

CHAPTER 2

global burden of neurological disorders

estimates and projections

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Ever-increasing demand for health services forces health planners to make choices about resource allocation. Information on relative burden of various health conditions and risks to health is an important element in strategic health planning. What is needed to provide this information is a framework for integrat-

ing, validating, analysing, and disseminating the fragmentary, and at times contradictory, data that are available on a population's health, along with some understanding of how that population's health is changing over time.

The Global Burden of Disease (GBD) approach is one of the most widely used frameworks for information on summary measures of population health across disease and risk categories. The GBD framework is based on the use of a common metric to summarize the disease burden from diagnostic categories of the International Classification of Diseases and the major risk factors that cause those health outcomes.

GBD STUDIES AND THEIR KEY RESULTS

In 1993, the World Bank, WHO and the Harvard School of Public Health carried out a study to assess the global burden of disease for the year 1990. The methods and findings of the 1990 GBD study have been widely published (1–3). To prepare internally consistent estimates of incidence, prevalence, duration and mortality for almost 500 sequelae of the diseases and injuries under consideration, a mathematical model, DisMod, was developed

(4). The main purpose was to convert partial, often nonspecific, data on disease and injury occurrence into a consistent description of the basic epidemiological parameters.

Many conditions including neuropsychiatric disorders and injuries cause considerable ill-health but no or few direct deaths. Therefore separate measures of survival and of health status among survivors needed to be combined to provide a single, holistic measure of overall population health. To assess the burden of disease, the 1990 GBD study used a time-based metric that measures both premature mortality (years of life lost because of premature mortality or YLL) and disability (years of healthy life lost as a result of disability or YLD, weighted by the severity of the disability). The sum of these two components,

disability-adjusted life years (DALYs), provides a measure of the future stream of healthy life (years expected to be lived in full health) lost as a result of the incidence of specific diseases and injuries (2). One DALY can be thought of as one lost year of healthy life and the burden of disease as a measure of the gap between current health status and an ideal situation where everyone lives into old age free from disease and disability.

The results of the 1990 GBD study confirmed that noncommunicable diseases and injuries were a significant cause of health burden in all regions of the world. Neuropsychiatric disorders and injuries in particular were major causes of lost years of healthy life as measured by DALYs, and were significantly underestimated when measured by mortality alone (2).

The 1990 GBD study represented a major advance in the quantification of the impact of diseases, injuries and risk factors on population health globally and by region. Government and nongovernmental agencies alike have used these results to argue for more strategic allocations of health resources to disease prevention and control programmes that are likely to yield the greatest gains in terms of population health. Following publication of the initial results of the GBD study, several national applications of its methods were used, which led to substantially more data in the area of descriptive epidemiology of diseases and injuries.

As a follow-up to the 1990 GBD study, WHO undertook a new global assessment of the burden of disease for the year 2000 and subsequent years in 2002. The GBD 2000 study drew on a wide range of data sources to develop internally consistent estimates of incidence, health state prevalence, severity and duration, and mortality for over 130 major causes, for 14 epidemiological subregions of the world (5).

Projections of global mortality and burden of disease

In order to address the need for updated projections of mortality and burden of disease by region and cause, updated projections of future trends for mortality and burden of disease between 2002 and 2030 have also been prepared by WHO (6). These have been based on methods similar to those used in the original GBD 1990 study, but use the latest available estimates for 2002 and the latest available projections for HIV/AIDS, income, human capital and other inputs (7). Relatively simple models were used to project future health trends under various scenarios, based largely on projections of economic and social development, and using the historically observed relationships of these with cause-specific mortality rates.

Rather than attempt to model the effects of the many separate direct determinants or risk factors for diseases from the limited data that are available, the GBD methodology considered a certain number of socioeconomic variables including: average income per capita, measured as gross domestic product (GDP) per capita; average number of years of schooling in adults, referred to as “human capital”; and time, a proxy measure for the impact of technological change on health status. This latter variable captures the effects of accumulating knowledge and technological development, allowing the implementation of more cost-effective health interventions, both preventive and curative, at constant levels of income and human capital. These socioeconomic variables show clear historical relationships with mortality rates, and may be regarded as indirect, or distal, determinants of health. In addition, a fourth variable, tobacco use, was included in the projections for cancer, cardiovascular diseases and chronic respiratory diseases, because of its overwhelming importance in determining trends for these causes.

Projections were carried out at country level, but aggregated into regional or income groups for presentation of results. Baseline estimates at country level for 2002 were derived from the GBD analyses published in *The world health report 2004* (8). Mortality estimates were based on analysis of latest available national information on levels of mortality and cause distributions as at late 2003. Incidence, prevalence, duration and severity estimates for conditions were based on the GBD analyses for the relevant epidemiological subregion, together with national and sub-national

level information available to WHO. These baseline estimates represent the best estimates of WHO, based on the evidence available in mid-2004, and have been computed using standard categories and methods to maximize cross-national comparability.

