some minor differences, e.g. 4% more females in survey 1 and 5% more males in survey 3. The Couva and Chaguanas regions were overrepresented and underrepresented respectively in survey 1.

The combined sample was representative in terms of age, sex, and region. The largest differences between the sample and the geographic distribution of population were an over-representation of 3-4% in Arima, Port-of-Spain, and Diego Martin and an under-representation of 2-3% in Couva, Penal and Siparia.

EQ-5D measures and demographics

The mean EQ-5D-5L index value was 0.921, EQ VAS was 79.6 and the ceiling was 31.5%. Higher EQ-5D-5L index values, EQ VAS scores and ceilings all indicate higher levels of health. Table 2 presents EQ-5D-5L measures for age and sex subgroups. These reflect a general pattern of higher levels of health for younger respondents and for males in every age group. Exceptions to the age-group patterns were females in the 25–34 age group for index values and males in the 35–44 and 55–64 age groups for index values and EQ VAS scores. Ceilings for the two oldest age groups (both sexes) and females in the 35–44 age group were also exceptions.

Table 3 presents the EQ-5D-5L measures by 6 stratifiers. Of the three marital status groups, single respondents reported the highest levels of health, and separated/divorced respondents reported the lowest.

Respondents who had private health insurance also reported better health than those who did not. Generally, higher income and education were associated with more favourable EQ-5D measures except for the highest income level (index values), the three highest income levels (ceilings), and secondary versus vocational education. Ceilings declined as education level increased, but the differences were small between incomplete- versus complete secondary education.

Afro-ethnicity respondents reported higher levels of health than indo- and mixed ethnicity respondents. This difference was significant at the 5% level for EQ-5D-5L index values but not for EQ VAS scores.

Employed respondents reported more favourable EQ-5D responses than unemployed respondents, and similar responses to those who 'choose not to work'

Table 1 Sample characteristics across the three surveys

	Survey 1	Survey 2	Survey 3	Total Sample	Popu-lation*
N	1079	970	940	2989	*N/A*
Age Group					
18–24	15.1%	16.1%	14.9%	15.4%	15.6%
25–34	21.7%	23.7%	24.0%	23.1%	23.0%
35–44	20.4%	18.7%	14.4%	17.9%	17.9%
45–54	14.5%	19.3%	22.7%	18.6%	18.4%
55–64	16.2%	13.0%	10.7%	13.5%	13.2%
65+	12.1%	9.3%	13.3%	11.6%	11.8%
Sex					
Female	54.7%	50.1%	46.2%	50.5%	49.8%
Male	45.3%	49.9%	53.8%	49.5%	50.2%
Region					
Arima	1.6%	6.7%	8.2%	5.3%	2.7%
Chaguanas	3.2%	8.6%	13.0%	8.0%	6.5%
Couva / Tabaquite / Talparo	16.6%	6.5%	8.0%	10.6%	12.6%
Diego Martin	8.4%	13.7%	10.8%	10.9%	8.2%
Mayaro / Rio Claro	2.9%	0.7%	1.1%	1.6%	2.6%
Penal / Debe	4.2%	2.7%	3.6%	3.5%	6.5%
Pt Fortin	1.7%	1.3%	1.3%	1.4%	1.8%
Port of Spain	3.9%	8.7%	8.0%	6.7%	3.8%
Princes Town	7.5%	5.2%	5.5%	6.1%	7.1%
San Fernando	5.4%	6.4%	7.2%	6.3%	4.4%
San Juan / Laventille	13.7%	13.0%	12.9%	13.2%	12.2%
Sangre Grande	5.4%	3.4%	3.9%	4.3%	5.0%
Siparia	6.8%	2.2%	2.6%	4.0%	6.3%
Tobago	5.8%	3.6%	1.2%	3.7%	4.8%
Tunapuna / Piarco	13.2%	17.3%	13.0%	14.4%	15.8%

*Based on the 2011 Population and Housing Census of the Central Statistical Office (CSO) of Trinidad and Tobago

Table 2 EQ-5D population norms for Trinidad and Tobago, 2022–2023: age-sex sub groups (*N* = 1510 female and 1479 male)

