Population Health Metrics

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Quality-adjusted life expectancy norms for the Iranian population

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Abstract

Background Quality-Adjusted Life Expectancy (QALE) is a well-established approach for evaluating health expectancy, combining health-related quality of life (HRQoL) with life expectancy (LE) to produce a cohesive summary score. This study offers QALE estimates for the Iranian population, categorized by age group and sex.

Methods To establish QALE population norms, we integrated age- and sex-specific EQ-5D-3 L utility scores with the national life tables of the Iranian population, sourced from the World Health Organization. The utility scores were derived from data gathered through the EQ-5D questionnaire survey, collected from 27,704 participants during the eighth round of the nationwide Stepwise approach to surveillance (STEPS) conducted in 2021. EQ-5D health status was converted into utility scores using the existing value set provided through a face-to-face time trade-off method for the Iranian general population.

Results The utility score for men decreased from 0.95 in the 18–19 age group to 0.76 in the 85 + age group, while for women, it declined from 0.91 to 0.66 over the same age range. Although women have a higher life expectancy than men, the reverse is true for QALE. QALE at birth is 68.29 QALYs for men and 66.69 QALYs for women.

Conclusions This study presents Quality-Adjusted Life Expectancy (QALE) population norms for Iran. These norms can be used in economic assessments of health interventions and population health studies.

Keywords EQ-5D, Population health, Health-related quality of life, Quality-adjusted life expectancy

Background

Life Expectancy (LE) and Health-Related Quality of Life (HRQoL) are commonly utilized as metrics for monitoring population health. A composite measure that encompasses both of these indicators, known as a summary measure of population health (SMPH) can provide a more comprehensive view of population health [1]. SMPH combines information on both fatal and nonfatal health outcomes, resulting in a single value that provides an overview of the overall health status of a particular population [2]. SMPHs can broadly be categorized into two main groups. The first group comprises indices related to life years, such as disability-adjusted life years (DALYs) and quality-adjusted life years (QALYs). The second group encompasses indices related to life expectancy, also known as healthy life expectancy (HLE), which includes disability-free life expectancy (DFLE), disease-free life expectancy, disability-adjusted life expectancy (DALE), health-adjusted life expectancy (HALE), and quality-adjusted life expectancy (QALE) [3]. SMPHs are used for various purposes, including tracking changes

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in population health over time, making comparisons of population health between different countries, examining health disparities within a population, and measuring the advantages of healthcare interventions in cost-effectiveness evaluations [2].

A well-established approach for evaluating health expectancy is QALE, which utilizes a continuous ratio scale variable to quantify morbidity. QALE is an advanced and comprehensive metric for assessing population health; it combines health-related quality of life with life expectancy to produce a cohesive summary score [4–6].

So far, numerous studies have been published on QALE or related topics within populations of other countries [2, 4, 7–13]. However, in Iran, previous research has primarily focused on investigating HRQoL for population norms and providing a value set for EQ-5D specific to the Iranian population [14–18]. In this study, we present estimates of the QALE for the Iranian population, categorized by age group and sex.

Methods

Study setting

Iran is a Middle Eastern country with a population of about 88 million people. It is classified by the World Bank as a lower-middle-income country [19].

Data and variables

To establish QALE population norms, HRQoL scores should be combined with life expectancy. Therefore, we integrated age- and sex-specific EQ-5D-3 L utility scores with the national life tables of the Iranian population. We used the most recent available national life tables from 2019, sourced from the World Health Organization [20]. The WHO annually generates life tables for all Member States, which offer a comprehensive overview of mortality in a given population. These life tables serve as a fundamental component in the WHO's calculations of worldwide, regional, and national trends in mortality related to all causes and specific causes [21].

The data regarding self-reported health status were obtained from the eighth round of the nationwide Stepwise approach to surveillance (STEPS) survey on noncommunicable diseases (NCDs) risk factors in Iran in 2021. The STEPS surveys are conducted nationally, utilizing trained interviewers who conduct face-to-face interviews with survey participants. In this survey, data were collected from individuals aged 18 and above residing in both urban and rural areas across the 31 provinces of Iran. A comparative analysis between the sample included in the 2021 STEPS survey and the distribution of age and sex in Iran's total population, as provided by the Statistical Center of Iran, revealed no statistically significant differences (P-value = 0.675). This suggests that the STEPS survey is representative of the general Iranian population [22]. HRQoL scores were calculated from the EQ-5D questionnaire data of 27,704 participants, with further details about this calculation provided in another article [23]. It is noteworthy that in transforming EQ-5D-3 L health status into utility scores, we employed the value set developed by Guderzi et al. [18]. This set was derived through a face-to-face time trade-off (TTO) method, which involved a representative sample of the Iranian general population.

