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The Trends in Health Life Expectancy in Korea according to Age, Gender, Education Level, and Subregion: Using Quality-Adjusted Life Expectancy Method

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ABSTRACT

Background: Quality-adjusted life expectancy (QALE) means life expectancy (LE) reflecting health-related quality of life and is one of the indicators of healthy LE. We determined the trends in QALE in Korea by age, gender, educational level, and subregion from 2005 to 2013.
Methods: We applied the Sullivan method to estimate QALE. We calculated QALE from 2005 to 2013 by gender and QALE for 2005 and 2010 by educational level at the national level. Furthermore, we estimated QALE for 2005, 2008, and 2011 by subregion according to metropolitan and provincial levels.
Results: Population health in Korea measured by LE and QALE at age 0 increased steadily from 2005 to 2013. Annual percent changes of LE and QALE in men were 0.52 and 0.73, respectively (*P* value < 0.05), and those in women were 0.47 and 0.71, respectively (*P* value < 0.05). Koreans with a higher educational level had longer LE and QALE than those with a lower educational level, but the differences in LE and QALE according to educational level narrowed from 2005 to 2010. The LE and QALE at age 0 for each of the 16 subnational regions in 2011 increased compared to 2005, but there was still a difference of up to 4.57 years in QALE between subnational regions.
Conclusion: We showed that QALE could be easily calculated and be an appropriate measure for tracking the overall population's health level. The results from this study are expected to aid the Ministry of Health of Republic of Korea in setting up a goal for the National Health Plan.

Keywords: Life Expectancy; Quality of Life; Republic of Korea; Health Status Disparities

INTRODUCTION

Summary measures of population health (SMPH) have been calculated to estimate disease burdens in a particular population as a single numerical index, combining impacts of mortality and non-fatal health outcomes.[1] SMPH can be used in various ways, such as to compare population health in different populations, monitor changes in the health of

certain populations, identify health inequalities, investigate contributions of risk factors to disease burdens, and establish priorities for health service delivery and research.[2-5] SMPH can be divided into two types of composite summary measures: health gap measures such as quality-adjusted life years (QALYs) and health expectancy measures such as quality-adjusted life expectancy (QALE) and health-adjusted life expectancy (HALE).[1,6]

QALE means life expectancy (LE) reflecting health-related quality of life (HRQOL) and is one of the indicators of healthy LE.[7] That is, QALE represents the lifespan reflecting the HRQOL. LE is 80 years, but QALE is 70 years, which means there is a 10-year lifespan loss due to a decrease in HRQOL. QALE differs slightly from disability-free life expectancy (DFLE) and HALE. DFLE and HALE use disability weights to measure the average number of years while adjusting the level of severity of disease and injury.[8,9] However, QALE uses utility weight measured by preference-based HRQOL instruments to weight the remaining years of life, similar to QALY.

QALE has several strengths over other indicators of healthy LE. QALE would provide a more complete and comprehensive assessment of health during one's life time because HRQOL might significantly and constantly vary throughout the entire life span.[7] Although QALE may have problems with self-report measures, one strength of QALE would lie in how it handles the problem of co-morbidity compared with other disease-based calculation measures, such as HALE.[10] Furthermore, calculations of QALE are relatively easier than those of HALE because the calculation of HALE requires disability weights for all types of disease and injury.[2,9]

Because of these advantages of QALE, many countries have been reporting QALE at national and subregional levels, such as the United States,[5] England,[4] and the Netherlands.[11] Furthermore, studies on QALE loss due to disease[12,13] and risk factors[5,14] have been reported. Health inequalities in terms of QALE have also been investigated.[4,11] However, studies on QALE relatively remain undeveloped in Asian countries, including Korea, with a few exceptions.[13,15,16] In the present study, we determined the trends in QALE in Korea by age, gender, educational level, and subregion from 2005 to 2013.

