The Burden of Premature Mortality in Turkey in 2001 and 2008

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Background: Standard expected years of life lost (SEYLL) is a measure that is used to evaluate losses due to premature deaths.

Aims: The present study provides an analysis of premature mortality in Turkey for the years 2001 and 2008 and supplies evidence for making policies and setting health agendas over the long term.

Study Design: Cross-sectional study.

Methods: This study calculated SEYLL by gender, age group and causes of death in Turkey in 2014. The SEYLL measure counts the years lost in a population as a result of premature mortality and is computed by multiplying the number of deaths and standard life expectancy at the age at which death occurs.

Results: The burden of premature mortality in Turkey was calculated as 4 104 253 SEYLL and 4 472 443 SEYLL in 2001 and 2008, respectively. Among these 42.7% and 43.9% of SEYLL were in females in 2001 and 2008, respectively. The leading five causes of premature mortality in the Turkish population in 2001 were cardiovascular system diseases (34.72%), perinatal conditions (12.69%), neoplasms (12.51%), external causes of injury (7.66%), and infections and parasitic diseases (6.57%). In 2008, the major causes were cardiovascular diseases (41.17%), neoplasms (14.63%), respiratory system diseases (9.81%), perinatal conditions (5.59%), and external causes of injury (5.29%).

Conclusion: The majority of the burden of premature mortality in Turkey is attributable to non-communicable diseases. While premature deaths from infections and parasitic diseases, perinatal conditions and congenital anomalies decreased between 2001 and 2008, deaths from cardiovascular diseases, neoplasms and respiratory system diseases increased dramatically. Coordinated efforts for effective national prevention programs (such as regular monitoring of adults for early diagnosis of cardiovascular diseases and for malignancies by family physicians) should be developed by policy makers to decrease preventable and premature deaths from non-communicable diseases.

Keywords: Premature mortality, disease burden, standard expected years of life lost

The most appropriate measure to quantify the health status of a population or to make comparisons between populations has been debated for quite some time. Previously, age-specific and age-adjusted mortality have been used to compare health status between populations (1). Classical measures of mortality are influenced by diseases seen in older age groups and as a consequence they do not fully represent the burden of premature mortality (2,3). Measures that consider age of death provide a more accurate assessment of mortality because they also measure the losses due to premature mortality (4). Globally, health measures that include the time lost due to premature death are increasingly being used in public health, as up-to-date evidence on trends for age/sex-specific and cause-specific mortality is necessary for the development of health policies (5,6).

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Recently, new indicators such as disease burden have been developed to measure population health by combining morbidity, disability and mortality (7). Disease burden is a mathematical model that combines different data about health to compute and compare losses from different causes of morbidity and mortality in a population. One component of this model is disability adjusted life years (DALY), which combines years of life lost from premature deaths and years lived with disability (YLD) estimates to compute loss of healthy life from specific risk factors (8).

To report the burden of disease due to premature mortality in certain populations, a standardized form of years of life lost was developed in the Global Burden of Disease Study (9). Standard expected years of life lost (SEYLL) gives more weight to deaths that occur at young ages and less weight to deaths that occur at older ages. This new understanding quantifies the impact of premature deaths on a certain population, and does not only assess the number of deaths. SEYLL has some advantages as a measure of the burden of premature mortality because deaths at all ages take into account for calculating the burden of diseases independent from the population in which they occur (some other approaches use a certain cut-off age e.g., 65, 70 or 75 years) (7).

The burden of disease can be computed to obtain timely information about the health state of a population by using multiple data sources of mortality and morbidity and the contribution of different illnesses and accidents and injuries (10).

Summary measures guide health policy-makers on future health precedence and supply a way of monitoring the population's health and evaluating health care services. Summary measures like SEYLL, which quantify the burden of disease in certain populations, should be used by health policy-makers to plan health prevention and control programs (11). Countries can use this type of evidence to make policies, set their health agenda and assess the importance of diseases, injuries and risk factors in causing premature death and loss of health and to make comparisons with different countries (11).

Accordingly, the present study provides an analysis of premature mortality in Turkey for the years 2001 and 2008 and supplies evidence for making policies and setting the health agenda over the long term.