	Males			Females			Both Sexes		
	Mean or %	St. error	95% C.I.	Mean or %	St. error	95% C.I.	Mean or %	St. error	95% C.I.
EQ-5D-5L Index Values									
18–24	0.952	0.006	0.940–0.963	0.923	0.007	0.908–0.937	0.937	0.005	0.928–0.946
25–34	0.944	0.005	0.934–0.953	0.924	0.005	0.914–0.935	0.934	0.004	0.927–0.941
35–44	0.949	0.005	0.940–0.958	0.922	0.008	0.907–0.937	0.935	0.005	0.926–0.944
45–54	0.923	0.009	0.905–0.942	0.897	0.009	0.879–0.915	0.910	0.007	0.897–0.923
55–64	0.926	0.010	0.906–0.945	0.891	0.011	0.870–0.912	0.908	0.007	0.894–0.923
65+	0.885	0.015	0.856–0.915	0.882	0.013	0.856–0.908	0.883	0.010	0.864–0.903
Total	0.933	0.003	0.927–0.940	0.909	0.004	0.902–0.916	0.921	0.002	0.916–0.926
EQ VAS Scores									
18–24	83.3	0.995	81.4–85.3	80.1	1.112	77.9–82.2	81.7	0.749	80.2–83.2
25–34	82.5	0.751	81.0–83.9	79.0	0.888	77.3–80.8	80.8	0.583	79.6–81.9
35–44	82.7	0.869	81.0–84.4	76.6	1.112	74.4–78.8	79.6	0.718	78.2–81.1
45–54	79.6	0.981	77.7–81.6	76.1	1.073	74.0–78.2	77.9	0.730	76.4–79.3
55–64	81.7	1.061	79.6–83.8	78.7	1.314	76.1–81.2	80.2	0.848	78.5–81.8
65+	77.9	1.330	75.3–80.5	75.6	1.548	72.5–78.6	76.6	1.039	74.6–78.6
Total	81.5	0.394	80.7–82.3	77.7	0.466	76.8–78.6	79.6	0.308	79.0–80.2
Ceilings (Percentages)									
18–24	45.6	3.306	39.2–52.1	29.0	2.992	23.5–35.2	45.6	3.306	39.2–52.1
25–34	38.3	2.602	33.3–43.5	22.9	2.284	18.8–27.7	38.3	2.602	33.3–43.5
35–44	35.3	2.936	29.8–41.3	27.8	2.731	22.7–33.4	35.3	2.936	29.8–41.3
45–54	34.2	2.850	28.8–40.0	21.2	2.457	16.8–26.4	34.2	2.850	28.8–40.0
55–64	37.5	3.432	31.0–44.4	27.7	3.157	22.0–34.3	37.5	3.432	31.0–44.4
65+	35.7	3.835	28.5–43.5	26.5	3.217	20.6–33.2	35.7	3.835	28.5–43.5
Total	37.7	1.261	35.3–40.2	25.4	1.112	23.3–27.8	31.5	0.850	29.9–33.2

C.I.= Confidence Interval

(except for ceilings). Students had the most favourable responses and those on disability (two respondents) had the least favourable responses followed by retirees.

In addition to Table 3, health status by employment type was also investigated. Self-employed respondents had higher mean index values, EQ VAS scores and higher ceilings than those who work for others (0.948 vs. 0.928, 78.7 vs. 76.1, 37.0% vs. 27.0% respectively) and these differences were significant at the 5% level for index values and EQ VAS scores (*p* = 0.001 and 0.030 respectively).

Dimensions and states
Table 4 shows the 10 states making up 75% of the sample. The most commonly reported states beyond full health were ones with mild-to-moderate problems on anxiety/depression and pain/discomfort.

Table 5 presents the percentage of respondents reporting each level for each dimension. The dimension with the highest rate of reported problems was pain/discomfort followed by anxiety/depression and mobility. Females generally reported higher rates of problems than males except for two age groups in self-care and one age group in usual activities where rates of reporting were equal. As expected, rates of reported problems generally increased with age group with the most substantial change occurring between the two oldest age groups.

Inequality
The Kakwani index was 0.113 for EQ VAS scores of which 2.3% was associated with demographics with relative shares of: 50.7% for sex, 27.9% for income, 21.4% for age. For index values the Kakwani index was 0.058 of which 4.9% was associated with demographics with relative shares of 41.9% for sex, 30.9% for age, 26.0% for income and less than 1% for education.

In Table 6, the results of the logit analysis show the odds ratios associated with reporting levels 3 or higher for being in the female, lowest education, lowest income and highest age group respectively. Generally, being in the most 'disadvantaged group' was associated with higher odds of reporting level 3 or higher on all 5 dimensions except anxiety/depression and age or education level.

Comparison of 2022–2023 to 2012
Table 7 shows a comparison of the 2022–2023 versus 2012 population norms, using 2022–2023 index values for both periods, wherever identical demographic groups were used in both studies.