METHODS

We calculated QALE from 2005 to 2013 by gender and QALE for 2005 and 2010 by educational level at the national level. Furthermore, we estimated QALE for 2005, 2008, and 2011 by subregion according to metropolitan and provincial levels. We applied the Sullivan method to estimate QALE.[17] This method combines mortality and disability or HRQOL data and shows the average number of remaining years for all ages, adjusting for the level of disability or HRQOL. To calculate QALE, two main data sets are required: probability of death and HRQOL data.

Probability of death

We obtained probability of death data from the Korean Statistical Information Service (KOSIS) from the Statistics Korea (http://kosis.kr/eng/). The KOSIS provides data for probabilities of death at 5-year intervals by gender and year from 1970 to 2014 in an abridged life table. We used the probability of death data by gender for 2005 and 2007–2013, according

to available HRQOL data. In the case of QALE by educational level, we estimated the probability of death data based on the number of deaths by educational level provided by KOSIS, using the following formula.[18]

$$_nQ_x = (n \star {_nM_x})/\{1 + (n - {_nA_x}) \, _nM_x\}$$
$$_nM_x = {_nD_x}/{_nP_x}$$
  n: years in interval
  x: age at beginning of interval
$_nD_x$: number of deaths
$_nP_x$: total population
$_nA_x$: linearity adjustment

We assumed that the distribution of death in each age group was evenly distributed ($_nA_x = 0.5$), except for under 5 years of age ($_1A_0 = 0.1$, $_5A_1 = 0.4$).

We estimated the QALE for 2005 and 2010 by educational level because the total populations ($_nP_x$) at a national level are only available in 2005 and 2010 from KOSIS. Educational levels were categorized into elementary school graduation or less, middle school graduation, high school graduation, and college graduation or higher. Furthermore, we restricted the analyses to people between 20 to 80 years old for the calculation of QALE by educational level because the educational level is not yet fully attained under 19 years old and the number of deaths by educational level at an old age was too small to get a robust value for the probability of death in the old age groups.

We also used the probabilities of death by administrative districts in Korea from KOSIS. That is, we obtained the probability of death data for 2005, 2008, and 2011 for seven metropolitan cities and nine provinces at 5-year intervals, using the abridged life tables by subregion from KOSIS.

HRQOL

We obtained HRQOL data from the Korea National Health and Nutrition Examination Survey (KNHANES).[19] The KNHANES I survey was first conducted in 1998 and was followed by the KNHANES II (2001), KNHANES III (2005), KNHANES IV (2007–2009), and KNHANES V (2010–2012) surveys. At present, the KNHANES VI (2013–2015) survey is in progress. We used the KNHANES for each year to calculate the QALE by age, gender, and educational level corresponding to that year. For QALE by subregion, we used the KNHANES III, KNHANES IV, and KNHANES V to estimate the QALE for 2005, 2008, and 2011, respectively, to get a sufficient sample size in each subregion.

Since the KNHANES III, the HRQOL of respondents to the KNHANES is evaluated using the EQ-5D-3L. We transformed the EQ-5D-3L response from respondents to the EQ-5D-3L index using the Korean EQ-5D-3L value set.[20] The EQ-5D-3L used in this study comprised five dimensions, and each dimension had three levels reflecting severity.[21] The EQ-5D-3L index scale ranges from 0 (being dead) to 1 (full health). Because respondents under 18 years old do not report the EQ-5D-3L in the KNHANES, we used the average utility weight of the 20–24-year age group as a proxy for the utility weights of the age group under 19 years old. In addition, if the estimated utility weight of the old age group was unreliable, a reasonable and logically proper utility weight of the near-age interval was used as a substitution.

