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## Original Research

# Measuring the burden of disease and injury in Spain using disability-adjusted life years: An updated and policy-oriented overview

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## SUMMARY

**Objective:** To provide a comprehensive and detailed overview of the burden of disease in Spain for 2008. Implications for public health policies are discussed.

**Study design:** Cross-sectional population-based study.

**Methods:** Disability-adjusted life years (DALYs) were calculated at country level using the methodology developed in the Global Burden of Disease study. DALYs were divided into years of life lost and years of life lived with disability. Results were obtained using Spanish mortality data for 2008 and morbidity data estimated previously by the World Health Organization for Euro-A.

**Results:** In 2008, DALYs lost due to all diseases and injuries were estimated at 5.1 million. Non-communicable diseases accounted for 89.2% of the total DALYs. The leading causes of DALYs were neurological and mental disorders (29.9%), malignant neoplasms (15.8%) and cardiovascular diseases (12.5%). The main specific causes included depression (5.5%), ischaemic heart disease (5.5%), lung cancer (5.3%) and alcohol abuse (4.7%) among males; and depression (11.7%), dementias (10.0%), hearing loss (4.2%) and cerebrovascular disease (3.5%) among females.

**Conclusions:** Measuring DALYs specifically for Spain represents a systematic analysis of population health losses, and also provides an important measure to track the outcomes of future health interventions.

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## Introduction

Mortality measures such as life expectancy, infant mortality or cause-specific mortality rates have traditionally been used as metrics of a population's health. Spain, like most Western developed countries, has experienced high increases in life expectancy due to improved living conditions, public health interventions and improvements in the healthcare system. In particular, adult mortality rates have declined since the 1970s, leading to a life expectancy of 84.3 years for females and 78.2 years for males in 2008 (for both females and males aged >40 years with 78% and 69% of gains in life expectancy at birth between 1980 and 2008, respectively). Furthermore, maternal and infant mortality rates have experienced a dramatic improvement, with current rates scoring below European averages.<sup>1–4</sup> However, demographic and epidemiological transition observed in the past decades, with their greater predominance of chronic (non-communicable) diseases and long life expectancy, render it necessary for more sensitive measures to be sought that, aside from mortality, take into account the disability or losses of health-related quality of life caused by different health problems.<sup>5</sup>

In the Global Burden of Disease (GBD) study,<sup>6,7</sup> a new summary measure of population health was promoted to estimate and compare the magnitude of diseases and injuries in different regions and countries by combining both their fatal and non-fatal consequences, which could be expressed in a single metric, namely disability-adjusted life years (DALYs). DALYs have been used to assess global health trends and to set global health priorities.<sup>6,8</sup> Furthermore, studies using DALYs for specific countries,<sup>9–12</sup> subregions of countries<sup>13–16</sup> and health conditions<sup>17,18</sup> have been undertaken to guide debates for health planning and decision-making processes.<sup>8,19,20</sup> The ultimate goal of such studies should be the definition of health policies and programmes that decrease the overall impact and inequalities in disease, disability and premature death.

This paper provides a comprehensive and detailed overview of the burden of disease and injury in Spain for 2008, and will also discuss the implications for public health policies.

## Methods

The methods used for this study are directly derived from those developed in the original GBD study.<sup>6</sup> The authors largely followed this methodology to quantify the magnitude and distribution of diseases and injuries in the Spanish population by estimating DALYs by specific cause, sex and age group for 2008. Mortality data for disease causes of death were also provided. Following the disease burden classification system, health problems were divided into three broad groups: communicable diseases and maternal, perinatal and nutritional disorders (Group I); chronic non-communicable diseases (Group II); and all injuries (Group III). These groups are divided into 21 major categories that are mutually exhaustive and exclusive, and which can be disaggregated into approximately 100 subcategories.