MATERIALS AND METHODS

This study calculated SEYLL by gender, age group and causes of death in Turkey in 2014. Demographic data and death records of the Turkish population were obtained from the official registers of the Turkish Statistical Institute (TSI) (12). Data from 2001 and 2008 were used because the TSI have only published the details of age, gender and causes of death (for all age groups and for all disease groups) for these years. Deaths in Turkey were analyzed and classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10).

Standard expected years of life lost is a component of the disability adjusted life year (DALY) measure of disease burden. SEYLL is calculated from the expected remaining years, as specified by a normative survivorship that is derived from a model life table (2). The SEYLL measure counts the loss of years lived in a population as a result of premature mortality and is computed by multiplying the number of deaths and standard life expectancy at the age at which death occurs (7). As a substantial component of the disability-adjusted life years and measure of disease burden, SEYLL was calculated using World Health Organization standard life tables with life expectancy in 2000 for 2001 calculations and 2009 for 2008 calculations in this study (13).

To calculate SEYLL, the deaths were classified into 5-year age groups based on age at death of all people. The SEYLL was computed by multiplying the count of deaths (N) at a certain age with the rest of life expectancy (L) at the age of death (x):

$$SEYLL = NxL_x$$

The formula is as follows, with age-weighting and time-discounting terms:

$$SEYLL = N\,Ce^{(ra)} / (\beta+r)^2\,[e^{-(\beta+r)(L+a)}[-(\beta+r)(L+a)-1] - e^{-(\beta+r)a}[-(\beta+r)a-1]$$

where N=count of deaths, r=the discount rate, C=the age-weighting correction constant, e=a constant, β=the parameter from the age-weighting function, a=the age at death and L=the rest of life expectancy at the age of death (14).

The SEYLL for each person was summed to generate the total SEYLL for the population. Then, the SEYLL for both sexes, all age groups and cause of mortality was calculated and reported as a percentage. All data were analyzed and prepared in The Statistical Package for the Social Sciences version 21.0 (IBM Corp; Armonk, NY, USA).

This study was approved by Scientific Research Ethics Board of Trakya University School of Medicine.

Because TSI publishes demographic data and death records of the Turkish population anonymously via the official web site of the Institution, no permission was obtained.

TSI records for 2001 show a total Turkish population of 64 100 297, a crude mortality rate of 3.97/1000 and an infant mortality rate of 29 per 1000 live births. In 2008 the equivalent numbers were 70 363 511, 4.02/1000 and 17 per 1000 live births, respectively (15-17).

RESULTS

In Turkey, the burden of premature mortality was estimated to be 4 104 253 SEYLL and 4 472 443 SEYLL in 2001 and 2008 respectively; of these 42.7% and 43.9% were in females in 2001 and 2008 respectively (Figure 1). The SEYLL rate per 1 000 Turkish people was 64.0 in 2001 and 63.6 in 2008.

Figure 2 shows the SEYLL proportions by age groups in 2001 and 2008. It is apparent that SEYLL rates were high for children aged under 5 years and then dropped off in subsequent years. SEYLL rates increased slowly to 70 years, then peaked after 75 years of age. On account of age, the burden of premature mortality was high in ages under 5 years old in both 2001 and 2008 (30.9% and 22.1% respectively), but decreased dramatically from 2001 to 2008. Almost 11% of the burden of premature mortality in 2001 was in those aged over 75 years old and this increased to 18.4% in 2008.

Chronic non-communicable diseases (Group II) made up 66.7% of the total SEYLL, communicable, maternal, perinatal and nutritional conditions (Group I) made up 25.6% and accidents and injuries (Group III) made up 7.6% of the total SEYLL in 2001 (Table 1). In 2008, the proportion of chronic non-communicable diseases (Group II) increased to 83.5%, whereas that of communicable, maternal, perinatal and nutritional conditions (Group I) and accidents and injuries (Group III) decreased to 11.1% and 5.3%, respectively (Table 1).

The leading five causes of premature mortality in the Turkish population in 2001 were cardiovascular system diseases (34.72%), perinatal conditions (12.69%), neoplasms (12.51%), external causes of injury (7.66%), and infections and parasitic diseases (6.57%) (Table 2). In 2008 the composition and the ranking of the leading five causes of premature mortality changed. The major cause was cardiovascular diseases (41.17%). Neoplasms (14.63%), respiratory system diseases (9.81%), perinatal conditions (5.59%), and external causes of injury (5.29%) ranked second, third, fourth and fifth respectively (Table 2).

