Part ii – Neurological Disorders

CHAPTER 3
PUBLIC HEALTH

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CONTENTS

CHAPTER 3

PUBLIC HEALTH

Global burden of neurological disorders

Public health is about the prevention of disease and the promotion of healthy living. Public health necessarily focuses on the community and groups of people; this is in contrast to the doctor who focuses on the patient. However, they both represent two ends of the same spectrum, one dealing with disease at population level, and the other dealing with disease at individual level. This chapter briefly outlines some of the basic principles of public health and their relationship to neurological disorders and health care delivery. The student should aim to be able to define incidence, prevalence and mortality rates and to understand disease burden and its measurement and prevention with particular regard to neurological disorders.

MEASUREMENT OF DISEASE

Disease occurrence

The simplest measurement of any disease is how common it is or the frequency of the disease in a community. In order to answer that question accurately, public health has first to be able to define and diagnose the disease, according to certain criteria and then measure its frequency in relation to the size of population in which the disease occurs or cases arise. This information is essential for public health planning and implementation. The science and art of gathering such information are the instruments of public health, much in the same way as the neurology history and examination are the instruments used for clinical neurology. The parameters used most frequently to report information on disease are the incidence, prevalence and mortality rates.

Incidence rate

Incidence rate is the most accurate method of measuring the frequency of a disease. The incidence rate is the number of new cases occurring in a defined population over a period of time. Measuring incidence over a period of time in a defined population gives an accurate measurement of disease frequency. Incidence measured over a year can be used to obtain the annual incidence of the disease. The annual incidence of the disease will include all new cases, or events occurring in the defined population during one year, including those who die soon after getting the disease, and those who recover from their disease. Incidence is measured as a rate, since it is always necessary to specify the time of observation. Incidence rate is often expressed as the number of new cases per 1000 person-years, 10,000 person-years, or 100,000 person-years, according to how common the disease is. For very common diseases, like diarrhoea

or the common cold, or for diseases where epidemics occur over a short period of time, the incidence rate can be expressed as number of new episodes per 1000 person-months, or 10,000 person-months. In contrast some neurological disorders are expressed per 100,000 person-years because they are uncommon or rare like myasthenia gravis or Guillain Barre Syndrome GBS.

Prevalence rate/ratio

Prevalence measures the number of cases of a particular disorder in a defined population at a fixed point in time. This includes all cases, not just new cases. Prevalence is expressed as a ratio of the number of cases per 1000, 10,000 or 100,000 of the population. Prevalence is used mostly to measure the frequency of chronic diseases and disabilities that accumulate in the community over time. A disease with a short duration can have low prevalence despite a high incidence, whereas a disease with a long duration may have a high prevalence despite a relatively low incidence rate. Many neurological diseases have long durations and despite relatively low incidence rates, they can still have relatively high prevalence. These include chronic diseases like epilepsy, paraplegia, leprosy and stroke. Some neurological disorders have a particularly high prevalence e.g. migraine 5-10,000/100,000 of the population. When a disease is this common its frequency can be expressed more simply, as the proportion or percentage of the population affected, in the case of migraine 5-10%. Though epilepsy is ten times less common its prevalence can still be expressed more simply as 0.5-1% of the population affected.

Mortality rate

Mortality is expressed as the total number of deaths in a defined population over a defined period of time, usually during one year. Mortality rates are often expressed as the number of deaths per 1000, 10,000 or 100,000 of the population per year, according to how high the mortality is. The overall or crude death rate for all causes is often given as the total number of deaths per 1,000 of the population occurring during one year. The crude mortality rate for all causes in Sub-Saharan Africa is around 18/1,000 per year in contrast to around 9/1,000 per year in high income countries. However this does not mean that the risk of dying is just twice as high in Africa. In fact the risk is higher because crude death rate is heavily dependent on the age structure and life expectancy of a population. As the population in Africa is mainly young (50% <12 yrs) and average life expectancy short (<50 yrs) then the figure 18/1000 actually represents a much higher overall risk of death in Africa. Crude mortality rates are therefore a better guide to a change in overall risk within a population than to the comparison of risk across populations in different countries.

Mortality rate can be calculated for specific age groups, e.g. 0-1 year, 1-4 years, 5-14 years, 10 years e.g. 20-29 years & 15-49 years. Such age-specific rates can be used to validly compare mortality across population groups within countries and across different countries. During emergency situations e.g. epidemics of cholera a shorter study time period of a day, week or month may be used when calculating mortality rates.