DALYs for a disease or health condition in a population are calculated as the sum of years of life lost (YLLs) due to premature mortality and the years lived with disability (YLDs). One DALY can be thought of as one lost year of 'healthy' life. The sum of these DALYs across the population can be thought of as a measurement of the health gap between current status and an ideal situation where the entire population lives to an advanced age, free of disease and disability.<sup>6,9</sup>

### Calculation of YLLs

YLLs correspond to the number of un-lived years in a population as a consequence of premature mortality. The basic formula is:

$$YLL = N \times L$$

where  $N$  is the number of deaths due to a given cause of death, by age and sex, and  $L$  is standard life expectancy at age of death that enables the number of years lost due to each death to be ascertained.

Country-specific mortality data from 2008 by sex, age and cause of death were obtained from anonymized death records of the Spanish National Statistics Institute (Instituto Nacional de Estadística).<sup>21</sup> Death certificate data are coded according to the International Classification of Diseases, 10th Revision. For the current study, the standard expectations of the GBD study were used, where the 'ideal' standard life expectancies are based on a model life table – namely, Coale and Demeny West level 26 – which has a life expectancy at birth for females of 82.5 years and 80 years for males.<sup>6,22</sup>

### Calculation of YLDs

YLDs express the years of healthy life 'lost' due to living in a state of less-than-perfect health, and are estimated according to the time spent in such states and their degree of severity on a scale from 0 (perfect health) to 1 (dead). The basic formula is:

$$YLD = I \times DW \times L$$

where  $I$  is the number of incident cases,  $DW$  is disability weight, and  $L$  is average duration of the case until remission or death (years).

In this context, disability is understood in its fullest sense, incorporating personal, functional and social evaluations, and seeks to measure the social usefulness or value assigned by individuals to different states of health. For the purposes of this study, the authors selected morbidity and disability weight data previously published in the GBD 2004 study for countries belonging to the Euro-A region<sup>7</sup> – the Western European countries registering very low child and adult mortality, including Spain – together with 2008 mid-year Spanish data for specific age and sex groups. Therefore, these calculations should always be considered updated estimates from those previously reported by the World Health Organization in the GBD study. According to the GBD study, diseases were classified into two groups: high-mortality diseases (with age- and gender-based YLD-to-YLL ratios <10)

and low-mortality diseases (with age- and gender-based YLD-to-YLL ratios  $\geq 10$ ). In the first case, YLDs were computed by multiplying the YLLs specifically calculated for Spain by the proportion of YLD-to-YLL ratios corresponding to the Euro-A region. In the case of low-mortality diseases, YLDs were computed by multiplying the Euro-A region YLD rates by the Spanish population for each specific age group and both sexes.

### Discounting and age weighting

Social values were incorporated into the calculation of DALYs, YLLs and YLDs. In order to allow comparisons with other burden of disease studies, discount rates ( $r = 3\%$ ) and age weighting ( $K = 1$ ) were applied as proposed by Murray and Lopez. Finally, all data were analysed and prepared in GesMor (Instituto de Salud Carlos III, Madrid, Spain and Funsalud, Mexico DF, Mexico) and Epidat 4.0 (Consellería de Sanidade, Xunta de Galicia, Spain and Pan American Health Organization, Washington D.C., USA) software packages.<sup>23,24</sup>

## Results

### Total burden of disease and injury in Spain

In Spain, the burden of disease and injury was estimated to be 5,066,693 DALYs (47.1% of them in females) in 2008, with DALY rates per 1000 Spanish people of 111.0 (119.1 for males and 103.3 for females). From the total number of DALYs, 41.4% were due to premature mortality (YLLs) and 58.6% were due to disability (YLDs). Chronic non-communicable diseases (Group II) accounted for 89.2% of the total number of DALYs (48.2% in females); accidents and injuries (Group III) accounted for

5.9% of the total number of DALYs (26.7% in females); and communicable, maternal, perinatal and nutritional conditions (Group I) accounted for the remaining 4.9% of the total number of DALYs (50.7% in females).