Standard expected years of life lost calculated by sex showed small variations between males and females. The ranking of leading causes was similar for both sexes. For females, the leading five causes in 2001 were cardiovascular diseases, perinatal conditions, neoplasms, infections and parasitic diseases and congenital anomalies, while in 2008 neoplasms were ranked second and respiratory system diseases third. In males, external causes of injury were among the leading five causes of premature mortality instead of infections and parasitic diseases, both in 2001 and 2008 (Figure 3-4). SEYLL due to cardiovascular system diseases was higher in females than males in both years. And SEYLL due to external causes of injury was higher in males than females in both years (Figure 3,4).
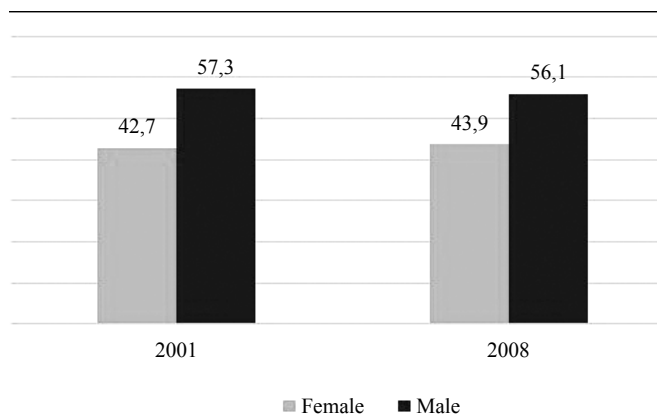
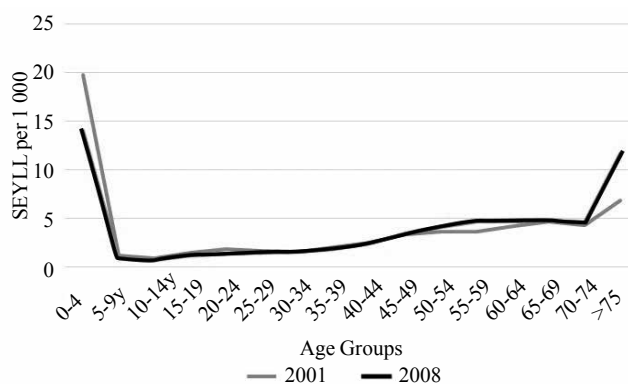**FIG. 1.** Distribution of standard expected years of life lost (SEYLL) by gender and year

FIG. 2. Distribution of standard expected years of life lost (SEYLL) by age group and year

TABLE 1. Standard expected years of life lost (SEYLL) by broad cause group, Turkey, 2001 and 2008

	2001			2008		
Case Group	Number	%	Rate per 1,000	Number	%	Rate per 1,000
Group I	1 052 396	25.6	16.4	499 849	11.1	7.1
Group II	2 738 769	66.7	42.7	3 736 049	83.5	53.1
Group III	314 087	7.6	4.9	236 545	5.3	3.4
Overall	4 104 252	100	64.0	4 472 443	100	63.6

Group I: communicable, maternal, perinatal and nutritional conditions;
Group II: non-communicable diseases; Group III: accidents and injuries

DISCUSSION

Comparative analyses of mortality and burden of premature mortality are a critical part of the evidence that guides health policies and development strategies. This study estimated the burden of premature mortality in Turkey in 2001 and 2008 on the basis of SEYLL. In 2001 and 2008, 64.0 and 63.6 years respectively were lost per 1 000 people be-