Calculating QALE

In this study, QALE was calculated based on the following formula, adapting the method of a previous study.[8]

$$QALE_{n,g} = \left(\sum_{n=1}^{22} (L'_{n,g}) \right) / l_{n,g}$$

$$L'_{n,g} = L_{n,g} \star H_{n,g}$$

n: year intervals, 1 (0 years), 2 (1–4 years), 3 (5–9 years), 4 (10–14 years), … 20 (90–94 years), 21 (95–100 years), and 22 (≥ 100 years)

g: gender, 1 (men) or 2 (women)

$H_{n,g}$: average utility weight at age interval by gender

$L_{n,g}$: number of person-years lived between age intervals by gender

$L'_{n,g}$: quality-adjusted number of person-years lived between age intervals by gender

$l_{n,g}$: number of people who were alive in the age interval by gender

The number of person-years lived between age intervals was extracted from the probability of death of the corresponding age group. By reflecting the average utility weight at each age interval, the quality-adjusted number of person-years lived between age intervals is calculated. Next, the cumulative quality-adjusted years lived at each age group was the summation of the number of person-years lived in the rest of life. The QALE at each age group was estimated as the cumulative quality-adjusted years lived at each age group divided by the number of people who were alive in each age group. The 95% confidence intervals (CIs) of QALE were estimated using the standard errors of utility weights.

To investigate health inequalities and their changes, we compared the trends in QALEs in Korea by age, gender, subregion, and educational level from 2005 to 2013. An annual percentage changes were calculated to statistically analyze trend changes of QALE by gender from 2005 to 2013. In particular, we decomposed the differences in QALE into the effects of the probability of death and HRQOL. That is, assuming the lowest probability of death among groups, the differences in QALE, which were considered to be the effect of HRQOL, were recalculated and the patterns or percentages of change were determined. For example, in the case of QALE by educational level, we assumed that all groups had the probability of death for college graduation or higher and confirmed the magnitude of the diminishing differences in QALE. We used Microsoft Office Excel 2007 and SPSS software (v21.0; IBM Corp., Armonk, NY, USA) for all analyses. *P* values of less than 0.05 were regarded as statistically significant in this study.

Ethics statement

Ethics approval was unnecessary because we used publicly available data without any personal identifiers.

