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The Effects of Diabetes, Hypertension, Asthma, Heart Disease, and Stroke on Quality-Adjusted Life Expectancy

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Abstract

Objective—Quality-adjusted life expectancy (QALE) is a summary measure that combines mortality and health-related quality of life across different stages of life. The objective of this study was to estimate QALE loss due to five chronic diseases—diabetes mellitus, hypertension, asthma, heart disease, and stroke.

Methods—Health-related quality of life scores were from the 1993–2009 Behavioral Risk Factor Surveillance System. Using age-specific deaths from the Compressed Mortality File, this study constructed life tables to calculate losses in life expectancy and QALE due to each of the five diseases from 1993 through 2009 and for 50 US states and the District of Columbia.

Results—In 2009, the individual-level QALE loss for diabetic people, compared with nondiabetic people, was 11.1 years; for those with hypertension, 6.3 years; for those with asthma, 7.0 years; for those with heart disease, 10.3 years; and for those with stroke, 12.4 years. At the population level, diabetes, hypertension, asthma, heart disease, and stroke contributed 1.9, 2.2, 0.8, 1.2, and 0.8 years of population QALE loss at age 18 years, respectively.

Conclusions—Persons with each of the five diseases had significantly lower life expectancy and QALE. Because the prevalence of diabetes and hypertension has increased significantly in the United States in the last two decades, the burdens of these two conditions, measured by population QALE losses, had increased 83% and 29% from 1993 to 2009, respectively. Also, by examining changes in population QALE loss at different ages, policymakers can identify age groups most affected by particular diseases and develop the most cost-effective interventions by focusing on these groups.

Keywords

chronic diseases; health-related quality of life (HRQOL); life expectancy; quality-adjusted life expectancy (QALE)

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Introduction

The health impact of diseases, injuries, risk factors, or determinants includes premature mortality and long-term nonfatal morbidity [1–4]. There are many indexes used for measuring different health outcomes, such as attributable mortality, years of potential life lost, and diminished health-related quality of life (HRQOL) [1–4]. A summary score would be particularly useful in quantifying with a single-valued index lifetime burden or effects of diseases on both mortality and morbidity [5,6]. Burden of disease (BOD) measures take into account both the years of life lost and the relative severity of disease and make it possible to quantify the overall health outcomes for the population or affected patients [7]. BOD analyses are also particularly useful for evaluating the cost-effectiveness of health policies, intervention programs, and alternative treatments for disease [7].

Life expectancy is a summary measure of the age-specific mortality rates across the entire lifespan [8,9]. It measures expected years of life or average life years starting at a certain age. Because HRQOL differs across different stages of life, calculating life expectancy adjusted by HRQOL provides a more complete measure for assessing overall health [10,11]. Like life expectancy, quality-adjusted life expectancy (QALE) measures average quality-adjusted life-years (QALYs) or expected QALYs starting at a certain age. In addition to mortality data, QALE estimates use HRQOL health preference measures, which assess a person's perception of her or his health and how much a person values one health state versus another state. The HRQOL health preference measures capture respondents' perceived health for different health states by using a summary score (also called utility value) anchored at 0 (dead) and 1 (perfect health) [12,13]. Thus, 1 year of life lived at a utility value of 0.8 is equal to 0.8 QALYs [10,11]. QALE at a certain age is defined and calculated as the average number of QALYs throughout the remainder of the expected life [10,11].

QALE differs slightly from World Health Organization's BOD measures, disability-adjusted life-years or years lived with disability [5,7]. First, disability-adjusted life-years/years lived with disability use disability (i.e., loss of functioning) to weight the remaining years of life. QALE uses HRQOL to weight these life years and relies on the preference of different health states obtained from the general population. Second, disability-adjusted life-years sum the years of potential life lost because of premature mortality and the years of productive life lost because of disability. QALE averages QALYs for a population, and similar to life expectancy, weights loss in QALYs more in the earlier stages of life [10,11].

Several studies have calculated the loss in QALE due to a disease/condition by following a cohort of patients prospectively [14,15]. For example, Hung et al. [15] followed 633 patients with prolonged mechanical ventilation from 1998 to 2007 to obtain their survival status. They calculated the probability of survival at each point of follow-up time adjusted by HRQOL scores and extrapolated to 300 months of follow-up to obtain the QALE. One of the weaknesses of this study was to assume a constant excess hazard for survival function extrapolation. This assumption may not be appropriate, especially for diseases that may not cause premature mortality. To deal with these weaknesses, some investigators have proposed estimating the survival function from National Death Index Linked health surveys

to construct life tables of patients and then applying age-specific HRQOL scores for those who had the disease from a different data set to the life table to calculate QALE [11,16]. This method would provide more reliable estimates of QALE loss due to a disease or a risk factor [11]. A validation study of this method demonstrated small bias and good reliability of the estimation method [11].