Table 1 shows disease categories of crude mortality and DALYs for all ages and both sexes. Table 2 shows the top 30 disease causes with the highest crude mortality rates and DALYs for all ages and both sexes. Neurological and mental disorders caused the greatest loss of DALYs (29.9%), and were a much greater burden for females (35.3%) than they were for males (25.1%). Malignant neoplasms ranked second (15.8% of DALYs), followed by cardiovascular diseases (12.5%) – both with more weight in men. These three disease categories accounted for 58.2% of the total DALYs lost in the Spanish population.

Calculating DALYs by sex revealed variations between males and females in the burden of disease. The ranking of the leading disease categories (Table 3) and specific causes (Table 4) in terms of DALYs and crude mortality were different for the two sexes. Unipolar depression was the leading cause of disease burden for both males and females (5.5% and 11.7% of the total DALYs, respectively). For males, ischaemic heart disease (5.5%) and lung cancer (5.3%) ranked second and third, respectively, followed by alcohol abuse (4.7%) and dementias (4.4%). Dementias (10.0%) and hearing loss (4.2%) were the second and third contributors for females, followed by cerebrovascular disease (3.5%) and osteoarthritis (3.2%).

Broken down by sex, DALY components were divided almost equally in males, whilst disability (YLDs) accounted for two-thirds (65.6%) of the burden of disease for females. Ranked by the disability component of DALYs, the following were among the leading causes: unipolar depression (14.4% of total YLDs), dementias (10.0%), hearing loss (6.9%), refractive errors (4.5%) and osteoarthritis (4.3%). In terms of fatal consequences, the leading causes of YLLs were: ischaemic

**Table 1 – Disease categories of crude mortality and disability-adjusted life years (DALYs) for both sexes, Spain 2008.**

Rank	Cause	Total deaths (per 1000 people) (%)	Rank	Cause	Total DALYs (per 1000 people) (%)
1	Cardiovascular diseases	2.8 (32.9)	1	Neurological and mental disorders	33.2 (29.9)
2	Malignant neoplasms	2.3 (26.9)	2	Malignant neoplasms	17.6 (15.8)
3	Respiratory diseases	0.8 (9.0)	3	Cardiovascular diseases	13.9 (12.5)
4	Neurological and mental disorders	0.7 (8.2)	4	Sense organ diseases	9.3 (8.4)
5	Digestive diseases	0.4 (5.2)	5	Respiratory diseases	7.7 (6.9)
6	Unintentional injuries	0.2 (2.9)	6	Musculoskeletal disorders	5.3 (4.8)
7	Genitourinary diseases	0.2 (2.8)	7	Unintentional injuries	5.1 (4.5)
8	Diabetes mellitus	0.2 (2.7)	8	Digestive diseases	4.6 (4.2)
9	Respiratory infections	0.2 (2.7)	9	Infectious and parasitic diseases	2.3 (2.1)
10	Infectious and parasitic diseases	0.2 (2.0)	10	Diabetes mellitus	2.2 (1.9)
11	Intentional injuries	0.1 (1.0)	11	Intentional injuries	1.5 (1.4)
12	Musculoskeletal disorders	0.1 (0.9)	12	Endocrine and blood disorders	1.5 (1.4)
13	Other neoplasms	0.1 (0.9)	13	Genitourinary diseases	1.3 (1.1)
14	Endocrine and blood disorders	0.1 (0.8)	14	Perinatal conditions	1.1 (1.0)
15	Skin diseases	0.03 (0.3)	15	Congenital anomalies	1.1 (1.0)
16	Perinatal conditions	0.02 (0.3)	16	Respiratory infections	0.9 (0.8)
17	Congenital anomalies	0.02 (0.2)	17	Oral conditions	0.8 (0.7)
18	Nutritional deficiencies	0.01 (0.1)	18	Nutritional deficiencies	0.6 (0.6)
19	Maternal conditions	0.00 (0.01)	19	Other neoplasms	0.4 (0.4)
20	Oral conditions	0.00 (0.00)	20	Maternal conditions	0.4 (0.4)
21	Sense organ diseases	0.00 (0.00)	21	Skin diseases	0.3 (0.2)
Total		8.4 (100)	Total		111.1 (100)