Limitations of the Global Burden of Disease framework

By their very nature, projections of the future are highly uncertain and need to be interpreted with caution. Three limitations are briefly discussed: uncertainties in the baseline data on levels and trends in cause-specific mortality, the “business as usual” assumptions, and the use of a relatively simple model based largely on projections of economic and social development (9).

For regions with limited death registration data, such as the Eastern Mediterranean Region, sub-Saharan Africa and parts of Asia and the Pacific, there is considerable uncertainty in estimates of deaths by cause associated with the use of partial information on levels of mortality from sources such as the Demographic and Health Surveys, and from the use of cause-specific mortality estimates for causes such as HIV/AIDS, malaria, tuberculosis and vaccine-preventable diseases. The GBD analyses have attempted to use all available sources of information, together with an explicit emphasis on internal consistency, to develop consistent and comprehensive estimates of deaths and disease burden by cause, age, sex and region.

The projections of burden are not intended as forecasts of what will happen in the future but as projections of current and past trends, based on certain explicit assumptions and on observed historical relationships between development and mortality levels and patterns. The methods used base the disease burden projections largely on broad mortality projections driven to a large extent by World Bank projections of future growth in income per capita in different regions of the world. As a result, it is important to interpret the projections with a degree of caution commensurate with their uncertainty, and to remember that they represent a view of the future explicitly resulting from the baseline data, choice of models and the assumptions made. Uncertainty in projections has been addressed not through an attempt to estimate uncertainty ranges, but through preparation of pessimistic and optimistic projections under alternative sets of input assumptions.

The results depend strongly on the assumption that future mortality trends in poor countries will have the same relationship to economic and social development as has occurred in higher income countries in the recent past. If this assumption is not correct, then the projections for low income countries will be over-optimistic in the rate of decline of communicable and noncommunicable diseases. The projections have also not taken explicit account of trends in major risk factors apart from tobacco smoking and, to a limited extent, overweight and obesity. If broad trends in risk factors are towards worsening of risk exposures with development, rather than the improvements observed in recent decades in many high income countries, then again the projections for low and middle income countries presented here will be too optimistic.

ESTIMATES AND PROJECTIONS FOR NEUROLOGICAL DISORDERS

This document presents the GBD estimates for neurological disorders from the projected estimates for 2005, 2015 and 2030. The complete set of tables is contained in Annex 4.

Cause categories

The cause categories used in the GBD study have four levels of disaggregation and include 135 specific diseases and injuries. At the first level, overall mortality is divided into three broad groups of causes: Group I consists of communicable diseases, maternal causes, conditions arising in the perinatal period and nutritional deficiencies; Group II encompasses the noncommunicable diseases (including neuropsychiatric conditions); and Group III comprises intentional and unintentional injuries. Deaths and health states are categorically attributed to one underlying cause using

the rules and conventions of the International Classification of Diseases. In some cases these rules are ambiguous, in which event the GBD 2000 followed the conventions used in the GBD 1990. It also lists the sequelae analysed for each cause category and provides relevant case definitions.

Methodology

For the purpose of calculation of estimates of the global burden of disease, the neurological disorders are included from two categories: neurological disorders within the neuropsychiatric category, and neurological disorders from other categories. Neurological disorders within the neuropsychiatric category refer to the cause category listed in Group II under neuropsychiatric disorders and include epilepsy, Alzheimer and other dementias, Parkinson’s disease, multiple sclerosis and migraine. Neurological disorders from other categories include diseases and injuries which have neurological sequelae and are listed elsewhere in cause category Groups I, II and III (10). The complete list used for calculation of GBD estimates for neurological disorders is given in Annex 3. Among the various neurological disorders discussed in this report, please note that for headache disorders, GBD includes migraine only (see Chapter 3.3). Also, GBD does not describe separately the burden associated with pain (see Chapter 3.7). There are also some diseases and injuries, which have neurological sequelae that have not been separately identified by the GBD study, and are not presented in this report; these include tuberculosis, HIV/AIDS, measles, low birth weight, birth asphyxia and birth trauma. The burden estimates for these conditions include the impact of neurological and other sequelae which are not separately estimated.

DATA PRESENTATION

This chapter summarizes data with the important findings presented as charts and maps for DALYs, deaths, YLDs and prevalence as estimated for neurological disorders in the GBD study. The complete set of tables is given in Annex 4. The data are presented for the following variables.