TABLE 2. Standard expected years of life lost (SEYLL) by year and some cause categories

| Cause categories	2001			2008		
	SEYLL	% of total SEYLL	Rank	SEYLL	% of total SEYLL	Rank
Infectious and parasitic diseases	269625	6.57	5	166422	3.72	6
Malign and benign neoplasms	513367	12.51	3	654340	14.63	2
Endocrine, nutritional and metabolic diseases	58502	1.43	11	50120	1.12	11
Blood disorders	7000	0.17	12	5480	0.12	12
Nervous system and sense organ diseases	63956	1.56	10	64884	1.45	10
Cardiovascular system diseases	1424382	34.72	1	1841497	41.17	1
Respiratory system diseases	252643	6.16	7	438840	9.81	3
Digestive system diseases	67416	1.64	9	84203	1.88	8
Urogenital system diseases	68094	1.66	8	96546	2.16	7
Congenital anomalies	258307	6.3	6	81266	1.82	9
Perinatal conditions	520788	12.69	2	249862	5.59	4
External causes of injury	314087	7.66	4	236544	5.29	5
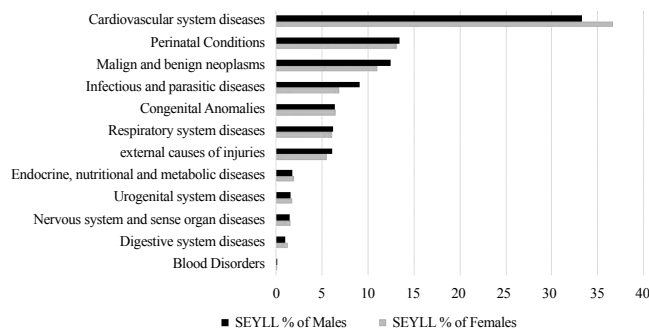
FIG. 3. Standard expected years of life lost (SEYLL) by gender in 2001
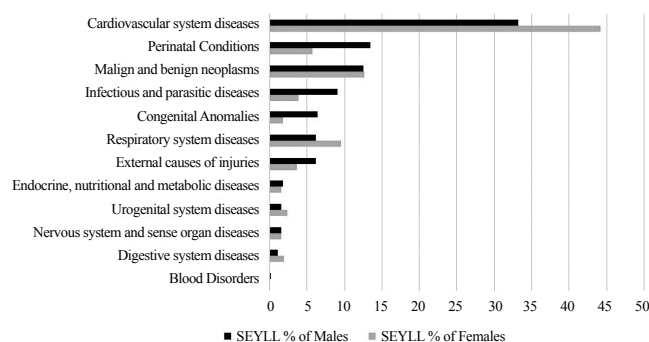

FIG. 4. Standard expected years of life lost (SEYLL) by gender in 2008

cause of early deaths, among which 42.7% and 43.9% were in females, as in all developing countries (5). However, our calculated result was lower than that (74.3/1000 people) of the National Burden of Disease Study of Turkey, 2004 (18). The difference in the results may have stemmed from the use of household survey and verbal autopsy results as well as the official records of the TSI in the National Burden of Disease Study of Turkey, 2004 (18).

An important finding of this study is that the burden of premature mortality was high in the under-5s in both 2001 and 2008 (30.9% and 22.1% respectively), but it decreased dramatically from 2001 to 2008. Since 1990, Turkey has witnessed a rapid decline in the under-5 mortality rate. The reduction in the under-5 mortality rate between 2001 and 2008 was 35%. The reduction in the rate of under-5 SEYLL between 2001 and 2008 was 30% and was similar to the reduction in the overall mortality rate (19). The reduction in both components (neonatal and post-neonatal) of the infant mortality rate (IMR) has enabled this decline. Shrinking family size and improved education for women, plus extensive improvements in the public health and health services in the country are responsible. The expansion of prenatal diagnosis and prenatal care, the increase in giving birth in health facilities and the expansion of neonatal intensive care in the country have contributed to the improved survival of newborns and children in this period (19).

Almost 11% of total SEYLL belonged to those over 75 years old in 2001 and this increased to 18.4% in 2008. Increased years of life expectancy at birth (72.3 years in 2001 and 75.7 years in 2008), an increase in the percentage of elderly (65 years old and over) in the total population (6% in 2001 and 6.8% in 2008) and the increasing rate of chronic diseases in Turkey may explain this transition (20-22).