RESULTS

From 2005 to 2013, the LE and QALE of Koreans tend to steadily increase (**Fig. 1**). Annual percent changes of LE and QALE in men were 0.52 and 0.73, respectively (*P* value < 0.05), and those in women were 0.47 and 0.71, respectively (*P* value < 0.05, Supplementary Data). For men, LEs and QALEs at age 0 were 75.13 years and 70.80 (95% CI, 70.78–70.82) years in 2005, respectively, whereas LEs and QALEs at age 0 were 78.51 years and 74.83 (95% CI, 74.82–74.85)
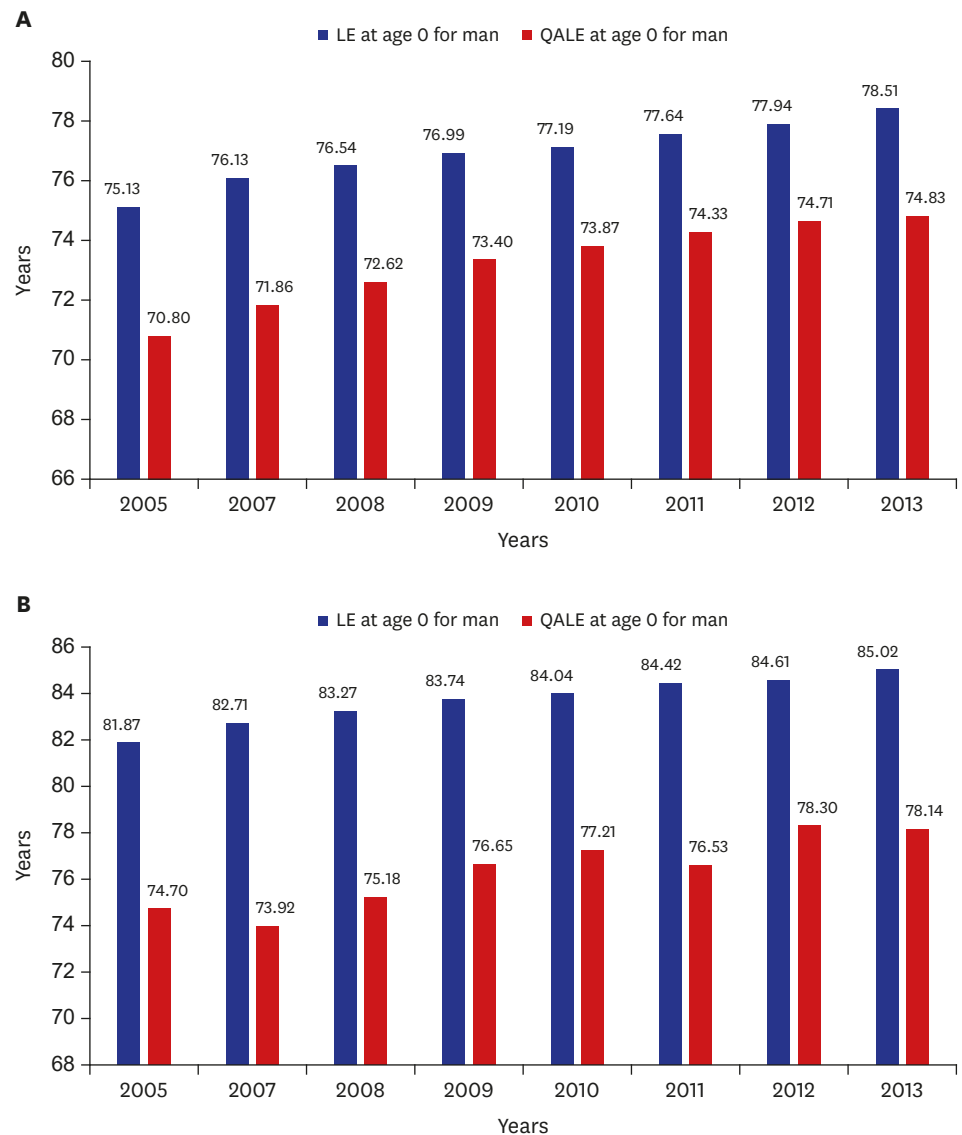
A

■ LE at age 0 for man ■ QALE at age 0 for man

B

■ LE at age 0 for man ■ QALE at age 0 for man

Fig. 1. Trends in LE and QALE at age 0 from 2005 to 2013 by gender.
LE = life expectancy, QALE = quality-adjusted life expectancy.

years in 2013, respectively. For women, LEs and QALEs at age 0 were 81.87 years and 74.70 (95% CI, 74.67–74.72) years in 2005, respectively, whereas LEs and QALEs at age 0 were 85.02 years and 78.14 (95% CI, 78.12–78.16) years in 2013, respectively. During the 8 years, LE at age 0 increased by 3.38 years among men and 3.15 years among women. QALE at age 0 increased by 4.03 years among men and 3.44 years among women during the same time period.

The gaps of QALE between men and women were smaller than gaps of LE between men and women. The differences in LE between men and women were 6.74 years in 2005, 6.75 years in 2009, and 6.51 years in 2013. However, the differences in QALE between men and women were 3.90 years in 2005, 3.25 years in 2009, and 3.31 years in 2013.