DALYs	Absolute numbers Percentage of total DALYs DALYs per 100 000 population
Deaths	Absolute numbers Percentage of total deaths Deaths per 100 000 population
YLDs	Absolute numbers Percentage of total YLDs YLDs per 100 000 population
Point prevalence	Total number of cases with different neurological disorders Prevalence per 1000 population of individual neurological disorders

Please note that prevalence and YLDs are available for the neurological cause – sequela combinations. These data are therefore provided for all neurological disorders within the neuropsychiatric category, cerebrovascular disease, combined for neuroinfections and neurological sequelae of infections (poliomyelitis, tetanus, meningitis, Japanese encephalitis, syphilis, pertussis, diphtheria, malaria), neurological sequelae associated with nutritional deficiencies and neuropathies (protein–energy malnutrition, iodine deficiency, leprosy, and diabetes mellitus), and neurological sequelae associated with injuries (road traffic accidents, poisonings, falls, fires, drownings, other unintentional injuries, self-inflicted injuries, violence, war, and other intentional injuries) (see Table 2.1).

While YLDs are separately estimated for each sequela, death (and hence YLLs and DALYs) are only estimated at the cause level, and for many causes it is not possible to describe sequela-specific deaths. The tables for DALYs and deaths therefore only describe data for neurological cause categories (Table 2.2).

Table 2.1 Neurological disorder groupings used for YLDs and prevalence data

Neurological disorders in neuropsychiatric category	Disorders/injuries with neurological sequelae in other categories
Epilepsy Alzheimer and other dementias Parkinson's disease Multiple sclerosis Migraine	Cerebrovascular disease Neuroinfections Nutritional deficiencies and neuropathies Neurological injuries

Table 2.2 Neurological disorder groupings used for DALYs and deaths data

Neurological disorders in neuropsychiatric category	Disorders/injuries with neurological sequelae in other categories
Epilepsy Alzheimer and other dementias Parkinson's disease Multiple sclerosis Migraine	Cerebrovascular disease Poliomyelitis Tetanus Meningitis Japanese encephalitis

Regional and income categories

Projections of mortality and burden of disease are summarized according to two groupings of countries, as follows.

■ **WHO regions.** WHO Member States are grouped into six regions (Africa, the Americas, South-East Asia, Europe, Eastern Mediterranean and Western Pacific, see <http://www.who.int/about/regions/en/index.html>). WHO regions are organizational groupings and, while they are largely based on geographical terms, are not synonymous with geographical areas. For further disaggregation of the global burden of disease, the regions have been further divided into 14 epidemiological subregions, based on levels of child (under five years of age) and adult (aged 15–59 years) mortality for WHO Member States (Table 2.3). When these mortality strata are applied to the six WHO regions, they produce 14 mortality subregions. These are listed in Annex 1, together with the WHO Member States in each group.

Table 2.3 Definitions of mortality strata used to define subregions

Mortality stratum	Child mortality	Adult mortality
A	Very low	Very low
B	Low	Low
C	Low	High
D	High	High
E	High	Very high

■ **Income categories.** The income categories are based on World Bank estimates of gross national income (GNI) per capita in 2001 (11). Each country is classified as low income (GNI US\$ 745 or less), lower middle income (GNI US\$ 746–2975), upper middle income (GNI US\$ 2976–9205), and high income (GNI \$ 9206 or more). Annex 2 lists countries according to the World Bank income categories.

The following tables and text describe the estimates for DALYs, deaths and YLDs for neurological disorders as estimated and projected for 2005, 2015 and 2030.

Estimates of disability-adjusted life years (DALYs)

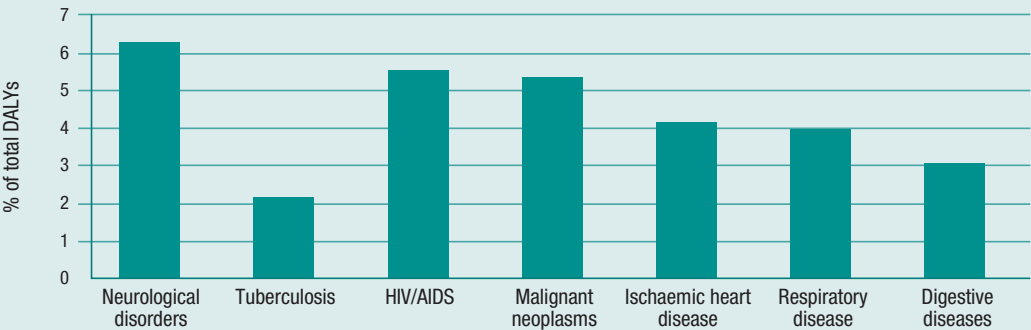
Neurological disorders included in the neuropsychiatric category contribute to 2% of the global burden of disease, while cerebrovascular disease and some of the neuroinfections (poliomyelitis, tetanus, meningitis and Japanese encephalitis) contribute to 4.3% of the global burden of disease in 2005. Thus neurological disorders constitute 6.3% of the global burden of disease (see Table 2.4). The term “neurological disorders” henceforth used in this chapter includes those conditions in the neuropsychiatric category as well as in other categories. Figure 2.1 presents selected diseases as a percentage of total DALYs, in order to compare the burden constituted by them with that of neurological disorders. For example, HIV/AIDS and malignant neoplasm each constitute slightly over 5% of total burden.