Since 1993, the ongoing Behavioral Risk Factor Surveillance System (BRFSS) has included a set of questions to track population HRQOL [17]. The BRFSS also asked respondents whether they had any chronic conditions, such as diabetes mellitus, hypertension, asthma, heart diseases, and stroke [18,19]. The present study examined the impact on QALE for US adults for these five conditions. Specifically, this study calculated the QALE loss for patients with the disease and for the entire population due to each of these five diseases and examined recent trends and stated differences in these QALE losses.

Methods

The 1993–2009 BRFSS survey was used to estimate population HRQOL scores by age categories (18–24, 25–34, …, >85 years), sex, state of residence, and the statuses of the five chronic conditions. The BRFSS is a state-based survey of noninstitutionalized civilian adult residents from each of the 50 states and the District of Columbia [18,19]. The BRFSS asked respondents to rank their general health from 1 (excellent) to 5 (poor) and to report the number of physically unhealthy days, mentally unhealthy days, and days with activity limitation during the past 30 days [17]. This study applied a previously constructed algorithm to obtain values for the EuroQol five-dimensional questionnaire index, a preference-based HRQOL measure, for respondents in the BRFSS, based on their age and answers to these four questions [12,20]. This algorithm provides valid estimates of EuroQol five-dimensional questionnaire scores of the US population by some demographic subgroups and common health conditions from the BRFSS [12,20], and the bias of estimated QALE from these scores has been estimated to be less than 1% of that using the actual EuroQol five-dimensional questionnaire questions [11].

The BRFSS includes a set of core questions asked in all 50 states and the District of Columbia and a set of modular questions asked in a subset of states. We used only the core questions to estimate QALE for the entire United States and by state. The BRFSS asked respondents whether they had ever been told they had diabetes, hypertension, asthma, heart diseases (myocardial infarction or coronary heart disease), or stroke by a doctor. Women told that they had diabetes or hypertension or both only during pregnancy were excluded. The core diabetes questions were asked annually, and the core hypertension question was asked every 2 years. The core asthma questions were asked annually since 2000, and the core heart disease and stroke questions were asked annually since 2005.

The Centers for Disease Control and Prevention has compiled state-level death summary statistics and makes them available to the pubic (available from: http://wonder.cdc.gov). The U.S. Census Bureau provides annual population estimates (available from: http://www.census.gov/popest/states/asrh/). Both data are avail able by state, age, gender, and other basic demographics. For the years 2007–2009, death data are not available. Because

the national and state death rates were relatively stable across the time period we analyzed, we estimated the death rate for these three missing years by using a time-series autoregressive moving-average model based on the 1993–2006 death rates [21].

The age-specific death rate (m) was obtained by dividing the number of deaths (d) by the population size (N). Death rates for those with the disease (m_1) and those without the disease (m_0) were estimated by using the hazard ratio (h) between diseased and nondiseased and the disease prevalence (p) by

$$m_1=\frac{hm}{hp+(1-p)} \quad \text{and} \quad m_0=\frac{m}{hp+(1-p)}$$

respectively. The hazard ratio was estimated from the National Health Interview Survey–linked mortality files (available from: http://www.cdc.gov/nchs/data_access/data_linkage/mortality/nhis_linkage.htm) by using the Cox proportional hazards model [22]. The proportion of the population who had a specific disease was estimated from the BRFSS.

QALE and QALE Loss

Formulas to calculate QALE and their standard errors were provided by Jia et al. [11], and there is a summary. The QALE at age x is calculated by summarizing QALYs throughout the remaining of expected life starting at age x over the population surviving to age x [10,11]. Let A_i be the number of hypothetical population surviving to age i and D_i be the total life years for the age interval i. The probability of dying in an n_i-year interval is estimated by $q_i = 1-e^{-n_i m_i}$ [23,24]. Assume that those who died during the interval for ages x less than 85 years lived an average $n_i/2$ years, that is,

$$D_i=A_i\left(1-\frac{n_i q_i}{2}\right)$$

and for the last age interval (85+ years), assume a constant death rate (m_{85}), so that the average years of life at age 85 years is $D_{85} = A_{85}/m_{85}$ [11,22–25]. If y_i is the mean HRQOL score, the QALY for this age interval is $D_i y_i$ Therefore, QALE for those at age x is

$$Q(x)=\frac{\sum_{i\geq x} D_i y_i}{A_x}$$

Let $Q(x, z)$ be the QALE at age x, conditional on a population characteristic, z; for example, $z = 1$ for diseased persons and $z = 0$ for nondiseased persons. Thus, the QALE loss contributed by a disease for diseased persons (i.e., the “individual” QALE loss) is the difference in QALE between those without the disease and those with the disease: $\Delta(x) = Q(x, 0) - Q(x, 1)$ [25]. This index quantifies the effect of the disease for a person who has the disease. This study examined each of the five diseases individually. For example, the QALE loss to diabetes was the difference in QALE between those who did not have diabetes

and those who had diabetes. This analysis did not estimate the impact on QALE by multiple diseases.

Suppose $Q(x)$ is the QALE for the total population (both diseased and nondiseased). The difference in QALE between nondiseased and the total population, $\Delta_p(x) = Q(x, 0) - Q(x)$, is the disease-related QALE loss to the population. This "population" QALE loss is similar to the "population-attributable risk" in epidemiology. It quantifies the burden of the disease for the entire population or the maximum QALE gained if the entire population were free from the disease.