In all of the demographic groups of Table 7, mean index values were lower in 2022–2023 than in 2012. This difference was significant at the 5% level for all groups except 65+, retirees and the lowest education group. Table 8

Table 3 Sample and population characteristics and EQ-5D population norms for Trinidad and Tobago, 2022–2023

	Sample		Population	EQ-5D-5L Index Values			EQ VAS Scores			Ceiling %
	N	**%**	**%**	**Mean**	**S.E.**	**p Val**	**Mean**	**S.E.**	**p Val**	
All Respondents	2989	100.0%	N/A	0.921	0.002		79.6	0.308		31.5
Marital Status*						< 0.001			0.027	
Single	1424	48.1%	54.2%	0.932	0.003		80.2	0.454		35.1
Married or cohabiting	1198	40.5%	41.2%	0.917	0.004		79.6	0.468		30.1
Separated or divorced	306	10.3%	4.7%	0.896	0.008		77.4	0.990		22.5
Health Insurance						< 0.001			0.003	
Yes	1016	36.2%	N/A	0.938	0.003		80.7	0.474		32.6
No	1791	63.8%	N/A	0.912	0.003		78.9	0.419		31.4
Ethnicity						< 0.001			0.540	
Afro	1152	38.5%	37.1%	0.931	0.003		79.9	0.487		33.5
Indo	900	30.1%	40.0%	0.909	0.005		79.7	0.570		30.2
Mixed / Other	937	31.4%	22.9%	0.920	0.004		79.1	0.552		30.4
Income (TT$ per month)						< 0.001			< 0.001	
$2500 or less	246	11.9%	N/A	0.867	0.013		75.0	1.374		28.9
$2,501-$5,000	586	28.4%	N/A	0.910	0.006		77.7	0.797		29.9
$5,001-$12,000	719	34.8%	N/A	0.925	0.004		79.6	0.576		27.4
$12,001-$20,000	319	15.4%	N/A	0.942	0.004		81.0	0.774		30.4
over $20,000	196	9.5%	N/A	0.930	0.007		81.1	1.089		32.1
Education						< 0.001			0.049	
Incomplete secondary or less	387	13.0%	28.8%	0.887	0.009		78.2	1.034		33.3
Complete secondary	1216	40.7%	51.5%	0.926	0.003		79.9	0.475		33.1
Vocational	399	13.4%	8.2%	0.915	0.008		78.1	0.836		28.6
University	987	33.0%	11.5%	0.930	0.003		80.4	0.495		30.2
Employment Status**						0.031			< 0.001	
Employed	588	62.6%	50.1%	0.932	0.004		76.5	0.733		28.7
Choose not to work	48	5.1%	45.0% ***	0.923	0.011		78.1	2.472		12.5
Retired	143	15.2%		0.886	0.016		73.0	1.691		25.9
Disability	2	0.2%		0.509	0.227		55.0	N/A		0.0
Student	44	4.6%		0.941	0.013		81.6	2.097		36.4
Unemployed	115	12.2%	4.9%	0.862	0.019		69.7	2.234		20.9

* The census includes a category for widowed which the survey did not include. Widows/widowers were counted as 'Single' in the survey. The population figure in the table is 48.9% (never married) + 4.7% (widowed) = 54.2%

** Employment data are based on the sample of 940 respondents in survey 3 since employment data were not collected in the first two surveys. Population employment status was taken from the 2022 Annual Economic Survey of the Central Bank of Trinidad and Tobago

***The Labour market figures are based on the reported Labour force participation rate of 55% and the unemployment rate of 4.9%

Table 4 Most common health states (*N* = 2989)

State	Frequency	Cumulative %	Index value	EQ VAS score
11111	943	31.6%	1.000	88.7
11121	344	43.1%	0.956	82.8
11112	322	53.8%	0.980	83.3
11122	262	62.6%	0.936	78.3
11123	94	65.7%	0.882	73.7
11113	73	68.2%	0.926	80.1
11222	69	70.5%	0.925	67.6
21121	56	72.4%	0.929	75.2
21221	49	74.0%	0.918	76.7
11221	48	75.6%	0.945	73.6

shows the mean EQ VAS and ceilings for 2022–2023 and 2012. EQ VAS scores and ceilings for demographic groups in 2012 have been presented elsewhere [6].