Table 2.4 presents the total number of DALYs in thousands associated with neurological disorders and as percentage of total DALYs for 2005, 2015 and 2030. Neurological disorders contribute to 92 million DALYs in 2005 projected to increase to 103 million in 2030 (approximately a 12% increase). While Alzheimer and other dementias are projected to show a 66% increase from 2005 to 2030, there is an estimated 57% decrease in DALYs associated with poliomyelitis, tetanus, meningitis and Japanese encephalitis combined.

Table 2.4 Number of DALYs for neurological disorders and as percentage of global DALYs projected for 2005, 2015 and 2030

Cause category	2005		2015		2030	
	No. of DALYs (000)	Percentage of total DALYs	No. of DALYs (000)	Percentage of total DALYs	No. of DALYs (000)	Percentage of total DALYs
Epilepsy	7 308	0.50	7 419	0.50	7 442	0.49
Alzheimer and other dementias	11 078	0.75	13 540	0.91	18 394	1.20
Parkinson’s disease	1 617	0.11	1 762	0.12	2 015	0.13
Multiple sclerosis	1 510	0.10	1 586	0.11	1 648	0.11
Migraine	7 660	0.52	7 736	0.52	7 596	0.50
Cerebrovascular disease	50 785	3.46	53 815	3.63	60 864	3.99
Poliomyelitis	115	0.01	47	0.00	13	0.00
Tetanus	6 423	0.44	4 871	0.33	3 174	0.21
Meningitis	5 337	0.36	3 528	0.24	2 039	0.13
Japanese encephalitis	561	0.04	304	0.02	150	0.01
Total	92 392	6.29	94 608	6.39	103 335	6.77

Figure 2.1 Percentage of total DALYs for selected diseases^a and neurological disorders^b



^a GBD cause categories
^b Neuropsychiatric plus other categories

Among neurological disorders, more than half of the burden in DALYs is contributed by cerebrovascular disease, 12% by Alzheimer and other dementias and 8% each by epilepsy and migraine (see Figure 2.2).

Neurological disorders contribute to 10.9%, 6.7%, 8.7% and 4.5% of the global burden of disease in high, upper middle, lower middle and low income countries, respectively, in 2005 (see Figure 2.3). The higher burden in the lower middle category reflects the double burden of communicable diseases and noncommunicable diseases. DALYs per 100 000 population for neurological disorders are highest for lower middle and low income countries (1514 and 1448, respectively) as estimated for 2005 (see Table 2.5).

Table 2.5 DALYs per 100 000 population for neurological disorders globally and by World Bank income category, 2005

Cause category	World (100 000 population)	Income category			
		Low	Lower middle	Upper middle	High
Epilepsy	113.4	158.3	80	139.2	51.3
Alzheimer and other dementias	172	90.7	150.7	166.9	457.3
Parkinson's disease	25.1	15.1	19.7	17.5	70.8
Multiple sclerosis	23.4	20.1	23.3	24.9	32.5
Migraine	118.9	114	106.8	147.1	146.3
Cerebrovascular disease	788.4	662.5	1 061.2	612.2	592
Poliomyelitis	1.8	2.6	1.6	0.9	0.6
Tetanus	99.7	228.6	10.8	1.3	0.1
Meningitis	82.9	143.2	51.2	39.7	10.7
Japanese encephalitis	8.7	13	9	0.4	0.6
Total	1 434.3	1 448.1	1 514.3	1 150.1	1 362.2

As shown in Table 2.6, neurological disorders contribute most to the global burden of disease in the European Region (11.2%) and the Western Pacific Region (10%) compared with 2.9% in the African Region in 2005. DALYs per 100 000 population as estimated for 2005 are highest for Eur-C epidemiological subregion (2920) and lowest for Emr-B (751) (see Figure 2.4).