Statistical analysis

Descriptive statistics were utilized to summarize the item responses for each EQ-5D-3 L dimension and the utility scores. The Sullivan method [24] was employed to compute QALEs by integrating mean utility scores with LE as follows:

$$QALE_{g,a} = \frac{\sum_{a}^{z}(LY_{g,a}.HRQoL_{g,a})}{L_{g,a}}$$

In the given formula, $LY_{g,a}$ represents the cumulative life years experienced within a specific sex and age group. $HRQoL_{g,a}$ signifies the mean health related quality of life within the same sex and age category. $L_{g,a}$ denotes the count of individuals surviving within the life table cohort corresponding to a particular sex and age group and z defines the maximum age group of the life table.

For the analysis, we made several assumptions. First, we assumed that HRQoL was constant within each age band. Second, the STEPS survey does not include EQ-5D data for individuals under the age of 18. Given the lack of information on HRQoL for children in Iran, we employed two scenarios to estimate HRQoL for individuals under the age of 18. In the first scenario, we followed the approach used in a study on the population of Engndla [10]. Similarly, we assumed that individuals under the age of 18 have the same HRQoL as those aged 18 to 19 years. In the second scenario, we assumed that the HRQoL for individuals under the age of 18 was equal to one. We acknowledge that this is a simplifying assumption and may not accurately reflect the true HRQoL of children in this age group. However, in the absence of data, we chose to assume perfect health for this age group. Consequently, for the first five age groups, we present two sets of QALE results, with the second set provided in the appendix.

The analyses were conducted using Stata version 14 and excel.

Results

A total of 27,714 participants were included in the study, with women comprising 55.2% of the sample. The distribution of responses within the EQ-5D-3 L dimensions indicates that pain/discomfort (31% in males and 44.3%

Table 1 Mean EQ-5D-3 L utility scores based on age group and sex for Iranian population

Age Group (years)	Female		Male	
	N	Mean (95% CI)	*N*	Mean (95% CI)
18–19	455	0.912 (0.901–0.923)	333	0.95 (0.940–0.960)
20–24	942	0.917 (0.910–0.924)	926	0.937 (0.930–0.944)
25–29	1,261	0.900 (0.893–0.907)	994	0.925 (0.918–0.932)
30–34	1,629	0.888 (0.882–0.894)	1,330	0.914 (0.907–0.921)
35–39	1,884	0.873 (0.867–0.879)	1,339	0.914 (0.908–0.920)
40–44	1,674	0.860 (0.853–0.867)	1,253	0.903 (0.896–0.910)
45–49	1,615	0.835 (0.828–0.842)	1,177	0.899 (0.892–0.906)
50–54	1,465	0.822 (0.814–0.830)	1,124	0.888 (0.880–0.896)
55–59	1,316	0.803 (0.795–0.811)	1,076	0.876 (0.868–0.884)
60–64	1,133	0.790 (0.780–0.800)	960	0.876 (0.867–0.885)
65–69	925	0.770 (0.759–0.781)	776	0.860 (0.849–0.871)
70–74	509	0.751 (0.735–0.767)	515	0.845 (0.831–0.859)
75–79	244	0.746 (0.722–0.770)	312	0.839 (0.819–0.859)
80–84	144	0.652 (0.613–0.691)	186	0.796 (0.770–0.822)
85 +	95	0.661 (0.593–0.729)	122	0.759 (0.709–0.809)
Total	15,291	0.842 (0.840–0.844)	12,423	0.895 (0.893–0.897)

Table 2 Life expectancy and quality adjusted life expectancy based on age and sex for Iranian population