Case fatality ratio

Case-fatality ratio or proportion can be defined as the number of deaths from a disease divided by all cases of that disease that occurred over a period of time. It is usually expressed as a percentage. The case fatality for rabies is 100% and for tetanus is over 50%, in contrast the case fatality for tension headache is zero.

Definitions

- Incidence rate: number of new cases of a disease occurring in a population during a specified time period
- Prevalence rate: total number of cases present in a defined population at a point in time.
- Prevalence ratio: proportion of a population affected by a disease at a given point in time
- Mortality rate: the total number of deaths in a population during a specific time period
- Case fatality ratio: the number of deaths divided by the number of cases diagnosed during a specific time period

DISEASE BURDEN

Disability-adjusted life years (DALYs)

WHO uses the term disability adjusted life years (DALYs) lost to measure disease burden. This approach combines the number of years of healthy life lost (YLL) as a result of premature death, and the years lost through disability or (YLDs). The combined sum of YLLs and YLDs is called DALYs which is defined as the number of healthy years lost due to disability and premature death. This provides a measure of the number of years of healthy life which are lost as a result of a particular illness or disease. Burden of disease measurements like DALYs are particularly useful for measuring the community burden of neurological disorders, many of which are chronic, disabling and eventually shorten life.

Disability is counted in terms of years, but because it is not the same for every disorder, e.g. the degree of disability with paraplegia is much greater than that with headache, it needs to be adjusted depending on the type of the disability and also the age of the patient. The disability severity varies on a scale between 0 and 1 and this disability weight reflects the average degree of disability associated with each disorder. The years lived with a disability are multiplied by the disability weight for the condition in question to get the years lost due to the disability. The disability weight scale assigned to the different neurological disorders is available through WHO.

The gold standard assumes an expected healthy life of 82.5 years. For example if a man dies at the age of 30 years as a complication of a paraplegia which resulted from a RTA which happened when he was 20 years old then the number of years of expected life lost (YLLs) due to his premature death are 82.5 - 30 = 52.5 years. The number of DALYs lost is even greater as it includes the 10 years of life lived with paraplegia that has a disability weight of **0.671**. This will then correspond to 10 x 0.671 = 6.7 life years lost due to disability, and the sum of DALYs lost will be: 52.5 + 6.7 = 59.2 years.

Definitions

- YLLs: years of life lost due to premature death
- YLDs: years lived with a disability
- DALYs: the sum of life years lost due to premature death and disability

The burden of neurological disorders in Africa

The burden of deaths and disability attributable to neurological disorders in Africa is presented below according to WHO estimate 2005.

Death

Neurological disorders are an important cause of mortality and constitute about 12% of all deaths worldwide, with stroke alone accounting for 85% of all neurologic deaths. In Africa the proportion of all deaths (**YLLs**) attributable to neurological disorders is **4.6%** (Fig 3.1). This is comprised of **stroke 3.2%, infections 1.0% and epilepsy 0.4%**. The main reasons for this relatively lower proportion are the younger population distribution with high rates of fatal non neurological infections and also notably the burden of neurological deaths related to human immunodeficiency virus (HIV) infection are not included in this figure.

Deaths attributable to neurological disorders in Sub-Saharan Africa (4.6% of all deaths)

**Figure 3.1** Deaths caused by neurological disorders
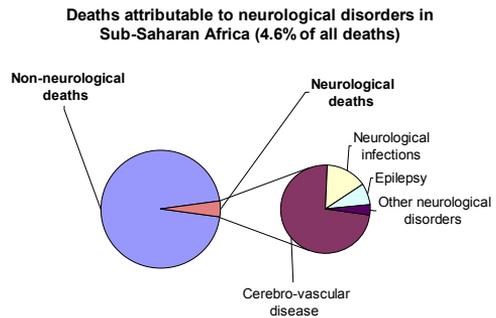
Disability

Disability can be defined as a physical or mental impairment that substantially limits one or more major life activities. Disabilities can be caused by disease, trauma or other health conditions and may require ongoing medical care. Many neurological diseases result in disability, and lasting disability is the most common outcome after a neurological illness or injury. The main neurological disabilities are impairment of motor or cognitive functions. These include a wide range, from loss of mobility in stroke and paraplegia to cognitive impairment in head injury. Other lasting disabilities include epilepsy and loss of sight or hearing. Disability may be a fixed disability as occurs in head injury or progressive as in dementia. Neurological disorders contribute **>14%** of the total burden of **YLDs** in Africa. (Fig. 3.2). The causes include **infections 4.2%, nutrition/neuropathies 4%, head injuries 3.6%, epilepsy 0.9%, migraine 0.6%, stroke 0.4%,** and **neurodegeneration 0.4%**.