If we assumed that men had probabilities of death for women, the QALEs in men were longer than those in women and the differences in QALE between them were 1.48, 2.48, and 2.12 years
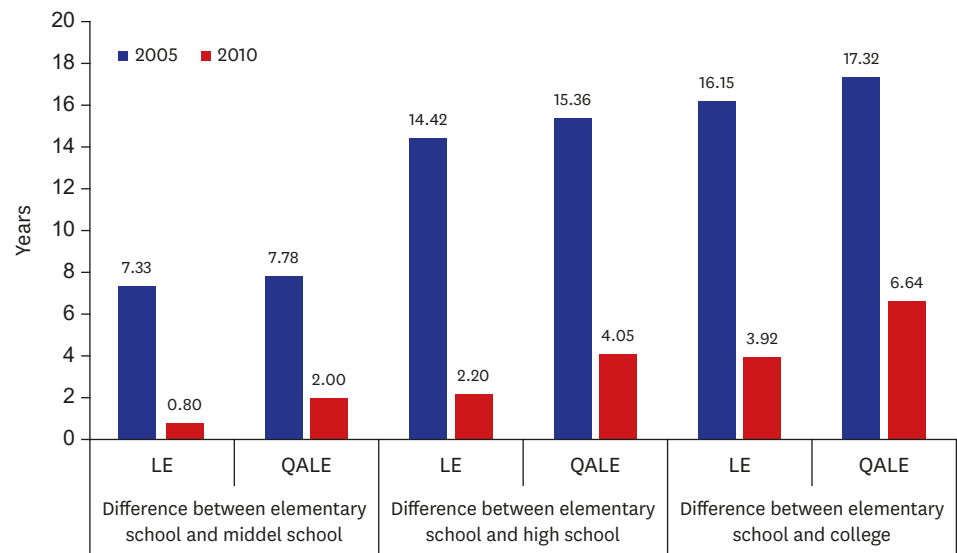
Fig. 2. Differences in LE and QALE at age 25 by educational level.
LE = life expectancy, QALE = quality-adjusted life expectancy.

in 2005, 2009, and 2013, respectively (Supplementary Data). Supplementary Data provides the LEs and QALEs including their 95% CIs at 5-year intervals by gender from 2005 to 2013.

The differences in LE and QALE in the 25–29-year age group according to educational level were decreased (**Fig. 2**), but the differences between educational levels were greater for QALE than for LE in both 2005 and 2010. The differences in LE and QALE between elementary school and college were 16.15 years and 17.32 years in 2005, respectively. However, in 2010, the differences in LE and QALE between elementary school and college were 3.92 years and 6.64 years, respectively.

By assuming that all groups had the probability of death for college graduation or higher, we decomposed the differences of QALE for educational level into the effects of mortality and HRQOL. In 2005, the differences in QALE according to educational level were mainly due to the probability of death (**Table 1**). About 80% of the difference in QALE between elementary school and college was caused by the probability of death. However, in 2010, the effects of HRQOL on the differences of QALE increased. The effects of probability of death and HRQOL on the difference in QALE between elementary school and college were about 50%, respectively.

The LE and QALE at age 0 for each of the 16 metropolitan cities and provinces in 2011 increased compared to 2005 (**Table 2**). In 2005, LE at age 0 was highest in Seoul (80.36 years), followed by Daejeon (79.20 years), whereas it was lowest in Jeju (74.43 years), followed by Gyeongnam

Table 1. Contributions to the educational differences in QALE at age 25

Year	Difference between elementary school and middle school			Difference between elementary school and high school			Difference between elementary school and college		
	Due to probability of death	Due to HRQOL	Sum	Due to probability of death	Due to HRQOL	Sum	Due to probability of death	Due to HRQOL	Sum
2005	5.95 yr (76.5)	1.83 yr (23.5)	7.78 yr (100.0)	12.24 yr (79.7)	3.12 yr (20.3)	15.36 yr (100.0)	13.82 yr (79.8)	3.50 yr (20.2)	17.32 yr (100.0)
2010	0.70 yr (34.9)	1.30 yr (65.1)	2.00 yr (100.0)	1.98 yr (48.9)	2.07 yr (51.1)	4.05 yr (100.0)	3.55 yr (53.4)	3.09 yr (46.6)	6.64 yr (100.0)

Data are shown as number (%).
QALE = quality-adjusted life expectancy, HRQOL = health-related quality of life.