Age Group (years)	Female			Male		
	LE[1] (years)	QALE[2] (95% CI)	Differences between LE and QALE	LE (years)	QALE (95% CI)	Differences between LE and QALE
0–1	79.09	66.69 (65.73–67.65)	12.4	75.69	68.29 (67.19–68.69)	7.40
1–4	78.95	66.50 (65.54–67.46)	12.45	75.61	68.17 (67.07–68.56)	7.44
5–9	75.1	62.98 (62.06–63.90)	12.12	71.76	64.50 (63.47–64.92)	7.26
10–14	70.23	58.52 (57.66–59.39)	11.71	66.87	59.85 (58.99–60.36)	7.02
15–19	65.33	54.05 (53.23–54.87)	11.28	62	55.22 (54.56–55.88)	6.78
20–24	60.47	49.61 (48.84–50.37)	10.86	57.32	50.75 (50.14–51.36)	6.57
25–29	55.62	45.14 (44.41–45.87)	10.48	52.7	46.40 (45.82–46.98)	6.3
30–34	50.76	40.76 (40.06–41.46)	10	48.03	42.07 (41.51–42.62)	5.96
35–39	45.91	36.44 (35.77–37.11)	9.47	43.35	37.78 (37.25–38.30)	5.57
40–44	41.08	32.20 (31.56–32.85)	8.88	38.69	33.50 (33.00-33.99)	5.19
45–49	36.29	28.06 (27.45–28.68)	8.23	34.08	29.32 (28.86–29.79)	4.76
50–54	31.56	24.10 (23.52–24.68)	7.46	29.57	25.25 (24.81–25.68)	4.32
55–59	26.94	20.28 (19.73–20.83)	6.66	25.25	21.39 (20.98–21.79)	3.86
60–64	22.48	16.67(16.15–17.19)	5.81	21.18	17.79 (17.41–18.17)	3.39
65–69	18.27	13.30 (12.81–13.79)	4.97	17.37	14.40 (14.04–14.77)	2.97
70–74	14.33	10.21 (9.75–10.68)	4.12	13.81	11.30 (10.96–11.63)	2.51
75–79	10.75	7.46 (7.02–7.90)	3.29	10.57	8.50 (8.19–8.81)	2.07
80–84	7.83	5.14 (4.73–5.55)	2.69	7.91	6.16 (5.87–6.45)	1.75
85 +	5.39	3.57 (3.20–3.93)	1.82	5.59	4.24 (3.97–4.52)	1.35

1. LE is life expectancy

2. QALE is quality adjusted life expectancy years

in females) and anxiety/depression (26.6% in males and 42.1% in females) are the most prevalent reported problems for both sexes. Anxiety and depression tend to peak during midlife, while issues in other dimensions typically increase with advancing age. This pattern is observed in both women and men, though the reported prevalence of these problems is generally higher in women across most age groups. (See Supplementary table S1 and S2)

In Table 1, mean EQ-5D-3 L utility scores by age group for males and females are presented as measures of HRQoL. The mean utility scores for females and males were 0.895 and 0.842, respectively. The utility score for men decreased from 0.95 in the 18–19 age group to 0.76 in the 85 + age group, while for women, the score declined from 0.91 to 0.66 across the same age range.

The age- and sex-specific LE and QALE are presented in Table 2. Despite women having a higher life expectancy