Mental Disease

Neuropsychiatric disorders including **depression**, **psychoses, alcohol abuse** and **substance use** account for significant proportion of global disease burden **>14%** of **YLDs**. These frequently coexist with neurological disorders but are not covered in this textbook. Neurological and mental disease together account for >**28%** of total **YLDs** in Africa.

Disability (YLDs) attributable to neurological disorders in Sub-Saharan Africa (14.17%)

Figure 3.2 Disability caused by neurological disorders
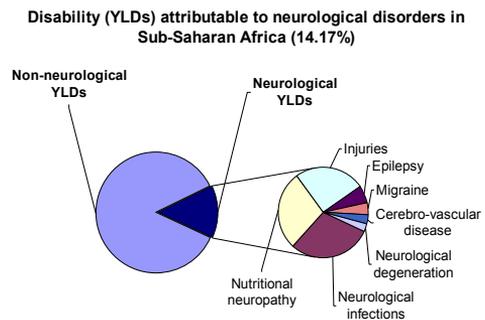
Death and disability (DALYs)

Globally neurological disorders contribute **>6%** of the total DALYs. In Africa NDs account for about **3%** of total burden of disease as measured by DALYs. The main neurological disorders contributing to DALYs in Africa are **stroke 1.1%, infections** (mostly tetanus & meningitis) **0.9%**, and **epilepsy 0.5%**. However this is an underestimate as the burden of HIV related

neurological disorders is not included in this category by WHO estimate. **HIV/AIDS** on its own accounts for over **5%** of total DALYs worldwide, most of which occurs in SSA.

HEALTH PROMOTION AND DISEASE PREVENTION

Health promotion can be defined as the process of enabling people to increase control over their health and its determinants, and thereby improve their lives. The primary means of health promotion occurs through developing a healthy public policy that addresses the prerequisites of health such as income, housing, food, water, security, employment, transport and quality working conditions.

Disease prevention (preventive medicine or preventive care) refers to measures taken to prevent illness or injury, rather than curing them. The major preventable risk factors for global disease are outlined below in Table 3.1. Prevention strategies are designed to decrease morbidity and mortality and are categorised as primary, secondary and tertiary prevention (Table 3.2). These strategies are aimed either at the general population or targeted at selective subgroups of the population. Specific examples of prevention strategies in neurology are presented in Table 3.3.

Table 3.1 Major preventable risk factors for disease globally, WHO

Risk factor	% global disease burden
Under nutrition	15
Over nutrition	13
Unsafe sex	6
Tobacco	4
Alcohol	4
Unsafe water/sanitation/hygiene	4

Primary prevention strategies intend to avoid the development of a disease. Primary prevention stops a disease from happening or stops individuals from becoming at risk. Most population-based health promotion activities are primary preventive measures. General or population based prevention is designed to stop or reduce known risks in the whole population. Examples are to vaccinate all infants at birth in order to prevent tetanus and to promote healthy eating and exercise to prevent non communicable diseases.

Selective or targeted primary prevention normally targets high risk groups and may require some form of screening test in order to identify those at increased risk. Examples are preventive programmes targeted towards high risk groups, identified after screening for non communicable diseases or HIV.

Secondary prevention activities are aimed at early disease detection and treatment, thereby increasing opportunities for interventions to prevent disease progression and the emergence of symptoms. Secondary prevention aims at decreasing disease severity through the early detection, diagnosis and treatment of the disease. Examples of this include diagnosing and treating hypertension to prevent stroke or treating HIV with ARTs to prevent AIDS.

Tertiary prevention reduces the negative impact of an already established disease by restoring function and reducing disease-related complications. Thus tertiary prevention involves treating and managing disease complications which have already occurred, in order to prevent death and reduce disability. Examples of this in neurology are rehabilitation of stroke and paraplegia. Rehabilitation is an active process by which those affected by injury or disease

achieve a full or optimum recovery, in all aspects of life. It is one of the key components of health care, along with prevention and treatment.

The distribution and determinants of risks in a population have major implications for which type of public health intervention is used. Decreasing a small risk in a large number of people usually results in more cases being prevented than decreasing a larger risk in a smaller number. Thus, general prevention strategies aiming at reaching the whole population are often more cost-effective than prevention targeted to high risk groups only. However, combining population-based and high risk strategies can be even more effective.

