Epidemiology Of Speech, Language And Hearing Disorders

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- Epidemiology is the basic science of preventive and social medicine.
- By identifying risk factors of chronic disease, evaluating treatment modalities and health services, it has provided new opportunities for prevention, treatment, planning and improving the effectiveness and efficiency of health services.

History

- Epidemiology is derived from the word epidemic (epi=among; demos=people; logos=study).
- The foundation of epidemiology was laid in the 19th century, when a few classic studies made a major contribution to the saving of life.
- Mention is made of an Epidemiological Society in London in 1850s under the presidency of the Earl of Shaftesbury.
- The society's main concern was the investigation of infectious diseases.

- In 1927, W.H.Frost became the first professor of epidemiology in U.S.
- Later Major Greenwood became the first professor of epidemiology and medical statistics in the University of London.
- Epidemiology has grown rapidly during the past few decades.
- It has now become firmly established in medical education.

Definitions

- There appears to be almost as many definitions of epidemiology as there are authors who have written on the subject, ranging from Hippocrates to those of the preesnt day. They are given below:

- That branch of medical science which treats of epidemics (Parkin, 1873).
- The science of the mass phenomena of infectious diseases (Frost, 1927).
- The study of disease, any disease, as a mass phenomenon (Greenwood, 1934).
- The study of the distribution and determinants of disease frequency in man (MacMohan, 1960).

- Epidemiology has been defined by John M Last in 1988 as

  "The study of the distribution and determinants of health related states or events in specified populations, and the application of this study to the control of health problems".

Components

- **Disease Frequency**

  The basic measure of disease frequency is a rate or ratio. These rates are essential for comparing disease frequency in different populations or subgroups of the same population in relation to suspected causal factors. This is a vital step in the development of strategies for prevention or control of health problems. Equally, epidemiology is also concerned with the measurement of health related events and states in the community(e.g. Health needs, demands, tasks) and variables such as blood pressure, height, weight, etc.

Distribution of disease

An important function of epidemiology is to study distribution patterns in the various subgroups of the population by time, place and person. That is, the epidemiologist examines whether there has been an increase or decrease of disease over time span; whether there is a higher concentration of disease in one geographic area than in others; whether the disease occurs more often in men or in a particular age group, and whether most characteristics or behaviour of those affected are different from those not affected. Epidemiology addresses itself to a study of these variations or patterns, which may suggest or lead to measures to control or prevent the disease.

Determinants of disease

A unique feature of epidemiology is to test aetiological hypotheses and identify the underlying causes of disease. This aspect of epidemiology is known as “analytical epidemiology”. Analytical strategies help in developing scientifically sound health programmes, interventions and policies.

Aims of Epidemiology

- According to the International Epidemiological Association(IEA), epidemiology has three main aims:

a) To describe the distribution and magnitude of health and disease problems in human populations

b) To identify aetiological factors in the pathogenesis of disease; and

c) To provide the data essential to the planning, implementation and evaluation of services for the prevention, control and treatment of disease and to the setting up of priorities among those services.

Epidemiology approach

The epidemiological approach to problems of health and disease is based on two major foundations:

- Asking questions
  - Related to health events
  - Related to health action

- Making comparisons

  The basic approach in epidemiology is to make comparisons and draw inferences. This may be comparison of two- one group having the disease and the other group not having the disease, or comparison between individuals.

Measurements of Epidemiology

It includes the following:

- Measurement of mortality
- Measurement of morbidity
- Measurement of disability
- Measurement of natality
- Measurement of the presence, absence or the distribution of the characteristic or attributes of the disease
- Measurement of medical needs, health care facilities, utilization of health services and other health related events

- Measurement of the presence, absence or distribution of the environmental and other factors suspected of causing the disease, and
- Measurement of demographic variables.

Tools of Measurement

The basic tools of measurement in epidemology are:

1. Rates
2. Ratios
3. Proportions

- **Rate**

  A rate measures the occurrence of some particular event in a population during a given time period. It indicates the change in some event that take place in a population over a period of time.