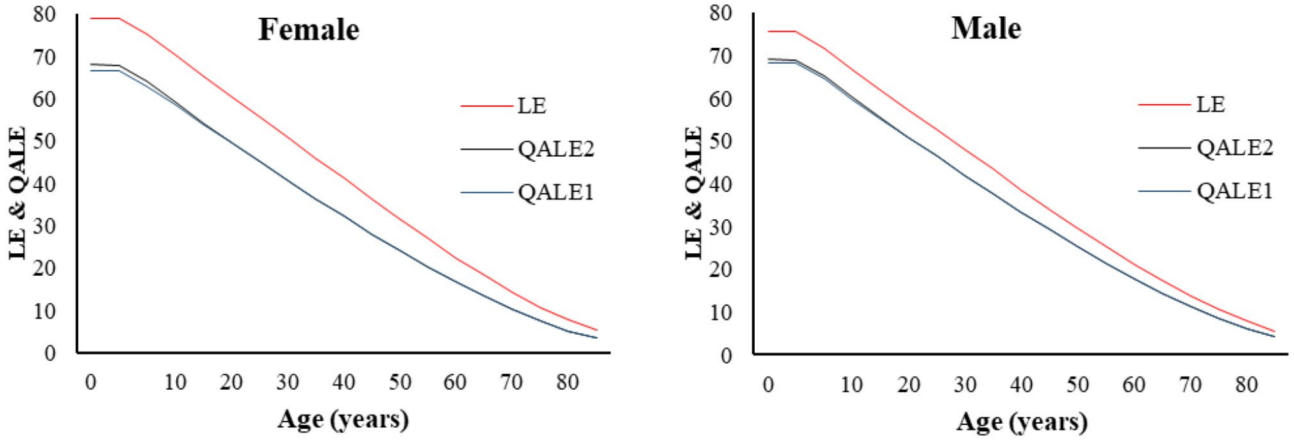

Fig. 1 LE and QALE based on age and sex. LE is life expectancy and QALE is quality adjusted life expectancy years. QALE1: Assuming that children aged 0 to 17 years had the same HRQoL as those aged 18 to 19 years. QALE2: Assuming that children aged 0 to 17 years had a HRQoL score of 1

compared to men, they exhibit a lower quality-adjusted life expectancy. QALE at birth is 68.29 QALYs for men and 66.69 QALYs for women. Additionally, as depicted in Fig. 1, the disparity between LE and QALE is more pronounced in females than in males, albeit this gap diminishes over time. The results of QALE based on the second scenario, in which the HRQoL for individuals under the age of 18 is assumed to be one, are provided in Supplementary Table S3.

Discussion

To the best of our knowledge, this study is the first to present established QALE norms for Iran. Our findings reveal that, despite women having a higher LE at birth compared to men—79.1 years versus 75.7 years—the QALE at birth is lower for women (66.69 QALYs) than for men (68.29 QALYs). This discrepancy can be attributed to the observed lower HRQoL in women, with a utility value of 0.84, compared to men, who have a higher utility value of 0.90. This finding highlights the critical need for targeted public health interventions to improve the HRQoL particularly among women, as it reveals that women have a lower QALE despite having a longer LE compared to men.

Studies have reported varying QALE estimates across countries, which further underscores the significance of contextual factors in shaping these metrics [11, 12]. The differences in QALE between populations can be attributed to three main factors within SMPH: mortality, health states, and health-state values [11].

A comparison with recently reported QALE norms for England [10] and Australia [13] provides further insights into gender differences. In England, although women have a higher LE than men (83.33 years vs. 79.67 years), their QALE is nearly identical to that of men (68.24 years vs. 68.21 years). In contrast, in Australia, women not only have a higher LE than men (85 years vs. 80.7 years), but also a higher QALE (77.1 years vs. 74.6 years). This suggests that, while both countries show differences in LE between genders, the impact of HRQoL varies, leading to different QALE outcomes. The greater disparity in EQ-5D-5 L utility values between men and women in England, where women report lower HRQoL than men, might explain why their QALEs are more similar despite the LE gap.

The findings of this study align with previous research conducted in Iran [16, 18, 25], which consistently identifies pain/discomfort and anxiety/depression as the most prevalent health concerns in the Iranian population. Results from the EQ-5D questionnaire further highlight that the prevalence of reported health problems increases with age across most dimensions. Given the rapid growth of the aging population in Iran [26], addressing these concerns has become even more critical. Recent studies [15, 23] also demonstrate a correlation between chronic diseases and reduced HRQoL. As Iran's demographic profile shifts, the need for targeted interventions aimed at improving HRQoL and promoting healthier aging becomes increasingly urgent. Public health strategies must prioritize both the prevention and management of chronic diseases, with a particular focus on reducing the prevalence of pain, discomfort, and mental health conditions such as anxiety and depression. Additionally, the development of comprehensive healthcare programs that integrate physical, mental, and social aspects of health is essential. These interventions not only have the potential to alleviate current health challenges but also to improve QALE for the population.

QALE is a comprehensive and sensitive metric for measuring population health, derived from LE and HRQoL utility scores [6, 7]. It serves as a valuable tool for healthcare professionals and policymakers and also functions as a reference point for assessing the effectiveness of healthcare interventions [8]. In 2022, NICE

introduced severity-of-condition modifiers, defined as the expected QALYs lost by individuals with the condition when receiving standard care. In evaluating severity, both the absolute and proportional QALY shortfalls are considered, and greater weight may be assigned to QALY gains for conditions of high severity [27]. To calculate absolute and proportional QALY shortfalls, two types of information are required: estimates of the future QALYs that individuals receiving the current standard of care are expected to accrue over their lifetime, and estimates of the future QALYs they would have accrued if they were in optimal health. QALE serves as the basis for calculating both absolute and proportional QALY shortfalls [10]. Given that health technology assessment outcomes guide the integration and prioritization of new healthcare interventions in Iran [28], it is recommended that the severity-of-condition modifiers proposed by NICE be considered.