Two factors contribute to the QALE loss: that due to mortality (i.e., shortened life expectancy) and that due to morbidity (i.e., poor HRQOL). The proportion of QALE loss attributed to mortality only was calculated by assuming that the HRQOL scores were the same for both diseased and nondiseased persons and that the only difference between them was their mortality rates. Because information on HRQOL from the BRFSS is available only for adults 18 years old or older, the estimated life expectancies, QALE, and QALE losses refer to the remainder of the lifespan for the adult aged 18 years.

Results

From 1993 to 2009, the remaining life expectancy of an 18-year-old adult in the US population increased consistently from 58.8 to 61.1 years. However, the average HRQOL score of US adults aged 18 years and older had declined from 0.936 to 0.926 during the same period. Combining these two factors, the QALE for an 18-year-old adult increased slightly from 51.6 years to 52.6 years between 1993 and 2009.

Diabetes Mellitus

In 2009, 18-year-old diabetic persons were expected to live 53.8 years while nondiabetic persons of the same age were expected to live 62.8 years (Table 1). This 9.0-year difference was the individual-level loss in life expectancy due to diabetes mellitus. The corresponding QALE for 18-year-old diabetic and nondiabetic persons were 43.4 and 54.5 years, respectively. Therefore, the diabetes-related QALE loss for an 18-year-old diabetic person was 11.1 years. Of the 11.1 years of QALE loss, about two thirds (66.2% or 7.3 years) was due to mortality. QALE loss to diabetes declined gradually with age (Table 2), going from 11.1 years at age 18 years to 3.0 years at age 85 years. The consistent decline suggests that diabetes significantly affects patients' health during both early adulthood and later adulthood. The diabetes-related QALE loss differed somewhat between men and women (Table 3). Diabetic women lost 3.9 (95% confidence interval 3.3–4.5) more years of QALE to diabetes than diabetic men did (12.9 vs. 9.0 years in QALE loss; $P < 0.0001$). The trend of QALE loss (Fig. 1) shows that diabetes-related QALE was relatively unchanged between 1993 and 2009. This is because 1) life expectancy for both diseased and nondiseased had increased (from 50.7 to 53.8 vs. from 59.7 to 62.8 years, respectively) and 2) HRQOL scores for both diseased and nondiseased also had decreased (from 0.765 to 0.754 vs. from 0.903 to 0.886, respectively).

At the population level, diabetes caused the US adult population to lose 1.9 years of QALE starting at age 18 years in 2009. The population QALE loss also declined with age, but at a smaller rate and only for those aged 55 years and older, indicating that diabetes prevalence was significantly higher among older populations (3.2% for those younger than 55 years and 5.8% for those 55 years or older). The burden of diabetes for the population had increased significantly, from 1.0 year of population QALE loss in 1993 to 1.9 years of population QALE loss in 2009, an 84% increase (Fig. 2). This is different from the trend of individual-level QALE loss. Such an increase in the burden of diabetes to the population paralleled the increases in the prevalence of diabetes for US adults, from 4.5% to 8.9%, a 95% increase. Like the individual-level burdens, more than two-thirds (72.2% or 1.3 years) of the population QALE loss was due to mortality.

Because the state prevalence of diabetes varies greatly (ranging in 2009 from 5.8% in Colorado to 12.4% in West Virginia), the difference in state-level population QALE loss due to diabetes also varied greatly (Table 4). The states with the biggest burden of diabetes for their respective populations were Mississippi (2.3), Alabama (2.3), Kentucky (2.2), Louisiana (2.2), and West Virginia (2.2), the states with the highest prevalence of diabetes.

Hypertension

Although QALE loss for persons diagnosed with hypertension was the lowest (6.3 QALE loss at age 18 years in 2009) among the five diseases, the population QALE loss due to hypertension was the highest (2.2 population QALE loss in 2009) due to its substantially higher prevalence of hypertension (29.2% in 2009 vs. the prevalence of other four diseases, ranging from 2% to 7%).

Like diabetes, the individual-level hypertension-related QALE loss declined gradually with older ages. The population hypertension-related QALE loss also declined at a smaller rate and only after age 45 years. The hypertension prevalence was 6.5% for those younger than 45 years versus 22.7% for those 45 years or older. Also, like diabetes, the individual-level hypertension-related QALE loss did not change much during the study period, but the population QALE loss had increased significantly since 1993, from 1.7 in 1993 to 2.2 in 2009, a 29% increase. Such an increase in population QALE loss paralleled the increasing prevalence of hypertension from 21.6% to 29.2%, a 35% increase. Unlike the other diseases, less than half of the QALE loss and population QALE loss could be attributed to mortality alone, probably because the hazard ratio of dying for people with hypertension was only 1.06, which was substantially smaller than those for the other four diseases (all ≥1.3). Also, the gender differences in the burden of hypertension, both at the individual and the population levels, were very small.