Table 2. LE and QALE at age 0 by subregion in Korea

Metropolitan cities	2005			2008			2011		
	LE	QALE (95% CI)	Difference	LE	QALE (95% CI)	Difference	LE	QALE (95% CI)	Difference
Seoul	80.36	74.26 (74.23–74.28)	6.11	81.66	76.07 (76.05–76.08)	5.59	82.64	78.19 (78.18–78.21)	4.44
Busan	77.83	72.71 (72.67–72.76)	5.12	78.80	73.62 (73.60–73.65)	5.18	80.21	74.24 (74.21–74.27)	5.97
Daegu	78.54	72.15 (72.09–72.21)	6.39	79.57	74.09 (74.06–74.12)	5.48	80.64	76.53 (76.51–76.56)	4.11
Incheon	78.49	71.30 (71.24–71.36)	7.19	80.04	74.66 (74.63–74.68)	5.39	80.71	75.61 (75.58–75.64)	5.10
Gwangju	79.03	73.17 (73.09–73.25)	5.86	79.99	74.83 (74.80–74.87)	5.16	80.77	77.47 (77.44–77.51)	3.29
Daejeon	79.20	74.42 (74.36–74.48)	4.78	80.31	73.45 (73.40–73.49)	6.87	81.26	76.06 (76.03–76.09)	5.20
Ulsan	77.72	72.87 (72.80–72.95)	4.85	79.22	73.62 (73.59–73.66)	5.59	80.19	75.04 (75.00–75.08)	5.15
Gyeonggi	79.15	73.75 (73.73–73.78)	5.39	80.65	74.69 (74.68–74.71)	5.96	81.69	76.35 (76.34–76.37)	5.33
Gangwon	77.54	72.46 (72.41–72.51)	5.08	78.99	73.45 (73.41–73.48)	5.55	80.70	76.14 (76.11–76.18)	4.56
Chungbuk	77.59	72.53 (72.48–72.58)	5.06	79.11	72.29 (72.25–72.33)	6.82	80.10	73.62 (73.58–73.67)	6.48
Chungnam	77.96	71.35 (71.30–71.41)	6.60	79.71	73.62 (73.59–73.65)	6.09	81.06	75.31 (75.28–75.34)	5.75
Jeonbuk	78.14	72.53 (72.48–72.58)	5.61	79.22	72.01 (71.97–72.05)	7.21	80.73	74.77 (74.73–74.8)	5.96
Jeonnam	77.73	71.60 (71.55–71.65)	6.13	79.11	73.05 (73.02–73.08)	6.06	80.15	74.87 (74.84–74.9)	5.28
Gyeongbuk	77.73	72.01 (71.97–72.05)	5.72	79.02	73.06 (73.03–73.08)	5.96	80.14	75.58 (75.56–75.6)	4.56
Gyeongnam	77.50	72.66 (72.62–72.7)	4.84	78.95	72.39 (72.36–72.41)	6.56	80.32	75.27 (75.25–75.29)	5.04
Jeju	74.43	67.71 (67.60–67.83)	6.72	81.29	75.63 (75.59–75.68)	5.65	82.11	76.14 (76.09–76.19)	5.97
Difference between the highest and the lowest	5.93	6.71 (-)	-	2.85	4.06 (-)	-	2.54	4.57 (-)	-

LE = life expectancy, QALE = quality-adjusted life expectancy, CI = confidence interval.

(77.50 years). In the same year, QALE at age 0 was highest in Daejeon (74.42 years), followed by Seoul (74.26 years), whereas it was lowest in Jeju (67.71 years), followed by Incheon (71.30 years). In 2011, LE at age 0 was highest in Seoul (82.64 years), followed by Jeju (82.11 years), whereas it was lowest in Chungbuk (80.10 years), followed by Gyeongbuk (80.14 years). In the same year, QALE at age 0 was highest in Seoul (78.19 years), followed by Gwangju (77.47 years), whereas it was lowest in Chungbuk (73.62 years), followed by Busan (74.24 years). Furthermore, the differences in QALE between the highest and lowest regions were 6.71 quality-adjusted years in 2005 and 4.57 quality-adjusted years in 2011. The minimum and maximum ranges of QALE were greater (6.71 years in 2005 and 4.57 years in 2011) than those of LE (5.93 years in 2005 and 2.54 years in 2011) among subnational regions.