Due to its strong intuitiveness, QALE serves as a more effective metric for health policy advocacy and the promotion of investment in healthy lifestyle interventions, particularly in resource-constrained environments [13]. By focusing on both the quantity and quality of lived years, QALE is especially valuable in guiding public health interventions, as it emphasizes the importance of years lived in good health. For instance, increases in LE without corresponding gains in QALE are likely to lead to greater healthcare utilization over the course of life. This scenario can place a significant strain on limited healthcare resources, as individuals may live longer but with chronic illnesses or disabilities that require ongoing treatment and care. Thus, employing QALE as a guiding metric allows for a more strategic and sustainable approach to health policy, ensuring that interventions yield both health and economic benefits.

Additionally, QALE serves as a valuable indicator for assessing health inequalities [7, 29] by enabling the identification of groups that may have longer LE but experience poorer health outcomes, as well as those with both shorter LE and HRQoL. This dual perspective is crucial for detecting inequalities that may be overlooked when relying solely on traditional metrics such as LE. Future studies should explore the various factors influencing QALE and the disparities associated with it in specific national contexts. A granular understanding of these factors will facilitate more precise and effective public health interventions that address both the quantity and quality of life across different population groups.

In this study, the data required to calculate HRQoL was obtained from the 2021 STEPS survey. While the survey was conducted during the COVID-19 pandemic, the findings suggest that participants' HRQoL was not substantially affected by the pandemic. To provide further context, we compared our findings with those of a 2016 study conducted in the capital city of Iran, which also used the EQ-5D-3 L questionnaire [30]. The prevalence of reported problems across the EQ-5D-3 L dimensions in the 2016 study is comparable to those in the 2021 STEPS survey. The rates of reported problems in the current survey were as follows: mobility (7.7%), self-care (2.9%), usual activities (6.2%), pain/discomfort (38.3%), and anxiety/depression (35.2%). In contrast, the 2016 study reported slightly higher rates for mobility (10.82%) and slightly lower rates for self-care (1.27%), usual activities (4.03%), pain/discomfort (34.41%), and anxiety/depression (33.37%). This relative stability in HRQoL dimensions over time suggests that HRQoL in Iran has remained consistent during this period. Despite the similarities between the two studies, it is important to acknowledge the limitations of these comparisons. The 2016 study was conducted solely in the capital city, which may limit the generalizability of its findings to the national population. A 2021 study conducted in Fars province, aimed at evaluating HRQoL in the Iranian general population during the COVID-19 pandemic, provides additional points of comparison. The study reported a mean EQ-5D-3 L index value of 0.80 [31], which is lower than the mean index value of 0.87 reported by participants in the 2021 STEPS survey [17]. Methodological differences, including variations in study populations, sampling methods, and data collection techniques, can significantly influence the results between these two studies.

Conclusion

This study presents QALE population norms for Iran based on large community sample at the national level. While women typically exhibit a higher LE compared to men, the inverse holds true for QALE at birth. These norms can be used in economic assessments of health interventions and population health studies.

Strengths and limitations

The primary advantage of this research is its large sample size and national-level sampling. This study used the EQ-5D-3 L survey to measure HRQoL. Including more dimensions in the EQ-5D is expected to lead to an improvement in the precision of population health evaluation.

Abbreviations

HRQL	Health-related quality of life
QALE	Quality-adjusted life expectancy
LE	Life expectancy

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12963-025-00366-0.

Supplementary Material 1

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Author contributions
All authors contributed to the study conception and design. Data preparation and analysis were performed by A.M, R.D. and A.A.S. The first draft of the manuscript was written by A.M, S.A. and F.D. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval
This study was approved by the ethics committee of the Tehran University of Medical Sciences, (IR.TUMS.SPH.REC.1401.237). All authors confirm and declare that this study was conducted in compliance with the Declaration of Helsinki.

Consent to participate
The participants were assured that their information would remain confidential. Informed consent was obtained from all individual participants included in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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