- An example of a typical rate is the death rate. It is written as

$$\text{Death rate} = \frac{\text{Number of deaths in one year}}{\text{Mid year population}} \times 1000$$

- The various categories of rates are:
  - **Crude rates:** These are the actual observed rates such as the birth and death rates. These are also known as unstandardized rates.
  - **Specific rates:** These are the actual observed rates due to specific causes or occurring in specific groups or during specific time periods.
  - **Standardized rates:** These are obtained by direct or indirect method of standardization or adjustment, e.g. age and sex standardized rates.

Ratio

It expresses a relation in size between two random quantities. It is expressed in the form of:

x : y or x/y

e.g. $\frac{\text{The number of children with scabies at a certain time}}{\text{The no. of children with malnutrition at a certain time}}$

Proportion

A proportion is a ratio which indicates the relation in magnitude of a part of the whole. A proportion is usually expressed as a percentage, e.g.

$$\frac{\text{The no. of children with scabies at a certain time}}{\text{The total no. of children in the village at the same time}} \times 100$$

Measurement of Mortality

- Traditionally and universally, most epidemiological studies begin with mortality data.
- Many countries have routine systems for collecting mortality data. Each year, information on deaths is analyzed and the resulting tabulations are made available by each government.
- Mortality provides the starting point for many epidemiological studies.
- The basis of mortality data is the Death Certificate.
- In order to improve the quality of maternal mortality and infant mortality data and to provide alternative method of collecting data on deaths during pregnancy and infancy, a set of questions are added to the basic structure of international death certificate for use in India.

Limitations of mortality data

a) Incomplete reporting of deaths
b) Lack of accuracy
c) Lack of uniformity
d) Choosing a single cause of death
e) Changing
f) Diseases with low fatality

Uses of mortality data

- Statistics on causes of death are important and widely used for a number of purposes.
- They may be employed in explaining trends and differentials in overall mortality
- Indicating priorities for health action and the allocation of resources
- In designing intervention programmes
- In the assessment and monitoring of public health problems and programmes
- For epidemological research

Mortality Rates And Ratios

- **Crude death rate**

It is defined as "the number of deaths per 1000 estimated mid year population in one year, in a given place". The crude death rate is calculated from the formula:

$$\frac{\text{No. of deaths during the year} \times 1000}{\text{Mid year population}}$$

The crude death rates have a major disadvantage, that is, they lack comparability for communities with populations that differ by age, sex, race, etc. However, they should always be examined first, and later the age specific death rates which are the most single measures of mortality.

❑ Specific death rates

The specific death rates may be (a) cause or disease specific e.g. tuberculosis, cancer; (b) related to specific groups e.g. age specific, gender specific, etc.Specific death rates can help us to identify particular groups or groups "at risk", for preventive action. e.g.

- Specific death rate for males =

$$\frac{\text{no. of death among males during a calender year}}{\text{mid year population of males}} \times 1000$$

- Death rate for january = $\frac{\text{deaths in jan.} \times 12}{\text{mid year population}} \times 1000$

- **Case fatality rate (Ratio)**

$$\frac{\text{Total no. of deaths due to a particular disease}}{\text{Total no. of cases due to same disease}} \times 100$$

Case fatality rate represents the killing power of a disease. It is simply the ratio of deaths to cases.

- **Proportional mortality rate (Ratio)**

Proportional mortality rate expresses the "number of deaths due to a particular cause per 100 total deaths". Thus we have:

(a) Proportional mortality from a specific disease

$$= \frac{\text{No. of deaths from the specific disease in a year}}{\text{total deaths from all causes in that year}} \times 100$$

(b) Under 5 proportionate mortality rate

$$= \frac{\text{No. of deaths under 5 years of age in the given year}}{\text{Total no. of deaths during the same period}} \times 100$$

(c) Proportional mortality rate for aged 50 years and above

$$= \frac{\text{No. of deaths of persons aged 50 years and above}}{\text{Total deaths of all age group in that year}} \times 100$$

- **Survival rate**

It is the proportion of survivors in a group, studied and followed over a period.

$$\text{Survival rate} = \frac{\text{Total no. of patients alive after 5 years}}{\text{Total no. of patients diagnosed or treated}} \times 100$$

❑ Adjusted or standardized rates

Standardization is carried out by one of two methods:

Direct standardization

Indirect standardization

Direct standardization: The direct method of standardizatio is feasible only if the actual specific rates in subgroups of the observed population are available with the number of individuals in each subgroup.