Discussion

Population norms

The mean index value and EQ VAS score recorded in the 2022–2023 population norms for Trinidad and Tobago of 0.921 and 79.6 were lower than the index value of 0.965 in Table 7 and EQ VAS score of 83.6 recorded in the 2012 survey. Based on the results of a systematic review of 35 EQ-5D-5L population norms studies [5], Trinidad and Tobago would now rank 7th (for index values) and 15th (for EQ VAS). The ceiling for Trinidad and Tobago fell from 71.6% in 2012 to 31.5% in 2022–2023 putting Trinidad and Tobago in 22nd place. Comparing the distribution of levels among the dimensions in Table 5 with

Table 5 Percentages of respondents reporting problems for each dimension

	18–24		25–34		35–44		45–54		55–64		65+		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
N	228	231	350	340	266	270	278	278	200	202	157	189	1479	1510	2989
Mobility															
1	91	93	93	87	89	85	82	72	74	69	66	57	84	78	81
2	7	7	5	12	9	12	15	20	21	22	23	29	12	16	14
3	0	0	2	1	2	2	0	5	3	7	5	6	2	3	3
4	2	0	0	0	0	1	2	3	3	1	5	5	2	2	2
5	0	0	0	0	0	0	1	0	0	1	1	2	0	0	0
Self-Care															
1	98	98	98	98	96	97	96	96	95	89	91	89	96	95	96
2	1	1	2	2	4	2	3	4	3	8	5	6	3	3	3
3	0	0	0	0	0	0	0	0	1	2	2	2	0	1	1
4	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0
5	0	0	0	0	0	0	1	0	1	0	1	2	0	0	0
Usual Activities															
1	86	83	86	77	85	82	84	74	77	69	71	64	82	75	79
2	11	13	13	21	14	15	13	21	18	23	21	28	14	20	17
3	2	3	1	2	2	1	1	4	3	5	4	4	2	3	3
4	1	1	0	0	0	1	1	1	2	2	2	2	1	1	1
5	0	0	0	0	0	1	0	0	1	0	3	2	0	0	0
Pain / Discomfort															
1	71	57	61	49	56	46	51	32	50	35	45	39	57	43	50
2	24	38	33	43	37	47	41	53	42	46	36	42	36	45	40
3	4	3	4	6	6	5	3	8	4	14	10	13	5	8	6
4	1	2	2	2	1	2	4	5	4	5	8	5	3	3	3
5	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0
Anxiety / Depression															
1	59	37	54	37	55	49	61	52	73	59	72	72	61	49	55
2	27	33	31	39	34	32	27	31	20	26	20	17	28	31	29
3	11	21	9	18	9	13	9	14	7	12	7	10	9	15	12
4	4	4	2	3	1	3	1	2	1	2	1	2	2	3	2
5	0	5	3	3	0	2	2	1	1	1	1	0	1	2	2

the data from 2012 [6], the overall rates of reporting problems increased by: 35% for anxiety/depression, 28% for pain/discomfort, 14% for usual activities, 8% and 2% for mobility and self-care respectively. These increases were generally equally distributed between the sexes and mainly affected level 2. There were also increases in the percentages of respondents reporting problems on multiple dimensions. For example, the percentage of respondents reporting problems on 2 dimensions increased from 8% to 32%. The rates of reporting problems on 3 or more dimensions increased from 7% to 20%. Investigation of this disparity in the ranking of Trinidad and Tobago for index values versus ceilings revealed two main causes. Trinidad and Tobago ranked very low on ceiling for anxiety/depression (30th), mobility (16th) usual activities (17th) and pain/discomfort (18th) but higher (10th) on self-care. A review of 25 EQ-5D-5L value sets [15] revealed that the Trinidad and Tobago coefficients for level 2 on the 5 dimensions are relatively low compared to other countries. Thus, for state 22222 Trinidad and Tobago has the second highest value compare with the 25 countries in the review of value sets, but this does not extend to states 33333, 44444 and 55555 where Trinidad and Tobago would rank 11th, 8th and 13th respectively. The relatively low level 2 coefficients and high level 2 reporting rates (especially for anxiety/depression) would explain the disparity of the relatively high mean index value and relatively low ceiling when compared to other countries.