Figure 2.2 DALYs for individual neurological disorders as percentage of total neurological disorders

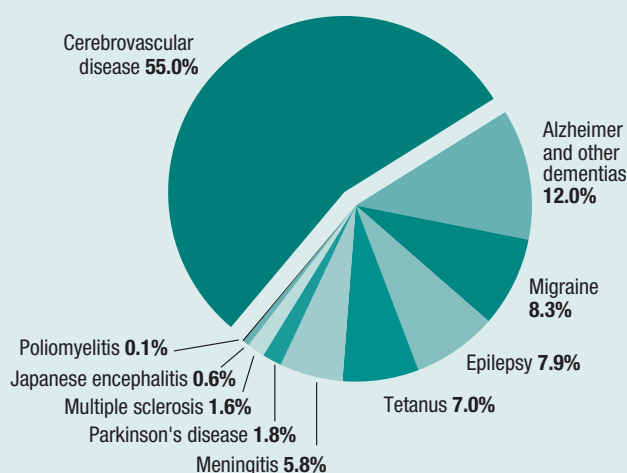


Figure 2.3 Neurological disorders as percentage of total DALYs for 2005, 2015 and 2030 across World Bank income category

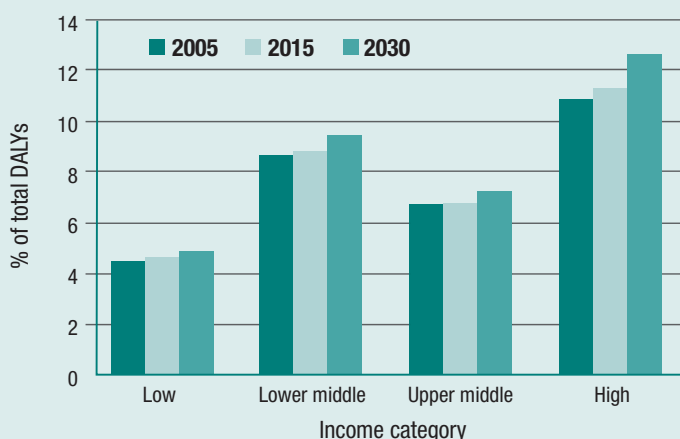


Figure 2.4 DALYs per 100 000 population associated with neurological disorders by WHO region and mortality stratum, 2005

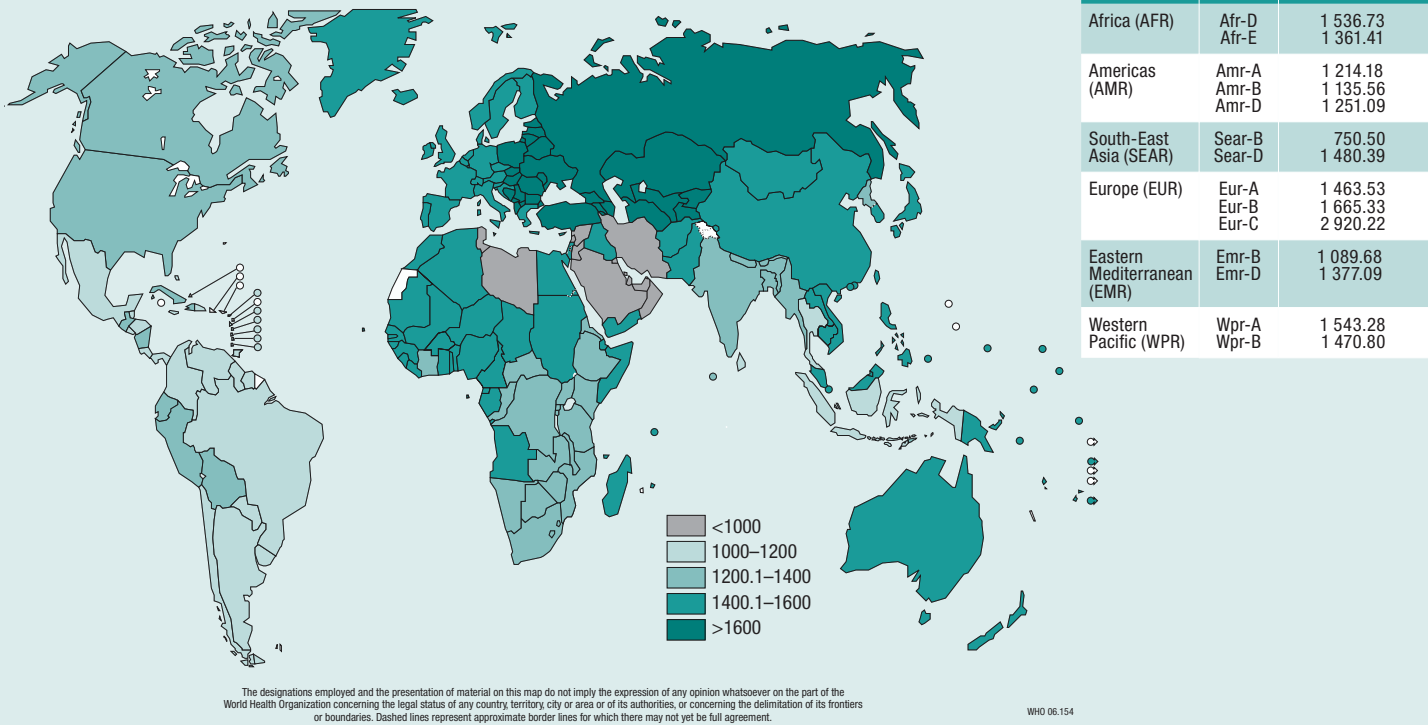


Table 2.6 Neurological disorders as percentage of total DALYs by WHO region, 2005