Like the other diseases we evaluated, hypertension-related population QALE loss of the states was highly related to the state prevalence. States with the most hypertension-related population QALE loss were West Virginia (3.3), Mississippi (3.2), Kentucky (3.0), Arkansas (2.9), and Oklahoma (2.7). About half (R^2 = 53%) of the between-state variation in population QALE loss due to hypertension can be explained by the state hypertension prevalence.

Asthma

Both the individual-level QALE loss and the population QALE loss due to asthma were the lowest among the five diseases examined. In 2009, the QALE for an 18-year-old person with asthma and without asthma was 46.4 years and 53.4 years, respectively. Therefore, asthma contributed 7.0 years of QALE loss for those with asthma and 0.77 years of QALE loss for the population. The population QALE loss due to asthma had significantly increased 22% since 2000, the first year when the asthma question was asked in all states. Unlike the other four diseases in which individual-level burdens of disease were nearly unchanged, the individual-level QALE loss due to asthma increased significantly (approximately 17% from 2000 to 2009; $P < 0.0001$). This was due primarily to the difference in HRQOL scores between those with and without asthma, which widened from 0.086 in 2000 to 0.100 in 2009, also a 17% increase.

Unlike the other four diseases, individual-level and population-level QALE loss for asthma declined at a similar rate with older age, and both individual-level and population-level loss declined during all age intervals, between the ages 18 and 85 years. This is because younger populations had similar asthma prevalence compared with older populations (4.3% for those younger than 55 years vs. 4.2% for those 55 years or older). Women had a much higher prevalence of asthma (10.4% in 2009) than did men (6.5%). Women also had more asthma-related QALE loss than did men, both for those with asthma and for the entire population (7.4 vs. 6.6 years and 1.0 vs. 0.5 years, respectively). States with the most population QALE asthma-attributed loss in 2009 were West Virginia (2.2), Kentucky (1.1), Alaska (1.1), Missouri (1.1), and Tennessee (1.0). More than half of the QALE loss (52.4%) could be attributed to mortality alone, indicating that mortality was still the main source of burden for persons with asthma. However, at the population level, less than half ($r^2 = 43.2\%$) variation of the population QALE loss mortality.

Heart Disease

Data on the burden of heart disease (coronary heart disease and myocardial infarction) for the whole nation were available only for 5 years, 2005–2009. Therefore, there is not enough data to draw any conclusion regarding the trend of heart disease. The population QALE loss, however, had declined 1.6% annually since 2005 and in 2009, heart diseases contributed 1.2 years of population QALE loss. For those reporting heart disease, QALE was 43.4 years, 10.3 years less than for those without heart disease.

More than three-quarters (75.8%) of heart disease patients were aged 55 years and older. Therefore, the population-level QALE losses due to heart diseases were nearly unchanged between the ages 18 and 55 years. Nearly all the population QALE loss due to heart disease occurred after age 55 years (age-specific data are available on request) because 75% of the heart disease occurred after age 55 years, and the prevalence of heart disease for those aged 55 years and older was 14.5%, much higher than the 2.1% prevalence rate of those aged 54 years or younger.

Unlike the other four diseases, heart disease had contributed more population QALE losses for men (1.4 years) than for women (0.9 years) because of much higher prevalence of heart

disease among men (7.3% compared with 4.9% among women). West Virginia (2.3), Oklahoma (1.9), Kentucky (1.9), Florida (1.8), and Arkansas (1.8) had the most heart disease–related QALE losses in 2009.

Stroke

Stroke had the biggest impact on both mortality and morbidity for persons with the disease. The hazard ratio of dying from stroke was 1.53, and HRQOL was 0.232 points lower for those with stroke. The QALE loss from stroke was 12.4 years, the highest among the five diseases. Because the prevalence of stroke was very low (2.5% in 2009, and much lower than the prevalence of the other four diseases), stroke had the smallest population QALE lost among the five diseases, 0.78 years of population QALE loss in 2009.

Like heart disease, data on the burden of stroke for the whole nation were available only for 2005 through 2009. Stroke-related QALE losses at the individual level and at the population level did not change much during this time period. Like heart disease, the population-level QALE losses due to stroke were nearly unchanged between the ages 18 and 65 years and most of the population QALE loss occurred after age 65 years. Nearly all the population QALE loss occurred after age 55 years because most (84.4%) strokes occurred after age 55 years, and the prevalence of stroke for those aged 55 years and older was 5.9%, much higher than the 1.0% prevalence for younger adults.

The prevalence of stroke was nearly the same for both sexes (2.4% vs. 2.7% for men and women, respectively). Although women had slightly more QALE losses from stroke at both the individual level and the population level than did men, this difference was minimal. States with the most population QALE loss due to stroke in 2009 were Oklahoma (1.2), Arkansas (1.1), Kentucky (1.1), Missouri (1.0), and Mississippi (1.0).

Discussions

For public health planning, policymakers should be able to quantify the lifetime burden of specific diseases and to estimate the optimal burden that could be reduced by effective policies and programs [6,7]. This study used the QALE measurement to combine the duration and the quality of life as an index for the burden of each disease though different stages of life. Such an index allows the direct comparison of the burdens of different diseases or risk factors; the BOD in different demographic and socioeconomic subgroups, geographic regions, and time periods; and the effectiveness of different intervention programs, health policies, or treatments [7,11].

