

The Global Burden of Disease Study

Implications for Neurology

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Because of the epidemiological transition, the global burden of illness has changed. Several factors have contributed to this change, including improvements in maternal and child health, increasing age of populations, and newly recognized disorders of the nervous system. It is now evident that neurologic disorders have emerged as priority health problems worldwide. This is reflected in the Global Burden of Disease Study, jointly published by the World Health Organization and other groups. The proportionate share of the total global burden of disease resulting from neuropsychiatric disorders is projected to rise to 14.7% by 2020. Although neurologic and psychiatric disorders comprise only 1.4% of all deaths, they account for a remarkable 28% of all years of life lived with a disability. This study provides compelling evidence that one cannot assess the neurologic health status of a population by examining mortality statistics alone. Health ministries worldwide must prioritize neurologic disorders, and neurologists must be prepared to provide care for increased numbers of people individually and in population groups.

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The World Health Organization (WHO) has long been committed to the betterment of human health by promotion of public health measures affecting many fields of medical care. In recent years, greater attention has been given to public health aspects of neurologic disorders, as it has become evident that many priority health problems, in both developing and developed regions, affect the brain and the entire nervous system. In 1993, WHO launched a global initiative on neurology and public health, whose explicit goal was to encourage health ministries worldwide to acknowledge neurologic disorders as major public health problems.¹ A second project objective was to foster steps that would make medical care readily available at all levels of the health system for people with neurologic disorders. In light of the global shortage of neurologists, it became clear that such an accomplishment could only be realized by improvement of neurologic care in primary health care settings. More recently, WHO, in collaboration with the World Bank and the Harvard School of Public Health, published a report that estimates the total burden of illness globally, the Global Burden of Disease (GBD) Study.²⁻⁶ Because this study

provides important new information about the global burden of disease represented by brain and other neurologic disorders, yet has received little attention in the neurologic literature, it is our purpose here to highlight neurologic aspects of the GBD Study. We believe that this database provides compelling evidence that all neurologists must be committed to the provision of care for people individually and in population groups.

To examine the health status of any population, the GBD approach groups all disorders of human health into 3 broad categories:

- Group 1: communicable, maternal, perinatal, and nutritional conditions
- Group 2: noncommunicable diseases
- Group 3: injuries

The GBD Study exemplifies rather well the public health theory of an “epidemiological transition.” According to this theory, as the total mortality in any country decreases, there is a shift in the causes of deaths from group 1 to group 2 disorders. Indeed, some workers have suggested that the ratio of group 2 deaths to group 1 deaths is a proxy for the epidemiological transition. Thus, group 2 disorders already account for most deaths in the established market economies that

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have undergone the epidemiological transition. Moreover, by the year 2020, noncommunicable diseases will account for 70% of all deaths in developing regions, displacing traditional priority problems, such as malnutrition and infectious diseases. One major finding of the GBD Study is that, contrary to prevailing belief, the death rates for noncommunicable disorders (“diseases of affluence”) are, in fact, higher among adults of the developing world than in the established market economies.

ASSESSMENT OF NEUROLOGIC DISABILITY

For the field of neurology, perhaps the most important dimension of the GBD Study is the attention given to the total morbidity of populations, by quantifying the contribution of nonfatal (chronic) disorders to reductions of health status. Another major GBD project goal was to measure disease burden with a method that could also be used to assess the cost-effectiveness of interventions. In any case, the GBD Study has provided robust evidence that confirms the conviction of most neurologists that one cannot assess the neurologic health status of a population by examining mortality statistics alone. Clearly, such a disability-based framework is precisely what is needed to demonstrate that neurologic disorders are priority health problems globally.

To carry out this important work, the GBD researchers adopted an internationally standardized form of the quality-adjusted life-year, which they called the *disability-adjusted life-year* (DALY). Researchers have long agreed that time is an appropriate unit of measure of the effects of chronic illness: (1) time lost through premature death and (2) time lived with a disability. The DALY method aggregates years of life lost because of premature death (YLLs) and years lived with a disability of specified severity and duration (YLDs). By definition, 1 DALY is 1 year lost of healthy life. Japan served as the standardized population for premature death, since it is the world’s longest-surviving population. To calculate the total DALYs for any disorder in any population, one sums that disorder’s YLLs and YLDs. For example, to calculate the DALYs incurred through stroke in Thailand, one adds the total years of life lost because of stroke and the total years of life lived with disability by those who have suffered a stroke in that country.