If we assumed that all subregions had probabilities of death for Seoul, which had the highest LE among all subregions from 2005 to 2011, the minimum and maximum ranges of QALE decreased (Supplementary Data). Under this assumption, the differences in QALE between regions with the highest and lowest QALE were 3.85 years (42.7% reduction) in 2005, 2.27 years (44.0% reduction) in 2008, and 3.56 years (22.2% reduction) in 2011.

DISCUSSION

We have determined the trends in QALE in Korea by age, gender, educational level, and subregion. We also demonstrated that QALE can be calculated using publicly available data, so that QALE can be used as a routine indicator for continuous surveillance of population health by socioeconomic status. By including QALE in national health promotion plans, such as the "National Health Plan 2020,"[22] we can establish targets for improving the LE of various population groups. The results from our current study also provide empirical evidence for guiding intervention and research priorities.

First of all, population health in Korea measured by LE and QALE at age 0 has increased steadily from 2005 to 2013 and it is necessary to analyze the cause of this phenomenon. A

man and a woman born in 2013 will live an additional 4.0 and 3.4 quality-adjusted years compared with a man and a woman born in 2005. Considering the changes in LE, the major driving factor for these changes would be mortality declines, although enhancement of HRQOL also contributed. In particular, the improvement in HRQOL in the middle-age group was more remarkable than in other age groups (data not shown). Considering that rapid increases in LE in Korea before 2005 were explained by reductions in cardiovascular and infectious disease mortality,[23] cause-specific contributors to these improvements in LE and QALE need to be identified.

Another remarkable finding in this study was that the differences in QALE between men and women were smaller than those in LE. Specifically, the differences in LE between men and women were 6.74 years in 2005, 6.75 years in 2009, and 6.51 years in 2013, whereas the differences in QALE between men and women were 3.90 years in 2005, 3.25 years in 2009, and 3.31 years in 2013. In another way, however, it can be inferred that the HRQOL of women would be worse than that of men. Although women may live longer than men, women may suffer more diseases and injuries, in particular non-communicable diseases, than men.[3,24-26] In this respect, there is a reduction in the HRQOL of women in the older age groups than in the younger age groups.[3] Interventions to raise the HRQOL of women might be needed.

In comparison with the results of LE and healthy LE, such as QALE and HALE in previous studies, the difference between LE and QALE was smaller in our study.[4,7,11] For example, the difference between LE and QALE for an 18-year-old American adult in 2006 was 8.8 years,[7] but the differences between LE and QALE for the 20–24-year age group in 2005 were 4.0 years and 6.7 years, respectively (Supplementary Data). When we compared the gaps between LE and QALE in this study and those between LE and HALE reported by Lee et al.,[8] the gaps in this study were less prominent. The differences between LE and HALE at age 0 in 2011 were 11.8 years for men (HALE 65.8 years) and 15.5 years for women (HALE 68.9 years), respectively.[8] We assume that this phenomenon might be due to the EQ-5D-3L used to measure the HRQOL of Koreans. Based on the existence of ceiling effects in the EQ-5D-3L, the EQ-5D-3L might not fully reflect the HRQOL of Koreans, so that the HRQOL measured by the EQ-5D-3L might be overestimated.[27] Therefore, we need to focus on the trends in QALE using the EQ-5D-3L in Korea rather than the absolute differences between LE and QALE. In addition, it is necessary to calculate QALE using other instruments for HRQOL with low ceiling effects.