Cause category	World (%)	WHO region					
		AFR (%)	AMR (%)	SEAR (%)	EUR (%)	EMR (%)	WPR (%)
Epilepsy	0.50	0.46	0.73	0.46	0.40	0.54	0.44
Alzheimer and other dementias	0.75	0.10	1.47	0.26	2.04	0.42	1.32
Parkinson's disease	0.11	0.02	0.22	0.07	0.30	0.06	0.15
Multiple sclerosis	0.10	0.03	0.17	0.08	0.20	0.09	0.15
Migraine	0.52	0.13	0.97	0.41	0.80	0.51	0.73
Cerebrovascular disease	3.46	1.11	3.10	1.93	7.23	2.69	6.81
Poliomyelitis	0.01	0.00	0.00	0.01	0.00	0.01	0.01
Tetanus	0.44	0.77	0.01	0.81	0.00	0.54	0.10
Meningitis	0.36	0.24	0.39	0.81	0.24	0.43	0.24
Japanese encephalitis	0.04	0.00	0.00	0.05	0.00	0.06	0.09
Total	6.29	2.86	7.06	4.90	11.23	5.34	10.04

Estimates of deaths

Neurological disorders are an important cause of mortality and constitute 12% of total deaths globally (see Table 2.7). Within these, cerebrovascular diseases are responsible for 85% of the deaths due to neurological disorders (see Figure 2.5). Neurological disorders constitute 16.8% of the total deaths in lower middle income countries compared with 13.2% of the total deaths in high income countries (Figure 2.6). Among the neurological disorders, Alzheimer and other dementias are estimated to constitute 2.84% of the total deaths in high income countries in 2005. Cerebrovascular disease constitute 15.8%, 9.6%, 9.5% and 6.4% of the total deaths in lower middle, upper middle, high and low income countries respectively (Table 2.8).

Table 2.7 Deaths attributable to neurological disorders as percentage of total deaths, 2005, 2015 and 2030

Cause category	2005 (%)	2015 (%)	2030 (%)
Epilepsy	0.22	0.21	0.19
Alzheimer and other dementias	0.73	0.81	0.92
Parkinson's disease	0.18	0.20	0.23
Multiple sclerosis	0.03	0.03	0.02
Migraine	0.00	0.00	0.00
Cerebrovascular disease	9.90	10.19	10.63
Poliomyelitis	0.00	0.00	0.00
Tetanus	0.33	0.23	0.13
Meningitis	0.26	0.17	0.10
Japanese encephalitis	0.02	0.01	0.01
Total	11.67	11.84	12.22

Figure 2.5 Deaths from selected neurological disorders as percentage of total neurological disorders

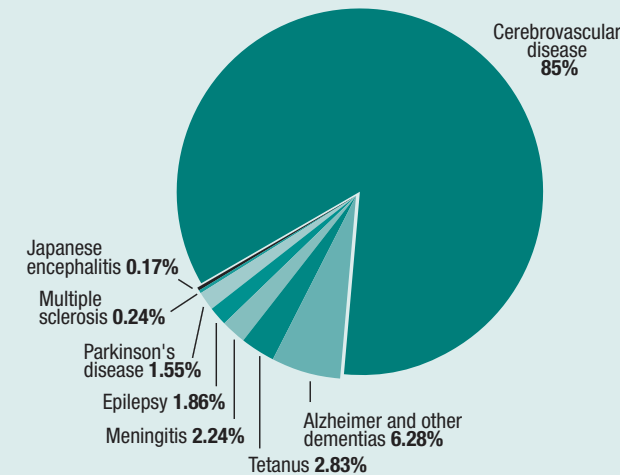


Figure 2.6 Neurological disorders as percentage of total deaths for 2005, 2015 and 2030 across World Bank income category