This study defines and calculates the QALE loss due to a disease both for those with the disease and for the entire population (both diseased and nondiseased). At the individual level, the QALE loss measures the overall impact of the disease on those who had the disease. It quantifies the severity and the prognostic outcome (both mortality and morbidity) of a disease in a single value. For example, stroke had the biggest individual-level QALE loss among the five diseases examined. This study ranks the severity and the prognosis of the five diseases from worse to the best as stroke, diabetes mellitus, heart disease, asthma,

and hypertension. This measure is also useful for the evaluation of the cost-effectiveness of disease treatments.

The individual-level QALE losses contributed by the five diseases are basically unchanged during the study period for two reasons. First, life expectancy has increased slightly for the US general population (about 4% in 17 years or about 0.2% annually) as well as in its main subgroups while HRQOL scores have declined slightly in recent years (0.1% annually) [26,27]. Together, the QALE has been relatively stable since 1993 (increased about 0.1% annually) and such trends have been observed in all major demographic subgroups and by the disease statuses. Second, the QALE is a measure of severity and prognostic outcomes of a disease over a lifetime. Although there have been significant recent advancements in the treatment of these diseases, the resulting changes in QALE may take many years to observe.

Compared with individual-level QALE loss, population QALE loss is more important for policymakers by allowing them to evaluate the maximum expected population impact of health policies and prevention programs. For example, hypertension had the most population QALE loss, much higher than did the other four diseases, mainly due to its high prevalence among US adults. Also, by examining changes in population QALE loss at different age intervals, policymakers can identify age groups most affected by particular diseases. For example, the population QALE losses due to asthma declined gradually by age. Therefore, one can concluded that asthma affects both younger and older populations in a similar manner in terms of BOD. By contrast, the decline in population QALE losses due to the other four diseases did not occur before age 45 years. For example, the stroke-related population loss remained unchanged between age 18 and 64 years, suggesting that stroke mostly affect older population. Therefore, stroke interventions would likely be most cost-effective by focusing on those aged 65 years and older while asthma interventions would be more likely to be most cost-effective across all age groups. This study also shows that the burdens of diabetes and hypertension for the US adults had increased significantly in the last 17 years because of the significant increases in their prevalence. While many explanations exist for these recent fast increases in hypertension and diabetes prevalence, this study provides evidence of the burden and the need for health policies and intervention programs for these two diseases.

QALE had been commonly used to evaluate prognosis for a specific disease [14,15]. For example, Oyunbileg et al. [14] estimated that the life expectancy for a cohort of 432 pneumoconiosis patients (average age 55.6 years) was 18.1 years compared with 27.6 years for those without the disease, a 9.5-year loss of life expectancy, and the QALE loss for pneumoconiosis was 12.5 years (15.1 years vs. 27.6 years). QALE was not commonly calculated to measure population health because of the lack of nationwide data including both HRQOL measures and end results (death) from diseases. Some investigators proposed obtaining HRQOL and mortality data from different data sets to estimate QALE [11,16]. Because HRQOL and mortality are highly associated, it is difficult to evaluate the reliability of estimated QALE by using data from different sources. A recent study provides the methodology to calculate QALE as well as their standard errors and demonstrates good reliability and small bias of the estimates [11,25].

For the future studies, it might be more useful to apply this method to evaluate health policies and interventions that promote healthy eating, physical activity, and smoking cessation. For example, one might be able to compare the difference in the QALE losses due to current smoking in a metropolitan area (such as New York City) before and after this metropolitan area implement bans on public smoking [28].

This study has two major weaknesses. First, respondents reported their own disease status, which was not validated by medical chart reviews. It is unlikely, however, that respondents would be motivated to report having a disease that they did not have, although it is possible that some individuals may forget to report a disease they have been diagnosed with. Moreover, because some who have diabetes or hypertension may not be aware of it, this study may have underestimated the disease prevalence and thus the losses in QALE due to these diseases. Second, the present study relied on unhealthy days' questions in the BRFSS to estimate preference-based HRQOL scores. The only large and population data set that includes direct preference-based HRQOL questions is the 2000–2003 Medical Expenditure Panel Survey (MEPS) [11,20,29]. Therefore, estimates of QALE loss would also likely be underestimated because of regress toward the mean [12,20,25,30,31]. The MEPS, however, would be unable to provide information on trends or at the state and local levels. Two previous studies that examined the bias of QALE estimates by comparing BRFSS and MEPS show that these underestimations were about 2.5% for QALE loss and 7% for population QALE loss. We consider such biases acceptable given that no other preference-based HRQOL data are available for such estimation. Also, because part of the discrepancies arose from sampling differences between the MEPS and the BRFSS, the actual bias from estimating preference-based HRQOL scores from the BRFSS unhealthy days' questions may be even smaller.