**Table 2 – Top 30 causes of crude mortality and disability-adjusted life years (DALYs) for both sexes, Spain 2008.**

Rank	Cause	Total deaths (per 1000 people) (%)	Rank	Cause	Total DALYs (per 1000 people) (%)
1	Ischaemic heart disease	0.8 (9.6)	1	Unipolar depression	9.4 (8.4)
2	Cerebrovascular disease	0.7 (8.5)	2	Dementias	7.9 (7.1)
3	Dementias	0.5 (6.3)	3	Ischaemic heart disease	4.7 (4.2)
4	Lung cancer	0.4 (5.6)	4	Hearing loss, adult onset	4.5 (4.1)
5	COPD	0.4 (4.5)	5	Cerebrovascular disease	3.8 (3.5)
6	Colorectal cancer	0.3 (3.9)	6	Lung cancer	3.8 (3.4)
7	Lower respiratory infections	0.2 (2.7)	7	Alcohol abuse	3.4 (3.1)
8	Hypertensive heart disease	0.2 (2.1)	8	Refractive errors	2.9 (2.6)
9	Nephritis, nephrosis	0.2 (1.9)	9	Osteoarthritis	2.8 (2.5)
10	Breast cancer	0.1 (1.7)	10	COPD	2.6 (2.3)
11	Inflammatory heart disease	0.1 (1.7)	11	Colorectal cancer	2.3 (2.1)
12	Stomach cancer	0.1 (1.6)	12	Road traffic collisions	2.0 (1.8)
13	Prostate cancer	0.1 (1.5)	13	Migraine	1.7 (1.5)
14	Pancreatic cancer	0.1 (1.5)	14	Breast cancer	1.6 (1.4)
15	Bladder cancer	0.1 (1.3)	15	Illicit drug use	1.6 (1.4)
16	Liver cancer	0.1 (1.3)	16	Asthma	1.5 (1.4)
17	Lymphoma and myeloma	0.1 (1.3)	17	Bipolar disorder	1.5 (1.3)
18	Liver cirrhosis	0.1 (1.2)	18	Macular degeneration	1.4 (1.3)
19	Road traffic collisions	0.1 (1.0)	19	Schizophrenia	1.4 (1.3)
20	Suicides	0.1 (0.9)	20	Liver cirrhosis	1.3 (1.2)
21	Leukaemia	0.1 (0.9)	21	Suicides	1.3 (1.2)
22	Brain cancer	0.1 (0.7)	22	Falls	1.1 (1.0)
23	Parkinson's disease	0.1 (0.7)	23	Rheumatoid arthritis	1.0 (1.9)
24	Kidney cancer	0.05 (0.6)	24	Stomach cancer	0.9 (0.8)
25	Falls	0.04 (0.6)	25	Inflammatory heart disease	0.9 (0.8)
26	Oropharyngeal cancer	0.04 (0.6)	26	Pancreatic cancer	0.9 (0.8)
27	Osteoporosis and pathological fracture	0.04 (0.6)	27	Insomnia	0.9 (0.8)
28	Ovarian cancer	0.04 (0.5)	28	Lower respiratory infections	0.8 (0.7)
29	Oesophageal cancer	0.04 (0.5)	29	HIV/AIDS	0.8 (0.7)
30	Laryngeal cancer	0.03 (0.4)	30	Panic disorder	0.8 (0.7)

COPD, chronic obstructive pulmonary disease; HIV/AIDS, human immunodeficiency virus /acquired immunodeficiency syndrome.

heart disease (8.5% of total YLLs), lung cancer (8.0%), cerebrovascular disease (5.9%), colorectal cancer (4.1%) and road traffic accidents (3.5%).