Koreans with a higher educational level had longer LE and QALE than those with a lower educational level, but the differences in LE and QALE according to educational level narrowed from 2005 to 2010. The difference in LE between elementary school and college was 16.15 years in 2005, whereas the difference in LE between elementary school and college was 3.92 years in 2010. Similar to the study by Jung-Choi et al.,[28] the differences in LE between educational levels in 2005 were substantial, but those in 2010 decreased by up to 8.5 years (between elementary school and high school). When the results are compared with those from the Netherlands,[11] the difference in QALE between educational levels in this study was smaller. Although their comparability is restricted due to the different study period and educational categories, the QALE difference between the low and highly educated in the Netherlands in 2011 was 8.1 healthy years for men and 7.1 healthy years for women.[11] We assume that the findings of our study might be related to the explosive increase in college enrolment and graduation rates. Among Organization for Economic Co-operation and Development (OECD) countries, Korea was the top-ranked country based

on the percentage of population with a high educational level. The percentage that attained tertiary education was 65% in the 25–34-year age group (OECD average, 38%) and 47% in the 35–44-year age group (OECD average, 33%).[29] However, there were still significant differences in QALE according to educational level. The difference in QALE between elementary school and college was 6.6 years in 2010. As for the differences in QALE between men and women, we believe that HRQOL inequalities by educational level might show little or no improvement. Further study is required to identify contributors to these HRQOL disparities by education.

The LE and QALE at age 0 for each of the 16 metropolitan cities and provinces in 2011 increased compared to 2005. Among 16 metropolitan cities and provinces in Korea, the average percentage increases in LE and QALE were 3.58% (2.78 years) and 4.68% (3.36 quality-adjusted years) during 6 years, respectively. In the case of the US, the overall percentage increases in QALE for men and women from 1993 to 2006 were 4.0% and 0.5%, respectively.[7] Furthermore, the difference in LE and QALE between the highest and lowest regions has decreased. For QALE, the difference between the highest and lowest regions was 6.71 quality-adjusted years in 2005 and 4.57 quality-adjusted years in 2011. Based on these findings, we assume that health inequalities by subregion in Korea have been gradually reduced.

However, we need to focus on the fact that there was still a difference of up to 4.57 quality-adjusted years in QALE between subnational regions. The most remarkable QALE finding by subregion was that the subregions around the Seoul metropolitan area, such as Seoul and Gyeonggi, had a high QALE. Population and infrastructure are still concentrated around the Seoul metropolitan area. In particular, almost half of medical institutions are located in the Seoul metropolitan area.[30] Of 44 tertiary hospitals in 2011, 17 and 5 tertiary hospitals were placed in Seoul and Gyeonggi, respectively.[31] It is necessary to decrease health disparities among subregions by considering balanced regional development.

One limitation of this study is that we used the average utility weight of the 20–24-year age group as a proxy for the utility weights of the age group under 19 years old when calculating QALE. This assumption was unavoidable because respondents younger than 18 years old do not report the EQ-5D-3L in the KNHANES. However, this assumption may lead to an overestimation of QALE. We need to ascertain whether there is a difference in HRQOL between adults and adolescents or children in Korea. Another limitation of this study is that we did not propose and verify the hypotheses regarding the differences of QALE. That is, we did not identify the determinants of QALE in this study. More empirical studies analyzing the determinants of QALE will be needed in the future.

In conclusion, our present study explored the trends in QALE by age, gender, educational level, and subregion in Korea from 2005 to 2013. We showed that QALE could be easily calculated and be an appropriate measure for tracking the overall population's health level over time. Although the term of healthy LE is widely used in public health planning, there is no clear guidance on how to measure and evaluate it. Therefore, by referring to this study, it may be useful to use QALE as a representative index of healthy LE. For example, the results from this study are expected to aid the Ministry of Health in setting up a goal for the National Health Plan in Korea. Furthermore, ongoing studies monitoring the QALE according to the socio-demographic factors will be required to improve the health level, ameliorate health inequalities, and assist policy makers with evidence-based decision making.

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