This study compared the differences in QALE for those who had diabetes, hypertension, asthma, heart disease, or stroke to those who did not have the disease. The proposed method can be particularly useful when examining burdens for common chronic diseases over time and at the local level (such as US states and some large substate areas) for program planning and evaluation. Resultant data might assist in the construction of specified quantitative targets for *Healthy People 2020* objectives and setting priorities for prevention in a given population as well as in sociodemographic subgroups [32,33].

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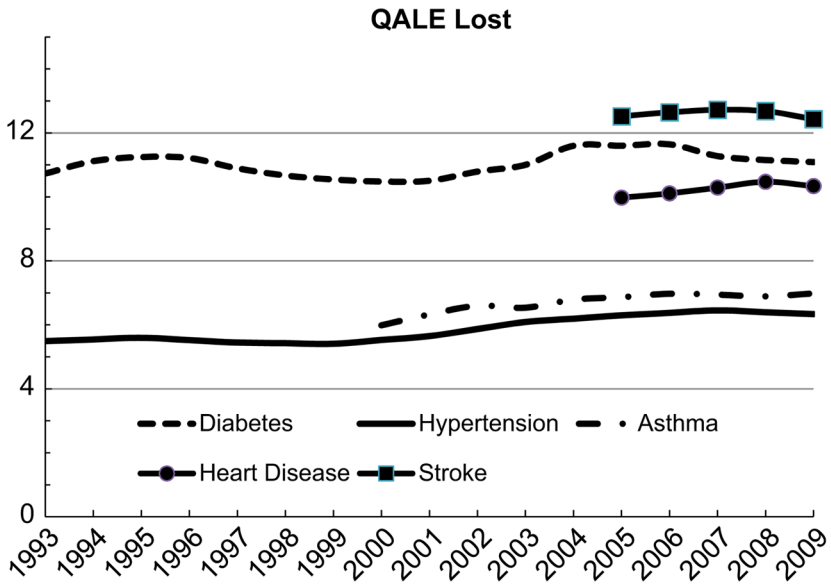

Fig. 1.

Trend of individual quality-adjusted life expectancy (QALE) loss due to diabetes, hypertension, asthma, heart disease, and stroke for US adults at 18 years of age, 1993–2009.

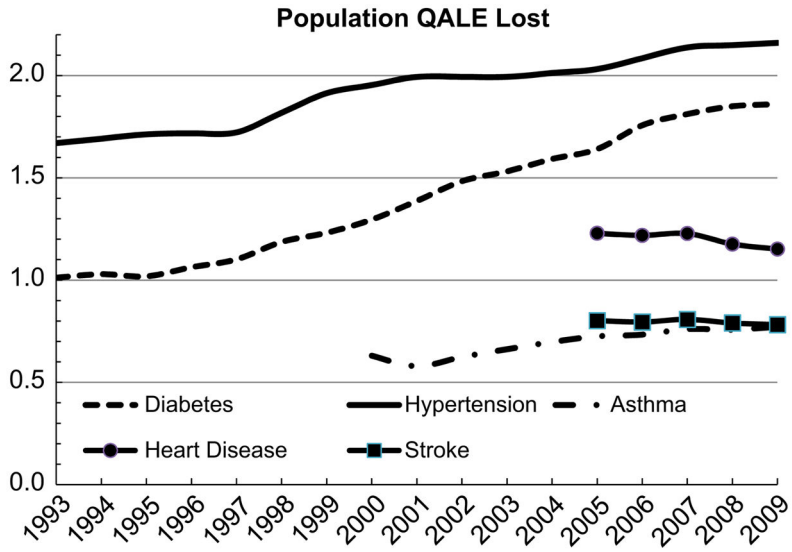

Fig. 2.

Trend of population quality-adjusted life expectancy (QALE) loss due to diabetes, hypertension, asthma, heart disease, and stroke for US adults at 18 years of age, 1993–2009.

Table 1

Life expectancy (LE), quality-adjusted life expectancy (QALE), and individual and population loss in LE and QALE due to diabetes, hypertension, asthma, heart disease, and stroke at 18 y of age, 2009.

	n*	HRQOL†	Life expectancy	SE	QALE	SE	% QALE lost to mortality
Total population	403,841	0.876	61.1	0.03	52.6	0.02	
By disease status							
Diabetes							
Yes	47,284	0.781	53.8	0.25	43.4	0.23	
No	356,238	0.885	62.8	0.20	54.5	0.16	
LE/QALE loss			9.0	0.09	11.1	0.15	66.2
Population LE/QALE loss			1.7	0.17	1.9	0.15	72.2
Hypertension							
Yes	154,627	0.829	59.3	0.23	48.4	0.19	
No	248,526	0.896	62.4	0.20	54.8	0.17	
LE/QALE loss			3.1	0.29	6.3	0.24	40.7
Population LE/QALE loss			1.3	0.17	2.2	0.15	48.1
Asthma							
Yes	35,372	0.782	57.0	0.22	46.4	0.20	
No	366,078	0.884	61.5	0.20	53.4	0.17	
LE/QALE loss			4.5	0.28	7.0	0.25	52.4
Population LE/QALE loss			0.4	0.18	0.8	0.15	43.2
Heart diseases							
Yes	35,004	0.718	55.3	0.26	43.4	0.30	
No	365,426	0.885	62.1	0.20	53.8	0.17	
LE/QALE loss			6.8	0.29	10.3	0.32	54.1
Population LE/QALE loss			1.0	0.18	1.2	0.15	72.1
Stroke							
Yes	15,264	0.704	52.1	0.29	41.0	0.34	
No	387,611	0.880	61.8	0.21	53.4	0.17	
LE/QALE loss			9.8	0.32	12.4	0.36	64.6
Population LE/QALE loss			0.7	0.18	0.8	0.15	74.5