In terms of age, 41.0% of the burden of disease was concentrated in subjects aged >60 years, with the general trend being for DALYs to increase with age. The principal component of the disease burden was disability (YLDs) from 5 to 44 years of age, and premature mortality (YLLs) thereafter. In the 0–4-years age group, however, the distribution of the DALY components virtually followed a ratio of 1:1. Perinatal conditions (31.9%) and congenital anomalies (25.5%) dominated the burden of disease in children aged 0–4 years, and neurological and mental disorders (45.1%), respiratory diseases (15.9%) and unintentional injuries (13.2%) were the leading causes of the disease burden for young people aged 5–14 years. Between the ages of 15–29 years and 30–44 years, neurological and mental disorders was the leading category of disease burden, accounting for 63.7% and 39.5% of total DALYs, respectively. From 45 to 59 years, malignant neoplasms (27.0%) assumed importance, particularly in the case of lung cancer in males (9.1%) and breast cancer in females (6.8%). Among males, ischaemic heart disease began to be a relevant public health problem (7.7%). The 60–69-years age group was a transition group in which the most noteworthy feature was musculoskeletal diseases in females (10.8%). Among people aged >70 years, dementias peaked

(14.0% in males and 27.4% in females), chronic obstructive pulmonary disease (COPD) became prominent in males (9.5%), and ischaemic heart disease assumed great importance in both sexes (7.8% in males and 5.6% in females).

Detailed information on DALYs by sex and age group for all disease and injury categories is given in [Appendix 1](#) (see supplementary online material).

## Discussion

One of the relevant contributions of burden of disease studies using DALYs is that they enable the comparison of fatal and non-fatal outcomes, while simultaneously taking their incidence, severity and duration into account. Diseases and injuries that lie in the lowest positions in the ranking when classical mortality metrics are used, rise to occupy the top positions if disability assessment is introduced; and diseases that give rise to moderate mortality and disability and yet affect a great number of people acquire their rightful importance, if one wishes to ascertain the main health problems from a public health perspective.

The present study attempted to provide a comprehensive and updated overview of some key public health issues that could be addressed by national health policies. The burden of disease in Spain was estimated to be 5 million DALYs in 2008.