Table 3.2 Prevention of disease

Primary	preventing a disease before it happens
Secondary	decreasing disease severity through early detection, diagnosis and treatment
Tertiary	treating & managing disease complications to increase quality of life, reduce disability & prevent death

Table 3.3 Examples of prevention strategies in neurological disorders in Africa

Prevention strategies	Measures	Expected outcome
Primary prevention	vaccination	prevents tetanus
	increased exercise healthy diet low salt diet stop smoking reduce cholesterol	combined with secondary measures decreases stroke by 70%
	wearing seatbelts/helmets	decreases death/head injury by 40-50%
Secondary prevention (screening, early diagnosis and treatment)	treating epilepsy	decreases mortality, morbidity >70% seizure free
	treating hypertension	decrease stroke, heart and renal failure
	ART and OI prophylaxis	decreases mortality/morbidity in HIV
Tertiary prevention (rehabilitation & palliative care)	rehabilitation hospital and community based	improved quality and independence of life
	palliative care	stops/decreases pain and other symptoms

HEALTH DELIVERY

Governments, departments of health and health care planners define health policies and implement disease prevention and care strategies. They are supported by non government organizations and voluntary organizations. The debate in health care in Africa as elsewhere in the world is "where to get the best value for your money". In general where resources are limited it is the public health based population primary prevention interventions that have the greatest priority and potential to save lives (Table 3.3). However, within health delivery there needs to be a balance between prevention and care as the successful implementation of both are linked and interdependent. In neurology successful examples of primary prevention include vaccination to prevent tetanus and meningitis and bed nets to prevent cerebral malaria.

Examples of secondary prevention include treating epilepsy, ART, prophylaxis of opportunistic infections in HIV and treatment of hypertension to prevent stroke. Both approaches are complementary to health care policy in Africa.

Neurological service provision

Adequate health systems are a prerequisite for health care. These are the institutions and organizations within a country that provide and deliver the health services. The basic resources needed to provide these services are staff, facilities, equipment and medications. Staff includes the ministry of health and the health care workers (HCW) including traditional practitioners. The services which they provide are delivered at three main levels in Africa (Table 3.4).

Primary care is the first point of contact of the health service with the patient. Health care is delivered at this level by primary health care workers (PHCW), mainly medical assistants and nurses working at dispensaries and health care centres. The most common neurological disorders encountered in primary care are headache and epilepsy. Limitations to the successful delivery of neurological service at this level include the lack of adequate education and training in neurology, cultural barriers and practical constraints both financial and geographic. Any long term measures designed to improve services at this level must be targeted on education and be culturally appropriate, sustainable and adequately resourced.

Secondary care is provided at district, regional and mission hospitals. The main health care workers (HCW) involved in secondary care are nurses, medical assistants and doctors. Available facilities at this level include general inpatient and outpatient services, paediatric, medical, surgical and obstetrical care in addition to laboratory, radiological and some rehabilitation services. Public health and some HCW training are sited at regional and also at some mission hospitals. The balance and make up of each facility depends on the type of hospital and where it is. However diagnostic neurology facilities including a CT scanner or electrophysiology facilities (EEG) are usually not available at this level. Patients presenting with major neurological disorders often present at this level for the first time. The most common disorders include epilepsy, stroke, infections, paralysis and coma and are the subject of individual chapters in this book.

Tertiary care is provided at referral or teaching hospitals. These specialist hospitals act as referral and care centres serving large areas of the country with populations involving many millions. The HCWs providing the service at this level are nurses, occupational and physiotherapists, doctors and specialists. The main aim in neurology is to provide a specialist diagnostic, treatment and management service. However because of the lack of trained specialists, mainly neurologists and neurosurgeons there is frequently only a limited service available. Diagnostic facilities usually available at these centres include neuroimaging, a CT scanner (occasionally MRI), electrophysiology facilities including EEG, and rehabilitation services including physiotherapy and occupational therapy. These centres also provide national facilities for undergraduate and postgraduate teaching and training and also for research into neurological disorders. The aim of this book is to support neurological education and training in Africa.

Table 3.4 Health care level and activities in Africa

Level	Site/population	Staff (HCW)	Activities
Primary health care	dispensary/health care centre (2000-5000)	nurses/medical assistants	immunization, maternal and child, family planning, treatment of common diseases including epilepsy
Secondary health care	district/mission hospital (100,000-200,000)	nurses/medical assistants and 1-2 doctors	emergency and curative services
	regional hospital (0.5-1 million)	nurses/medical assistants and doctors	care, preventative and training
Tertiary health care	consultant hospital (millions)	nurses/doctors and specialists	care, teaching, research

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