As carried out by the GBD researchers, this is not a value-free, objective process. For example, a range of data indicate that most people value a year of life lived by a young adult more than a year of life lived by a very young child or an older adult. That is to say, there is a broad social preference that assumes that the relative value of a year of life lived rises rapidly from birth to peak in the early 20s, after which it steadily declines, and such age weighting is incorporated into the DALY estimates. Likewise, there is also a belief, especially among economists, that a year of life lived now is preferable to one lived at a future date. In the thinking of economists, waiting always carries a cost in the form of a lost opportunity. The GBD researchers discounted future life-years by 3% per year in estimating DALYs. Therefore, with discounting and age weighting incorporated, the death of a girl on her first birthday results in a loss of 34 years of life, while the death of a young woman on her 25th birthday results in a loss of 33 years of life.

Table 1. The 15 Leading Causes of Disease Burden, 1990 and 2020*

Ranking	1990	2020
1	Lower respiratory tract infections	Ischemic heart disease
2	Diarrheal diseases	Unipolar major depression
3	Perinatal conditions	Road traffic accidents
4	Unipolar major depression	Cerebrovascular disease
5	Ischemic heart disease	Chronic obstructive pulmonary disease
6	Cerebrovascular disease	Lower respiratory tract infections
7	Tuberculosis	Tuberculosis
8	Measles	War
9	Road traffic accidents	Diarrheal diseases
10	Congenital anomalies	Human immunodeficiency virus
11	Malaria	Perinatal conditions
12	Chronic obstructive pulmonary disease	Violence
13	Falls	Congenital anomalies
14	Iron-deficiency anemia	Self-inflicted injuries
15	Protein-energy malnutrition	Trachea, bronchus, and lung cancers

*Data from Murray and Lopez.²⁻⁶

Needless to say, there is intense debate among ethicists and public health workers whether a year of healthy life is more preferable now rather than later, and more preferable at certain ages. The major effect of discounting and age weighting in the GBD study is to enhance the importance of brain disorders (and sexually transmitted diseases).

NEUROLOGIC PROBLEMS ARE PRIORITIZED

The GBD study demonstrates that, between 1990 and 2020, there will be a remarkable change in the rank order of disease burden globally, as measured by DALYs. This is shown in **Table 1** for the 15 leading causes of disease burden. The 10 leading causes of disease burden in 2020 for developed regions are shown below.

1. Ischemic heart disease
2. Cerebrovascular disease
3. Unipolar major depression
4. Trachea, bronchus, and lung cancers
5. Road traffic accidents
6. Alcohol use
7. Osteoarthritis
8. Dementia and other degenerative and hereditary central nervous system disorders
9. Chronic obstructive pulmonary disease
10. Self-inflicted injuries

In the estimation of disease severity, the GBD researchers recognized that chronic illnesses differ in their impact on the individual, including the differential impact resulting from the way friends, coworkers, and society at large respond to each chronic illness. Still, the GBD Study acknowledges the broad agreement among cultures about what constitutes a severe or a mild disability.

In assessment of disease severity, the GBD researchers employed the person trade-off method, which asks health

Table 2. Severity of Disability for 22 Indicator Conditions*

Disability Class	Severity Weights	Indicator Conditions
1	0.00-0.02	Vitiligo of face, weight for height less than 2 SDs
2	0.02-0.12	Watery diarrhea, severe sore throat, severe anemia
3	0.12-0.24	Radius fracture in a stiff cast, infertility, erectile dysfunction, rheumatoid arthritis, angina
4	0.24-0.36	Below-the-knee amputation, deafness
5	0.36-0.50	Rectovaginal fistula, mild mental retardation, Down syndrome
6	0.50-0.70	Unipolar major depression, blindness, paraplegia
7	0.70-1.00	Active psychosis, dementia, severe migraine, quadriplegia