BRFSS, Behavioral Risk Factor Surveillance System; HRQOL, health-related quality of life; SE, standard error.

*BRFSS sample sizes. Sample sizes may not summarize to total because of missing values.

†Mean HRQOL scores are adjusted by age and sex.

Table 2

Individual quality-adjusted life expectancy (QALE) loss and population QALE loss due to diabetes, hypertension, asthma, heart disease, and stroke at different ages, 2009.

	Diabetes		Hypertension		Asthma		Heart disease		Stroke	
	Value	SE	Value	SE	Value	SE	Value	SE	Value	SE
At age (y)	QALE loss									
18	11.1	0.15	6.3	0.24	7.0	0.25	10.3	0.32	12.4	0.36
25	10.8	0.14	6.0	0.24	7.0	0.24	10.2	0.29	12.2	0.34
35	10.0	0.11	5.2	0.23	6.9	0.23	9.3	0.25	11.2	0.30
45	8.9	0.09	4.3	0.22	6.4	0.22	7.9	0.22	9.2	0.24
55	7.3	0.07	3.3	0.22	5.2	0.22	5.9	0.21	7.2	0.23
65	5.5	0.06	2.3	0.20	4.0	0.21	4.3	0.19	5.4	0.19
75	4.0	0.05	1.3	0.15	2.7	0.15	2.7	0.12	3.6	0.12
85	3.0	0.04	0.9	0.03	2.0	0.06	2.1	0.04	2.8	0.04
At age (y)	Population QALE loss									
18	1.9	0.15	2.2	0.15	0.8	0.15	1.2	0.15	0.8	0.15
25	1.9	0.15	2.2	0.15	0.8	0.15	1.2	0.15	0.8	0.15
35	1.9	0.14	2.1	0.14	0.7	0.14	1.3	0.15	0.8	0.15
45	1.9	0.14	2.0	0.14	0.7	0.14	1.3	0.14	0.8	0.14
55	1.7	0.14	1.8	0.14	0.5	0.14	1.3	0.14	0.8	0.15
65	1.4	0.13	1.3	0.13	0.4	0.13	1.1	0.13	0.8	0.14
75	1.0	0.09	0.7	0.10	0.2	0.09	0.9	0.10	0.7	0.10
85	0.7	0.02	0.5	0.03	0.1	0.02	0.7	0.02	0.6	0.02

SE, standard error.

Table 3

Gender differences in individual quality-adjusted life expectancy (QALE) loss and population QALE loss due to diabetes, hypertension, asthma, heart disease, and stroke at 18 y of age, 2009.

Diseases	Sex	QALE loss	SE	Population QALE loss	SE
Diabetes	M	9.0	0.20	1.7	0.21
	F	12.9	0.20	2.0	0.11
Hypertension	M	6.2	0.33	2.1	0.21
	F	6.8	0.19	2.2	0.11
Asthma	M	6.6	0.36	0.5	0.21
	F	7.4	0.21	1.0	0.11
Heart disease	M	9.4	0.42	1.4	0.22
	F	12.1	0.31	0.9	0.11
Stroke	M	13.3	0.51	0.7	0.22
	F	11.5	0.33	0.9	0.12

F, female; M, male; SE, standard error.

Table 4

State population quality-adjusted life expectancy (QALE) loss due to diabetes, hypertension, asthma, heart disease, and stroke for 18-y-old US adults, 2009.