The declines in index values, EQ VAS scores and ceilings over 2012 to 2022–2023 were consistent across age, sex, insurance status, ethnicity, income, education and employment status. The pattern of EQ-5D-5L measures rising with income group, but with the highest income group being lower than the second highest was observed in 2012 and repeated in 2022–2023. Employed respondents reported better health status than unemployed respondents, however the 2012 finding of EQ VAS scores being higher for the unemployed group was not repeated in 2022–2023. The findings of higher health status among

Table 6 Odds ratios for different demographic groups reporting problems at levels 3 to 5 on each EQ-5D dimension (*N*=2989)

		Sex	Education Level	Income Group	Age Group
Mobility	O.R.	1.48*	2.92**	1.62	2.86**
	95% C.I.	1.04–2.11	1.96–4.36	0.96–2.72	1.90–4.30
Self-Care	O.R.	1.42	2.32*	2.61*	4.87**
	95% C.I.	0.71–2.82	1.09–4.93	1.08–6.27	2.35–10.08
Usual Activities	O.R.	1.43	2.14**	2.13**	2.00**
	95% C.I.	0.99–2.08	1.37–3.34	1.28–3.55	1.26–3.18
Pain / Discomfort	O.R.	1.51**	1.58**	1.93**	2.26**
	95% C.I.	1.18–1.94	1.14–2.18	1.33–2.79	1.65–3.11
Anxiety / Depression	O.R.	1.90**	0.96	1.59**	0.54*
	95% C.I.	1.55–2.33	0.70–1.32	1.15–2.21	0.38–0.78

O.R.= Odds Ratio

C.I.= Confidence Interval

*= $p < 0.05$

**=$p < 0.01$

self-employed persons than among those who work for others is consistent with findings in other research using EQ-5D-5L in the Caribbean region [23].

The 10 most commonly observed states in 2022–2023 (Table 4) were remarkably similar to those for 2012. There were two changes in the composition of this list: states 11131 and 31131 (in 2012) were replaced by 11123 and 11221. In both studies states with mild-to-moderate problems in pain/discomfort and anxiety/depression made up the majority of the top 10. The top 10 states made up 90% of the sample of 2,036 in 2012 and 75% of the sample of 2,989 in 2022–2023.

Inequality

The Kakwani index for EQ VAS scores moved from 0.103 in 2012 to 0.113 in 2022–2023 indicating an increase in inequality. The relative shares for sex and income increased while the relative share for age fell over the 10-year period. The Kakwani index was not calculated for index values in the 2012 study. The odds ratios in Table 6 reflect some changes compared to what was observed in 2012. Income group and age were found to be associated with reporting higher levels of problems on self-care which were not observed in 2012. The odds ratio for age group on anxiety/depression moved from 1.8 to 0.54. This finding of older respondents reporting better EQ-5D-5L anxiety/depression outcomes than younger respondents has been observed elsewhere [24–26]. The odds of reporting higher levels of problems with anxiety/depression associated with income also changed direction, moving from 0.02 in 2012 to 1.59 in 2022–2023. Being younger and having lower income were in

2022–2023 associated with increased odds of reporting problems with this dimension. The odds ratio for higher levels of education on reporting higher levels of problems with self-care fell from 11.9 to 2.3. The association between the odds of reporting higher levels of problems on mobility and age and income declined. Higher income was found to increase the odds of reporting higher levels of problems with self-care, usual activities and pain/discomfort (*p*<0.05, which was not observed in 2012).

The covid pandemic and the 2022–2023 data collection

Data collection for this study ran from July 2022 until May 2023, by which time the country had recovered from the covid-19 pandemic. From a peak of 27 deaths per day and 730 cases on December 21st 2021 [27], this fell to 2 deaths per day and 112 cases nationally by July 2nd, 2022 when data collection began. By July 2022 the complete lockdown with stringent covid restrictions on businesses and schools, and the parallel (covid) health system had all ended. The mask mandate was lifted in July 2022.

Results from the 2022–2023 EQ-5D-5L valuation study suggests that there were some changes in the way that citizens of Trinidad and Tobago view their health status over the period between the EQ-5D-3 L and EQ-5D-5L valuation studies (2015 versus 2022–2023). This has been inferred from changes in the relative importance of the dimensions as expressed in the valuation coefficients, which have been discussed elsewhere [16]. For example, greater awareness of mental health (e.g. through public awareness initiatives) and the salience of the direct experience with the covid 'lockdown' may have influenced the anxiety/depression and usual activities coefficients in the valuation study. Issues such as these might also have changed the ways that people think about the EQ-5D dimensions and their 'willingness' to self-report certain types of problems, contributing to the fall in ceiling effect.

Internationally, findings concerning the effect of stringency of covid restrictions on mental and physical health are mixed, with some studies showing a positive relationship between stringency of restrictions and health status in some groups [28, 29] others showing covid restrictions having an adverse effect on mental wellbeing [30, 31] and still others suggesting possible positive effects of stringency on mental health [32, 33]. Data collection for this study began after the covid restrictions had been lifted. In some other countries, EQ-5D-5L population norms studies were actually conducted during 2020 [5, 24, 34].