*Data from Murray and Lopez.^{2,6}

workers to make judgments about the trade-off between quality and quantity of life. How many years lived with a specified disability would you trade for a period of perfect health? Would you prefer to save 1 life-year for 1000 healthy people or 1 life-year for a larger number of people in less perfect health? Although such exercises may offend our moral sensibilities, they are practiced (implicitly) in health care systems globally. In a formal exercise involving health workers from all regions of the world, the relative severity of 22 “indicator conditions,” selected by the GBD researchers to represent distinct severities of disability, was weighted between 0.00 (perfect health) and 1.00 (equivalent to death). The disorders selected as indicator conditions were identified by the readily achieved consensus on weights among participants, despite diverse cultural backgrounds. These weights were then grouped into 7 classes where class 1 has a weight between 0.00 and 0.02 and class 7 a weight between 0.70 and 1.00. Results of the disability weighting process are shown in **Table 2**. Put summarily, the severity weight is determined by the number of people with a specified disorder whose claim on health care resources is thought equal to that of 1000 healthy people, in the judgment of health workers participating in the assessment process.

For example, if participants estimate that 1000 healthy people should have the same claim on resources as 8000 people with a disorder causing a severe disability, then the severity weight assigned to that disorder is equal to 1 minus (1000/8000), or 0.875. Likewise, if 1000 healthy people were thought to have a claim on resources equal to that of 2000 people with a disorder causing a less severe disability, then the severity weight assigned to this disorder would be 1 minus (1000/2000), or 0.5. A total of 483 sequelae representing 107 diseases and injuries, and 14 million death certificates, were rigorously analyzed to stratify each disorder within a disability class. As a GBD disability, paraplegia represents paralysis of 2 extremities and is therefore inclusive of both hemiplegia and paraplegia.

It is clear from the emerging trends in disease burden that neurology is at the focal point of the epidemiological transition. In developed regions, for example, stroke will account for 6.2% of the total burden of illness in 2020, and

dementia and other degenerative and hereditary central nervous system disorders, 3.5%. Furthermore, such disorders as unipolar depression, schizophrenia, bipolar affective disorder, and obsessive-compulsive disorder, among others, are brain disorders, mistakenly labeled in the GBD Study as examples of psychiatric disease or mental illness. Altogether, psychiatric and neurologic conditions accounted for 28% of all YLDs in 1990, even though they comprise only 1.4% of all deaths. The proportionate share of the total global burden of disease (YLLs plus YLDs) due to neuropsychiatric disorders is projected to rise from 10.5% in 1990 to 14.7% in 2020. Psychiatric and neurologic disorders are the most important contributor to YLDs in all regions of the world except sub-Saharan Africa, and even in this region they account for 16% of the total burden of disability.⁷ Moreover, much of the burden of illness due to road traffic accident, violence, war, falls, and alcohol use is a consequence of brain and neuromuscular dysfunction. As one of us (J.F.T.) has highlighted, brain dysfunction among world leaders is arguably one of the greatest threats to global peace, and therefore the health of populations, yet this politically sensitive problem has yet to receive open-minded attention at the World Health Organization.⁸

For the field of neurology, the results of the GBD severity weighting process are extremely important and must not be overlooked by health ministries worldwide. For the first time, neurologic disorders are properly classified as being priority health problems, notwithstanding their relatively small contribution to mortality statistics. It is revolutionary, for example, to find severe migraine ranked in the highest disability class, which is exactly where it should be. Of the 10 disorders in the 3 highest disability classes, 8 are neurologic problems. Given the prominent place of neurologic disorders in the GBD Study, it is surprising how little attention has been given to this study among national and regional organizations of neurologists. Perhaps it is because of the common tendency among public health workers to label many brain disorders as psychiatric problems when, in fact, they are diseases of the nervous system. The global community of neurologists, and their national and regional organizations, should join forces with the World Federation of Neurology to remedy this dilemma.

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