State	Diabetes	SE	Hypertension	SE	Asthma	SE	Heart disease	SE	Stroke	SE
Alabama	2.26	0.25	2.42	0.27	0.81	0.25	1.46	0.26	0.94	0.26
Alaska	1.41	0.46	2.24	0.47	1.05	0.45	1.60	0.49	0.68	0.47
Arizona	1.83	0.31	1.77	0.31	0.75	0.32	1.60	0.32	0.82	0.32
Arkansas	2.10	0.30	2.87	0.30	0.91	0.30	1.79	0.30	1.10	0.30
California	2.01	0.23	2.17	0.24	0.68	0.24	1.09	0.24	0.77	0.24
Colorado	1.26	0.23	1.72	0.23	0.53	0.23	0.95	0.24	0.50	0.24
Connecticut	1.30	0.28	1.43	0.27	0.60	0.28	1.08	0.29	0.51	0.29
Delaware	1.74	0.38	1.73	0.39	0.66	0.38	1.40	0.39	0.86	0.39
District of Columbia	1.97	0.62	2.52	0.63	0.74	0.61	0.95	0.63	0.85	0.63
Florida	2.02	0.28	2.36	0.26	0.80	0.28	1.81	0.28	0.93	0.28
Georgia	2.05	0.28	2.23	0.27	0.78	0.27	1.43	0.28	0.81	0.28
Hawaii	1.76	0.31	1.93	0.32	0.66	0.30	1.06	0.32	0.81	0.32
Idaho	1.57	0.29	2.16	0.29	0.73	0.29	1.30	0.30	0.65	0.30
Illinois	1.76	0.28	2.26	0.28	0.70	0.28	1.34	0.29	0.77	0.29
Indiana	2.08	0.25	2.20	0.24	0.91	0.25	1.63	0.25	0.86	0.25
Iowa	1.51	0.24	2.14	0.24	0.57	0.24	1.28	0.24	0.64	0.24
Kansas	1.73	0.19	1.82	0.18	0.67	0.19	1.17	0.19	0.62	0.19
Kentucky	2.23	0.27	3.04	0.28	1.09	0.28	1.88	0.28	1.08	0.28
Louisiana	2.20	0.24	2.52	0.24	0.69	0.24	1.74	0.25	0.92	0.24
Maine	1.63	0.26	1.90	0.26	0.83	0.26	1.53	0.27	0.79	0.27
Maryland	1.67	0.26	2.05	0.26	0.66	0.26	1.27	0.27	0.71	0.26
Massachusetts	1.51	0.23	1.59	0.23	0.79	0.24	1.18	0.24	0.53	0.24
Michigan	1.76	0.23	2.13	0.23	0.80	0.23	1.49	0.23	0.74	0.23
Minnesota	1.23	0.26	1.38	0.25	0.53	0.26	1.15	0.27	0.64	0.27
Mississippi	2.30	0.22	3.18	0.22	0.84	0.21	1.70	0.22	1.01	0.22
Missouri	1.84	0.28	2.28	0.28	1.05	0.28	1.64	0.29	1.02	0.29
Montana	1.30	0.27	1.56	0.27	0.74	0.27	1.12	0.28	0.70	0.27

State	Diabetes	SE	Hypertension	SE	Asthma	SE	Heart disease	SE	Stroke	SE
Nebraska	1.60	0.24	1.46	0.25	0.54	0.24	1.09	0.25	0.61	0.25
Nevada	1.84	0.37	1.56	0.38	0.87	0.36	1.42	0.38	0.82	0.37
New Hampshire	1.42	0.29	1.54	0.30	0.79	0.29	1.08	0.30	0.55	0.30
New Jersey	1.71	0.27	1.87	0.27	0.67	0.27	1.27	0.28	0.56	0.28
New Mexico	1.57	0.29	2.52	0.27	0.76	0.29	1.23	0.30	0.69	0.29
New York	1.92	0.34	1.83	0.34	0.95	0.34	1.37	0.35	0.71	0.35
North Carolina	1.91	0.23	2.44	0.23	0.74	0.23	1.47	0.23	0.73	0.24
North Dakota	1.45	0.25	1.54	0.26	0.63	0.25	1.10	0.26	0.74	0.26
Ohio	1.99	0.22	2.20	0.22	0.98	0.21	1.60	0.22	0.78	0.22
Oklahoma	2.14	0.22	2.71	0.22	1.03	0.21	1.91	0.22	1.21	0.22
Oregon	1.39	0.28	1.51	0.28	0.75	0.29	1.08	0.29	0.76	0.29
Pennsylvania	1.71	0.23	2.24	0.23	0.73	0.23	1.44	0.23	0.60	0.23
Rhode Island	1.30	0.29	1.44	0.30	0.83	0.29	1.18	0.30	0.65	0.30
South Carolina	1.97	0.27	2.50	0.26	0.81	0.26	1.50	0.27	0.94	0.27
South Dakota	1.27	0.25	1.79	0.25	0.65	0.24	1.31	0.26	0.74	0.25
Tennessee	2.11	0.30	2.56	0.29	1.04	0.30	1.75	0.31	0.85	0.31
Texas	1.93	0.23	2.35	0.23	0.64	0.24	1.49	0.24	0.81	0.24
Utah	1.36	0.24	1.74	0.24	0.59	0.24	1.33	0.25	0.71	0.25
Vermont	1.18	0.34	1.97	0.35	0.73	0.34	1.24	0.36	0.59	0.36
Virginia	1.70	0.29	1.93	0.29	0.77	0.29	1.35	0.30	0.72	0.30
Washington	1.46	0.23	1.77	0.23	0.74	0.23	1.17	0.23	0.77	0.24
West Virginia	2.20	0.31	3.28	0.30	1.13	0.30	2.29	0.31	0.98	0.31
Wisconsin	1.67	0.27	1.45	0.29	0.65	0.28	1.26	0.28	0.61	0.28
Wyoming	1.42	0.23	1.68	0.24	0.72	0.23	1.21	0.24	0.64	0.24

SE, standard error.