**Table 3 – Leading categories of crude mortality and disability-adjusted life years (DALYs) by sex, Spain 2008.**

Rank	Cause	Total deaths (per 1000 people) (%)	Rank	Cause	Total DALYs (per 1000 people) (%)
<i>Males</i>					
1	Malignant neoplasms	2.8 (32.3)	1	Neurological and mental disorders	29.9 (25.1)
2	Cardiovascular diseases	2.5 (28.6)	2	Malignant neoplasms	21.4 (18.0)
3	Respiratory diseases	0.9 (10.4)	3	Cardiovascular diseases	16.2 (13.6)
4	Neurological and mental disorders	0.5 (5.8)	4	Respiratory diseases	10.1 (8.5)
5	Digestive diseases	0.5 (5.3)	5	Sense organ diseases	9.1 (7.6)
6	Unintentional injuries	0.3 (3.6)	6	Unintentional injuries	7.4 (6.2)
7	Respiratory infections	0.2 (2.7)	7	Digestive diseases	5.6 (4.7)
8	Genitourinary diseases	0.2 (2.6)	8	Musculoskeletal disorders	4.4 (3.7)
9	Diabetes mellitus	0.2 (2.2)	9	Infectious and parasitic diseases	2.7 (2.3)
10	Infectious and parasitic diseases	0.2 (2.1)	10	Intentional injuries	2.3 (2.0)
11	Intentional injuries	0.1 (1.5)	11	Diabetes mellitus	2.0 (1.7)
12	Other neoplasms	0.1 (0.9)	12	Genitourinary diseases	1.6 (1.3)
13	Endocrine and blood disorders	0.1 (0.6)	13	Endocrine and blood disorders	1.3 (1.1)
14	Musculoskeletal diseases	0.05 (0.6)	14	Perinatal conditions	1.2 (1.1)
15	Perinatal conditions	0.03 (0.3)	15	Congenital anomalies	1.1 (0.9)
<i>Females</i>					
1	Cardiovascular diseases	3.0 (37.4)	1	Neurological and mental disorders	36.5 (35.3)
2	Malignant neoplasms	1.7 (21.0)	2	Malignant neoplasms	13.9 (13.4)
3	Neurological and mental disorders	0.9 (10.8)	3	Cardiovascular diseases	11.6 (11.2)
4	Respiratory diseases	0.6 (7.6)	4	Sense organ diseases	9.6 (9.3)
5	Digestive diseases	0.4 (5.1)	5	Musculoskeletal disorders	6.2 (6.0)
6	Diabetes mellitus	0.3 (3.3)	6	Respiratory diseases	5.4 (5.2)
7	Genitourinary diseases	0.2 (3.1)	7	Digestive diseases	3.7 (3.6)
8	Respiratory infections	0.2 (2.7)	8	Unintentional injuries	2.7 (2.7)
9	Unintentional injuries	0.2 (2.0)	9	Diabetes mellitus	2.3 (2.2)
10	Infectious and parasitic diseases	0.2 (2.0)	10	Infectious and parasitic diseases	1.9 (1.9)
11	Musculoskeletal disorders	0.1 (1.3)	11	Endocrine and blood disorders	1.7 (1.7)
12	Endocrine and blood disorders	0.1 (1.0)	12	Congenital anomalies	1.0 (1.0)
13	Other neoplasms	0.1 (0.9)	13	Perinatal conditions	1.0 (0.9)
14	Intentional injuries	0.04 (0.5)	14	Genitourinary diseases	1.0 (0.9)
15	Skin diseases	0.04 (0.5)	15	Nutritional deficiencies	0.9 (0.9)

This figure represents 111 years of healthy life lost among each 1000 Spanish people. In Spain, population health losses were fundamentally attributable to chronic non-communicable diseases, essentially neurological and mental disorders, malignant neoplasms and cardiovascular diseases. A large proportion of this disease burden was due to disability caused by diseases and injuries, with this being more noteworthy among women and people aged <45 years.

Recently, the National Quality Plan for the Spanish National Health System<sup>25</sup> has developed health strategies to ensure highest quality in healthcare services. Along these actions, the National Ministry of Health and Social Policy is elaborating national disease control strategies focussing on the most burdensome conditions in order to guarantee excellence in healthcare. Such approaches are advocating integrated focus combining disease prevention and treatment with the corresponding measures for cancer, mental health, ischaemic heart disease, diabetes or cerebrovascular disease, among others.<sup>26–32</sup> Analyses described in this manuscript will provide some of the information required for developing strategies currently under development, and will affect the health policy debate helping to shed light on whether there are potentially under-prioritized areas. For example, Alzheimer's disease and related dementias, musculoskeletal

disorders such as osteoarthritis, sense organ diseases, road traffic accidents and other chronic non-communicable diseases impose a substantial burden in the population, but they are not reflected in the current healthcare priority agenda. Previous national disease burden estimates have been helpful when identifying priority diseases for health research funding and to develop prevention policies.<sup>28,29,33</sup> Furthermore, where evidence exists on the effectiveness of particular health services and interventions, the results reported here can also provide data inputs necessary for the baseline models of generalized cost-effectiveness analyses evaluating the impact of alternative disease control strategies.<sup>34</sup> However, while the information from these studies can be used in economic evaluation research, the burden of disease on its own does not permit measurement of the efficiency of the allocation of resources. Therefore, the fact that the burden of disease is larger for one condition does not necessarily imply larger health benefits allocating more resources. Priority cannot just be determined by overall burden of disease, but that burden which could be avoided or requires other healthcare processes. Therefore, researchers and policy makers need to consider this, particularly in relation to interventions that could impact on the avoidable burden.