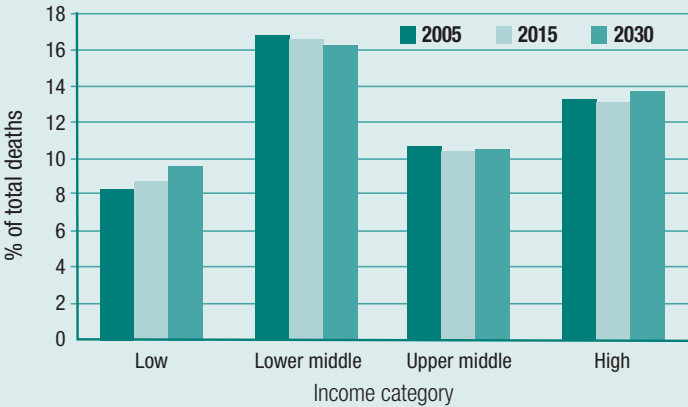


Table 2.8 Deaths attributable to neurological disorders as percentage of total deaths by World Bank income category, 2005

Cause category	World (%)	Income category			
		Low (%)	Lower middle (%)	Upper middle (%)	High (%)
Epilepsy	0.22	0.28	0.17	0.20	0.11
Alzheimer and other dementias	0.73	0.41	0.34	0.46	2.84
Parkinson's disease	0.18	0.06	0.18	0.15	0.60
Multiple sclerosis	0.03	0.01	0.02	0.05	0.10
Migraine	0.00	0.00	0.00	0.00	0.00
Cerebrovascular disease	9.90	6.41	15.81	9.64	9.48
Poliomyelitis	0.00	0.00	0.00	0.00	0.01
Tetanus	0.33	0.64	0.04	0.01	0.00
Meningitis	0.26	0.39	0.18	0.16	0.04
Japanese encephalitis	0.02	0.03	0.01	0.00	0.00
Total	11.67	8.23	16.77	10.67	13.18

Table 2.9 YLDs per 100 000 population associated with neurological disorders and other diseases and injuries with neurological sequelae and as percentage of total YLDs projected for 2005, 2015 and 2030

Cause category/sequelae	2005		2015		2030	
	YLDs (100 000 population)	Percentage of total YLDs	YLDs (100 000 population)	Percentage of total YLDs	YLDs (100 000 population)	Percentage of total YLDs
Epilepsy	64.7	0.73	60.9	0.73	55.6	0.71
Alzheimer and other dementias	147.4	1.66	165.4	1.98	203.9	2.60
Parkinson's disease	17.7	0.20	17.3	0.21	17.1	0.22
Multiple sclerosis	20	0.23	19.3	0.23	18.4	0.23
Migraine	118.9	1.34	108.9	1.31	96	1.22
Cerebrovascular disease	176.8	2.00	174.9	2.10	177.8	2.27
Neuroinfections	98.4	1.11	71.8	0.86	45.6	0.58
Nutritional deficiencies and neuropathies	194.9	2.20	174.3	2.09	133.9	1.71
Neurological injuries	425.4	4.80	393.5	4.72	360.8	4.60
Total	1264.2	14.27	1186.3	14.23	1109.1	14.14

Estimates of years of healthy life lost as a result of disability (YLDs)

Table 2.9 describes the estimates for YLDs per 100 000 population associated with neurological disorders and other diseases and injuries with neurological sequelae and as percentage of totals projected for 2005, 2015 and 2030 in the world. The number of YLDs per 100 000 population

associated with neurological disorders and other diseases and injuries with neurological sequelae is projected to decline from 1264 in 2005 to 1109 in 2030. This decline is expected to be attributable to a decrease in YLDs associated with cerebrovascular disease, neuroinfections, nutritional deficiencies and neuropathies, and neurological injuries. YLDs associated with Alzheimer and other dementias, however, are projected to increase by 38%. When expressed as a percentage of the total, YLDs associated with neurological disorders and other diseases and injuries with neurological sequelae comprise 14% of the total in 2005 and are projected to remain the same by 2030.

Figure 2.7 presents the top five categories of YLDs per 100 000 population globally and for World Bank income categories. YLDs per 100 000 population for neuroinfections, and the nutritional deficiencies and neuropathies category are highest for low income countries, while for neurological injuries, epilepsy and migraine, they are highest in upper middle income countries. For Alzheimer and other dementias, they are highest for high income countries. For cerebrovascular disease, YLDs are similar in lower middle and high income countries, demonstrating the epidemiological transition taking place in the lower middle income group of countries. Figure 2.8 demonstrates that almost half of the burden in terms of YLDs attributable to neurological disorders is in low income countries followed by lower middle income countries (31.7%). The higher burden is also a reflection of a higher percentage of population in low and lower middle income countries.

CONCLUSIONS

Burden of disease analyses as presented above are useful for informing health policy. They help in identifying not only the fatal but also the nonfatal outcomes for diseases that are especially important for neurological disorders. The above analyses demonstrate that neurological disorders cause a substantial burden because of noncommunicable conditions such as cerebrovascular disease, Alzheimer and other dementias as well as communicable conditions such as meningitis and Japanese encephalitis. As a group they cause a much higher burden than digestive diseases, respiratory diseases and malignant neoplasms.