This is the first study to investigate changes in EQ-5D-5L population norms and EQ-5D-5L health inequality over a 10-year period. The study had some limitations. The population norms are based on data from three surveys that used a combination of on-line and face to face computer-assisted interviews. Two of the surveys were

Table 7 Mean index values for demographic groups for 2022–2023 versus 2012 using the 2022–2023 value set

	2022–2023			2012			*p* Value
	N	Mean	S.E.	*N*	Mean	S.E.	
Overall		0.921	0.002		0.965	0.002	< 0.001
Age Group							
18–24	459	0.937	0.005	320	0.988	0.003	< 0.001
25–34	690	0.934	0.004	466	0.987	0.002	< 0.001
35–44	536	0.935	0.005	364	0.978	0.003	< 0.001
45–54	556	0.910	0.007	369	0.957	0.006	< 0.001
55–64	402	0.908	0.007	266	0.946	0.006	< 0.001
65+	346	0.883	0.010	248	0.908	0.009	0.068
Sex							
Male	1479	0.933	0.003	1002	0.974	0.002	< 0.001
Female	1510	0.909	0.004	1034	0.955	0.003	< 0.001
Health Insurance							
Yes	1016	0.938	0.003	458	0.981	0.003	< 0.001
No	1791	0.912	0.003	1556	0.959	0.003	< 0.001
Ethnicity							
Afro	1152	0.931	0.003	921	0.973	0.002	< 0.001
Indo	900	0.909	0.005	850	0.953	0.004	< 0.001
Mixed / Other	937	0.920	0.004	262	0.970	0.005	< 0.001
Income (TT$ per month)							
over $20,000	196	0.930	0.007	68	0.966	0.013	< 0.001
Education							
Incomplete secondary or less	387	0.887	0.009	625	0.898	0.018	0.586
Complete secondary	1216	0.926	0.003	1032	0.930	0.007	N/A
Vocational	399	0.915	0.008				N/A
University	987	0.930	0.003	376	0.972	0.005	< 0.001
Employment Status							
Employed	588	0.925	0.002	1273	0.978	0.005	< 0.001
Retired	143	0.886	0.016	308	0.904	0.009	0.335
Student	44	0.941	0.013	67	0.988	0.006	0.002
Unemployed	115	0.862	0.019	110	0.980	0.005	< 0.001

Table 8 Celings and mean EQ VAS scores in 2022–2023 versus 2012

	2022–2023	2012
N	2989	2036
EQ VAS Score	79.6	83.6
Ceiling %	31.5	71.6

based on a panel of a survey company and respondents received an inducement for participation. Efforts were made to avoid resampling (as the respondents came from the panel) but the first survey was not based on the panel, so some duplication may have been possible. The explanatory variables in Table 4 were dichotomized into reference group or not. This approach was necessary in order to maintain comparability with the 2012 findings. Age was collected as a categorical variable with the highest group being 65+to maintain comparability with the 2012 data. Future studies should disaggregate this into higher age groups. The inequality measures are limited to those in the EQ-5D-5L instrument.

Conclusion

EQ-5D has been recommended as a measure that can be easily included in ongoing national and regional surveys to track population health and health inequality over time [35]. This study has produced a set of updated EQ-5D-5L population norms for Trinidad and Tobago and found a decline in population health with an increase in health inequality over the 10-year period 2012 to 2022–2023. Such changes suggest that population norms studies should be undertaken periodically to capture changes in population health along with changes in the ways that people think about their states of health. Until such a time that a new EQ-5D-5L population norms study is undertaken for Trinidad and Tobago, the recommendation is that the values herein be used in clinical and economic applications for Trinidad and Tobago.

previous versions of the manuscript. All authors read and approved the final manuscript.

Data availability
The anonymised datasets generated during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval for this study was obtained from The University of The West Indies (Exemption letter CREC-SA.1468/03/2022 dated March 7th, 2022) and from the Ministry of Health of Trinidad and Tobago (Approval letter He:3/13/441 VolII dated April 8th, 2022).

Informed consent
was obtained from all individual participants included in the study.

Competing interests
Eleanor Pullenayegum and Fanni Rencz are on the Editorial Board of Health and Quality of Life Outcomes. All of the authors are members of the EuroQol Group. Bram Roudijk is employed by the EuroQol Research Foundation.

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