**Table 4 – Leading causes of crude mortality and disability-adjusted life years (DALYs) by sex, Spain 2008.**

Rank	Cause	Total deaths (per 1000 people) (%)	Rank	Cause	Total DALYs (per 1000 people) (%)
<b>Males</b>					
1	Ischaemic heart disease	0.9 (10.5)	1	Unipolar depression	6.6 (5.5)
2	Lung cancer	0.8 (9.3)	2	Ischaemic heart disease	6.5 (5.5)
3	Cerebrovascular disease	0.6 (6.9)	3	Lung cancer	6.3 (5.3)
4	COPD	0.6 (6.5)	4	Alcohol abuse	5.6 (4.7)
5	Colorectal cancer	0.4 (4.3)	5	Dementias	5.3 (4.4)
6	Dementias	0.3 (3.8)	6	Hearing loss, adult onset	4.6 (3.9)
7	Prostate cancer	0.3 (3.0)	7	COPD	4.2 (3.5)
8	Lower respiratory infections	0.2 (2.7)	8	Cerebrovascular disease	4.0 (3.4)
9	Bladder cancer	0.2 (2.1)	9	Road traffic collisions	3.2 (2.7)
10	Stomach cancer	0.2 (1.9)	10	Refractive errors	2.9 (2.4)
11	Nephritis, nephrosis	0.2 (1.8)	11	Colorectal cancer	2.7 (2.2)
12	Liver cirrhosis	0.1 (1.7)	12	Illicit drug use	2.4 (2.0)
13	Inflammatory heart disease	0.1 (1.6)	13	Suicides	2.0 (1.7)
14	Liver cancer	0.1 (1.6)	14	Liver cirrhosis	1.9 (1.6)
15	Pancreatic cancer	0.1 (1.5)	15	Asthma	1.6 (1.4)
<b>Females</b>					
1	Cerebrovascular disease	0.8 (10.3)	1	Unipolar depression	12.1 (11.7)
2	Dementias	0.7 (9.0)	2	Dementias	10.4 (10.0)
3	Ischaemic heart disease	0.7 (8.7)	3	Hearing loss, adult onset	4.4 (4.2)
4	Breast cancer	0.3 (3.6)	4	Cerebrovascular disease	3.7 (3.5)
5	Colorectal cancer	0.3 (3.5)	5	Osteoarthritis	3.3 (3.2)
6	Hypertensive heart disease	0.2 (2.9)	6	Breast cancer	3.1 (3.0)
7	Lower respiratory infections	0.2 (2.7)	7	Refractive errors	3.0 (2.9)
8	COPD	0.2 (2.4)	8	Ischaemic heart disease	2.8 (2.7)
9	Nephritis, nephrosis	0.2 (2.0)	9	Migraine	2.5 (2.5)
10	Inflammatory heart disease	0.1 (1.8)	10	Colorectal cancer	1.9 (1.9)
11	Lung cancer	0.1 (1.8)	11	Macular degeneration	1.7 (1.6)
12	Pancreatic cancer	0.1 (1.4)	12	Bipolar disorder	1.4 (1.4)
13	Stomach cancer	0.1 (1.3)	13	Rheumatoid arthritis	1.4 (1.3)
14	Lymphoma and myeloma	0.1 (1.3)	14	Asthma	1.4 (1.3)
15	Ovarian cancer	0.1 (1.1)	15	Lung cancer	1.3 (1.3)

COPD, chronic obstructive pulmonary disease; HIV/AIDS, human immunodeficiency virus /acquired immunodeficiency syndrome.