The leading cause of premature deaths in our country was chronic non-communicable diseases (Group II) in both 2001 and 2008, as in all developing and developed countries (3,7,23-25). However, the proportion of deaths due to chronic non-communicable diseases increased from 66.7% in 2001 to 83.5% in 2008, whereas the proportion of communicable, maternal, perinatal and nutritional conditions (Group I) declined from 25.6% in 2001 to 11.1% in 2008, following the same pat-

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tern as in other developed countries. In the developing world, 29% of deaths due to chronic non-communicable diseases occurred before 60 years of age whereas the equivalent rate was only 13% in developed countries (26). As in this study, the majority of Years of Life Lost (60.1%) was due to Group II diseases (chronic non-communicable diseases) in the National Burden of Disease Study of Turkey, 2004 and the ranking of causes of SEYLL was similar in 2001, 2004 and 2008 (18).

Another important finding of this study is the dramatic increase in the percentage of SEYLL due to chronic non-communicable diseases such as cardiovascular system diseases (34.7% to 41.2%), neoplasms (12.5% to 14.6%) and respiratory system diseases (6.2% to 9.8%), and the dramatic decrease in the percentage of SEYLL due to infectious and parasitic diseases (6.6% to 3.7%). This finding suggested an epidemiological transition of diseases from communicable to non-communicable diseases as in all other developed and developing countries (7,25,27-29). Chronic diseases are no longer only a problem of the developed world because it was reported that more than 80% of deaths due to chronic diseases took place in low and middle income countries (7,24,25,27-29). Similarly, the National Burden of Disease Study of Turkey, 2004 and the Turkey Prevalence of Chronic Diseases and Risk Factors Study reported a silently rising epidemic of non-communicable diseases in our country; the results of this study support the findings of that population-based study, which was carried out in 2013 (18,22).

Sex-specific SEYLL rates were higher in males than females for both years. The reason for this difference is that the quantity of perinatal conditions, congenital malformations and injuries that cause deaths at early ages was higher in males for both years. This was similar to the findings of the National Burden of Disease Study of Turkey, 2004 (98.6 YLL/1000 for males and 76.4/1000 for females) (18).

This study has some limitations. Calculating SEYLL requires reliable sources of mortality data. There are some problems with the current death registries, as 30% of registries contain faults in the Central Population Statistics System (30). There is insufficient data about deaths that occur outside health facilities, and for deaths that occur in rural areas, the medical cause of death may not be correct or recorded appropriately (30). We used death records that were based on nationwide registers from the Turkish Statistical Institute. The validity of the mortality data depends mostly on the accuracy and quality of the death records. We cannot verify the accuracy of the death certificates, which could potentially result in information bias. Another limitation of this study is that the SEYLL measure that we used is based only on death rates and does not deal with different disease conditions and their effect on public health. Other indicators of health status, such as disability adjusted life years and quality adjusted life years deal not only with the duration of life but also other outcomes such as non-fatal disabilities, combined mortality and morbidity issues in a single value.

Other methods of measuring years of life lost take into account only deaths before 65 or 70 and reduce the burden of some causes more if they occur at older ages or mortality is lower. Applying the SEYLL method as in the Global Burden of Disease Study like a life table standard with a very low mortality increases the burden of mortality at older ages (31).

This study analyzed deaths at earlier ages at the population level in Turkey. The burden of premature mortality in Turkey was attributable to non-communicable diseases, specifically cardiovascular diseases, neoplasms, perinatal conditions, respiratory system diseases and injuries in both 2001 and 2008. While infections and parasitic diseases, perinatal conditions and congenital anomalies decreased, cardiovascular diseases, neoplasms and respiratory system diseases increased dramatically from 2001 to 2008.

From a social perspective, the age at death is important if it occurs in the productive period of life. Because SEYLL mostly represents preventable loss of life, it will be an important guide for health policy makers. Coordinated efforts for evidence-based national prevention programs, like regular monitoring of adults for early diagnosis of CVS diseases and for malignancies by family physicians, supported by medical technology and more effective disease management programs based on clinical guidelines, should be made by policy makers in order to decrease preventable and premature deaths from non-communicable diseases. Effective health promotion programs for improving lifestyle factors (e.g., cigarette smoking, dietary salt intake, weight loss and alcohol consumption) and controlling risk factors such as obesity, smoking and arterial hypertension are also needed. Finally, there is a need to reduce social inequalities in order to reduce the disease burden of all causes of premature mortality.

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