Indirect age standardization:

(1) Standardized mortality ratio (SMR)

It is a ratio of the total number of deaths that occur in the study group to the number of deaths that would have been expected to occur if that study group had experienced the death rates of a standard population.

$$SMR = \frac{\text{observed deaths} \times 100}{\text{expected deaths}}$$

(2) Other Standardization techniques

- The calculation of an index death rate and a standardizing factor for each population of interest.

- Life table is an age adjusted summary of current all causes mortality.
- Regression techniques
- Multivariate analysis

Measurement of morbidity

- Morbidity has been defined as “any departure, subjective or objective, from a state of physiological well being”.
- The WHO Expert Committee on Health Statistics noted in its 6th report that morbidity could be measured in terms of 3 units:

✓ Persons who were ill;

✓ The illnesses that these persons experienced;

✓ The duration of these illnesses.

- The value of morbidity data may be summarized as follows:

a) They describe the extend and nature of the disease load in the community, thus assist in the establishment of priorities.

b) They usually provide more comprehensive and more accurate and clinically relevant information on patient characteristics, than can be obtained from mortality data, and are therefore essential for basic research.

c) They serve as starting point for aetiological studies, and thus play a crucial role in disease prevention.

d) They are needed for monitoring and evaluation of disease control activities.

Incidence

- Incidence rate can be defined as "the number of NEW cases occurring in a defined population during a specified period of time". It is given by formula:
- Incidence = No. of new cases of specific disease during a given time period × 1000 / population at risk during that period
- It will be seen from above definition that incidence rate refers

a) only new cases
b) during a given period
c) in a specified population or "population at risk", unless other denominators are chosen.

d) it can also refer to new spells or episodes of disease arising in a given period of time, per 1000 population.

$$\text{Incidence rate} = \frac{\text{No. of spells of sickness starting in a defined period}}{\text{Mean no. of persons exposed to risk in that period}} \times 1000$$

- **Special incidence rates**

a) Attack rate

An attack rate is an incidence rate used only when the population is exposed to risk for a limited period of time such as during an epidemic.

$$= \frac{\text{No. of new cases of a specified disease during a specified time interval}}{\text{Total population at risk during the same interval}} \times 100$$

(b) Secondary attack rate

It is defined as the number of exposed persons developing the disease within the range of the incubation period following exposure to a primary case.

Uses of incidence rate:

a) to control disease,

b) for research into aetiology and pathogenesis, distribution of diseases, and efficacy of preventive and therapeutic measures.

Prevalence

- The term “disease prevalence” refers specifically to all current cases existing at a given point in time, or over a period of time in a given population.
- A broader definition of prevalence is as follows: “the total number of all individuals who have an attribute or disease at a particular time divided by the population at risk of having the attribute or disease at this point in time or midway through the period”.
- Prevalence rate is really a ratio.
- It is of 2 types:

Point prevalence

Period prevalence

a) Point prevalence of a disease is defined as the number of all current cases (old or new) of a disease at one point of time, in relation to a defined population. It is given by the formula:

$$= \frac{\text{No. of all current cases of a specified disease existing at a given point in time}}{\text{Estimated population at a same point in time}} \times 100$$

Point prevalence can be made specific for age, sex and other relevant factors or attributes.

(b) Period prevalence: It is less commonly used measure of prevalence. It measures the frequency of all current cases existing during a defined period of time expressed in relation to a defined population.

- It is given by formula:

$$= \frac{\text{No. of existing cases of a specified disease during a given period of time interval}}{\text{Estimated mid interval population at risk}} \times 100$$

Relationship Between Prevalence and Incidence

- Prevalence depend upon 2 factors, the incidence and duration of illness.
- Given the assumption that the population is stable, and incidence and duration are unchanging, the relationship between incidence and prevalence can be expressed as:

$$P = I \times D$$

= incidence × mean duration

Conversely, it is possible to derive incidence and duration as follows:

Incidence = P/D

Duration = P/I

- The above equation shows that the longer the duartion of the disease, the greater its prevalence. For example, tuberculosis has a high prevalence rate relative to incidence. This is because new cases of tuberculosis keep cropping up throughout the year, while the old ones may persist for months or years. On the other hand, if the disease is acute and of short duration either because of rapid recovery or death, the prevalence rate will be relatively low compared with the incidence rate.
- When we see a change in prevalence from one time period to another, this can result from changes in

Incidence, changes in duration of disease or both. Further, if duration is decreased sufficiently, a decrease in prevalence could take place despite an increase in incidence.