A coordinated effort by national healthcare planners is warranted against premature death and preventable morbidity and disability from chronic diseases by supporting prevention, control and rigorous evidence-based public health research. Recently, the Non-Communicable Disease Alliance<sup>35,36</sup> has proposed overarching priority actions for the response to the chronic non-communicable diseases (leadership, prevention, treatment, international cooperation, and monitoring and accountability) and the delivery of priority interventions (e.g. tobacco control, salt reduction, improved diets and physical activity, reduction in hazardous alcohol intake, and essential drugs and technologies). These priorities were chosen for their health effects, cost-effectiveness, low implementation costs, and political and financial feasibility.

Several organizations and countries are committing themselves to DALYs which, aside from being useful for diagnosis of population health, is a tool that helps to establish health policy and research priorities.<sup>33,37,38</sup> As noted by similar studies in other countries and regions,<sup>9–16</sup> this study clearly highlighted the importance of including a disability (poor health) component when trying to quantify health losses. On the other hand, in its recently updated disease burden projections, the World Health Organization estimated that unipolar depression (8.8% of total DALYs), ischaemic heart

disease (6.2%) and dementias (5.8%) would be the principal causes of disease burden in high-income countries in 2030.<sup>7</sup> In Spain, these three causes are already the leading conditions in terms of numbers of DALYs lost.

This study has important limitations. Reliable sources of mortality and incidence data are required to calculate DALYs. In this study, the mortality data were based on a national census, but the incidence and severity (disability weights) estimates pertained to a variety of Western European countries that constitute the Euro-A region rather than data for Spain. It was assumed that these data would be acceptable as they respond to an epidemiological pattern similar to that of Spain, although the studies that have been and are currently being conducted with national data (such as cancer, cardiovascular and infectious diseases) will enable more accurate information to be obtained. Previously, several national or local burden of disease studies have also used YLD-to-YLL ratios to estimate the morbidity component of DALYs<sup>11,13–16,39,40</sup> because this methodology represents an efficient approach when incidence data are fragmentary and sometimes difficult to obtain for all specific disease conditions. However, if the current YLD rates for the country-specific population are significantly different from those used in this analysis, the DALYs reported may be over- or

underestimated for specific disease conditions. Another limitation of this study is the controversial social values incorporated into the DALYs. With regard to the standard life expectancy for calculation of YLLs, the authors used the Coale and Demeny life table recommended in the GBD study<sup>6,7</sup> because it is a sliding limit that assigns life expectancy at all ages and gives consideration to high life expectancies. As the standard used in most burden of disease studies, it also allows for comparisons to be made. Moreover, to be consistent with GBD methods, all DALYs were also age weighted and discounted.<sup>6,7</sup> The consideration of age weights is based on a number of studies that assign social preference towards life years of young adults (over an older adult or young child). However, not all such studies agree that the youngest and oldest ages should be given less weight, nor do they agree on the relative magnitude of the differences. Furthermore, the standard DALY form includes a 3% discount rate with time, thus favouring immediate over future health benefits. This assumption may increase the fraction of the disease burden due to YLDs and decrease the burden of disease in the youngest people (although this influence would be more relevant in countries or diseases with high infant mortality).

Finally, the DALYs reported here are developmental, and further improvements in data and methods are anticipated. These estimates could be improved in future by more refined methods; for example, by collecting incidence and disease duration data at national level and applying them to the mortality component of DALYs.

Although the above-mentioned limitations are recognized, the authors believe that estimation of DALYs means an approach in the identification of population health needs where more interventions and care could concentrate based on supplementary criteria (e.g. cost-effectiveness and social equity). Along these lines, measuring burden of disease and injury specifically for Spain provides a systematic analysis of health losses at a population level, and is an important component for identifying disease areas where greater attention by policy makers is required. The results obtained also provide a measure to track the outcomes of future public health interventions. Regardless of the methods used, DALYs are not the only input to a rational setting of healthcare priorities.

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## Competing interests

None declared.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.puhe.2012.08.012>.