The GBD framework provides a common denominator that can be used to judge progress over time within a single country or region or relative performance across countries and regions. It is clearly demonstrated, by comparing 2005 data with the previous GBD study (2), that neurological disorders continue to represent a significant burden. The GBD framework, for all its limitations,

Figure 2.7 Top five causes of YLDs among neurological disorders, by World Bank income category, 2005

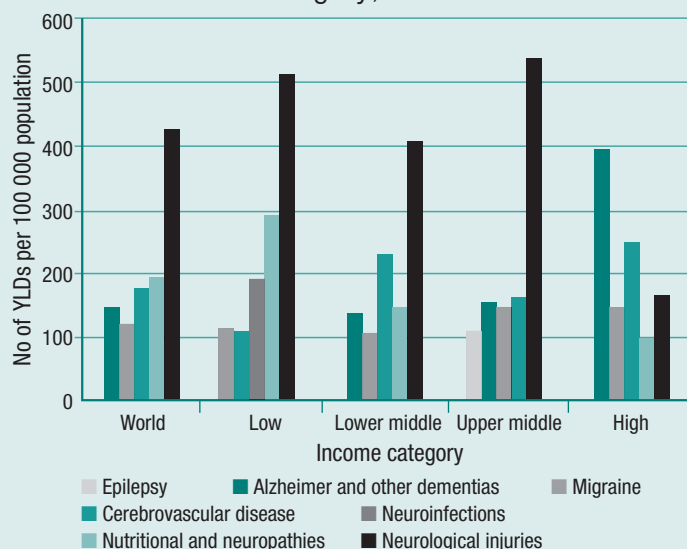
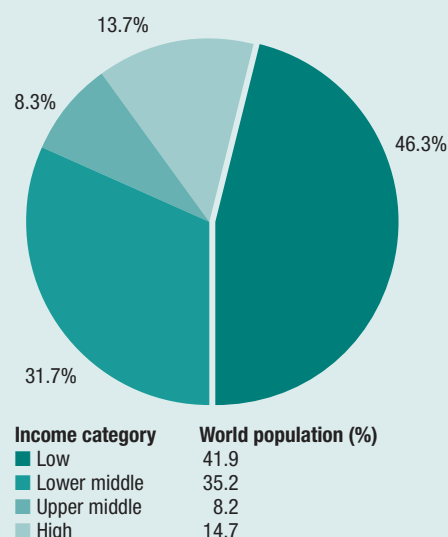


Figure 2.8 YLDs associated with neurological disorders by World Bank income category, 2005



is a useful approach for projecting future trends of mortality and burden of disease, which help in planning the strategy for control and prevention of diseases. A clear message emerges from the projections discussed in this chapter that — unless immediate action is taken globally — the neurological burden will continue to remain a serious threat to public health.

The double burden of communicable and noncommunicable neurological disorders in low and middle income countries needs to be kept in mind when formulating the policy for neurological disorders in these countries. In absolute terms, since most of the burden attributable to neurological disorders is in low and lower middle income countries, international efforts need to concentrate on these countries for maximum impact. Also the burden is particularly devastating in poor populations. Some of the impact on poor people includes the loss of gainful employment, with the attendant loss of family income; the requirement for caregiving, with further potential loss of wages; the cost of medications; and the need for other medical services.

The above analysis is useful in identifying priorities for global, regional and national attention. Some form of priority setting is necessary as there are more claims on resources than there are resources available. Traditionally, the allocation of resources in health organizations tends to be conducted on the basis of historical patterns, which often do not take into account recent changes in epidemiology and relative burden as well as recent information on the effectiveness of interventions. This can lead to suboptimal use of the limited resources. Economic evaluations consider marginal costs and benefits and use outcome measures such as DALYs to inform decisions. For example, phenobarbital is by far the most cost-effective intervention for managing epilepsy and therefore needs to be recommended for widespread use in public health campaigns against epilepsy in low and middle income countries. A population-level analysis of cost-effectiveness of first-line antiepileptic drug treatment is illustrated in the discussion on epilepsy (Chapter 3.2). Aspirin is the most cost-effective intervention both for treating acute stroke and for preventing a recurrence. It is easily available in developing countries, even in rural areas (12). The disease-specific sections discuss in detail the various public health issues associated with neurological disorders. This chapter strengthens the evidence provided earlier that increased resources are needed to improve services for people with neurological disorders. It is also hoped that analyses such as the above will be adopted as an essential component of decision-making and will be adapted to planning processes at global, regional and national levels, so as to utilize the available resources more efficiently.

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