- In other words, the element of duration reflects the prognostic factors, and incidence reflects the causal factors. Therefore incidence rates should be optimally used in the formulation and testing of aetiological hypotheses. When incidence rates are not available, prevalence rates may have to be used, but the contribution of duration element always has to be assessed.

Incidence And Prevalence Of Hearing Impairment

World Scene

- There are well over 123 million persons with hearing loss of the approximately 6 billion world population.
- This category ranks second among persons with severe activity limitation (WHO, 1998)
- Majority of them are said to be living in South Asian Countries.

CLASSIFICATION OF DATA

The available data on the incidence and/or prevalence of speech and hearing impairment either exist independently as an entity or co-exist along with the causative details.

A common type of classification of such data may be as follows:

- Geographical, i.e. according to the area or region.
- Chronological, i.e. according to occurrence of hearing impairment over defined stretch of time.
- Qualitative, i.e. according to the type of hearing impairment, whether it is conductive, sensori-neural, mixed, functional or central type of deafness.
- Quantitative, i.e. according to degree of hearing loss.
- Socio-Economic, i.e. according to social, religious or economic background of persons with hearing impairment.

- Geographical Data

The report of the 47th Round of NSSO, 1991 estimates that there are 32,42,000 persons with hearing impairment in India.

The following table gives the incidence and prevalence of disability gender-wise and for urban and rural areas, based on NSSO 1981 & 1991 surveys.

		MALE		FEMALE	
		1981	1991	1981	1991
Prevalence	Rural	595	498	510	435
	Urban	386	325	395	355
Incidence	Rural	20	16	18	14
	Urban	14	11	15	14

NSSO 2002

		Males	Females
Prevalence	Rural	351	332
	Urban	252	256
Incidence	Rural	10	7
	Urban	8	7

- Chronological Data

It is inferred that majority of the persons with hearing impairment are sheltered in rural areas, and are above the age of 60 years.

Reports indicate that 1% of children are born with HI (Kameswaran, 1985). It means that about 50 children with HI are born in a district of 20 lakh population, and about 60 children are born deaf everyday in India.

The age-wise distribution per 1000 persons with HI (NSSO, 1991)

AGE GROUP	HEARING IMPAIRMENT	
	Rural	Urban
0-4 yrs	N.A.	N.A.
5-14 yrs	85	80
15-59 yrs	387	377
60 yrs & above	526	541

- Quantitative Data

A DRC study of all persons who report for audiological remediation,

Degree of Hearing Loss	
Mild loss	2%
Moderate loss	25%
Moderately severe loss	19%
Severe loss	42%
Profound loss	12%

Each village had on the average 6 persons with HI.

The averages indicate the prevalence of HI in our country.

- Qualitative Data

  A DRC study

Type of loss	Percentage
Conductive loss	5%
Mixed loss	27%
Sensorineural loss	68%

- Socio-Economic Data

Social groups and Incidence of HL (per lakh)

Social Group	0-4 yrs	5-12 yrs
STs	158	576
SCs	385	1272
Religion		
Hindus	264	689
Muslims	324	1328
Christians	295	590
Other minorities	501	764

- Household income and incidence of hearing loss

There is evidence that the prevalence of disability is highly correlated with poverty and social disadvantage caused by the skewed distribution of society available resources.

Income-wise Incidence of HL (per lakh)

Household income group	0-4 yrs	5-12 yrs
Upto Rs 20,000	298	922
20,001-40,000	274	639
40,001-62,000	255	530
62,001-86,000	203	496
Above 86,000	206	295

There is a gradual decrease in the incidence of HL with increase in household income

- NSSO undertook a comprehensive survey for the first time in the NSS 36th round (July-December 1981) as 1981 was the International Year of the disabled persons.
- Detailed information relating to magnitude of disability, type of disability, cause, age at onset, type of aid/ appliance used and other socio-economic characteristics was collected in this survey.
- A decade later, at the request of MSJE, NSSO covered this subject again in its 47th round (July-December 1991), with the same basic framework including concepts, definitions and operational procedures as followed in the 36th round.
- While the earlier surveys were restricted to only the physically handicapped persons, in the survey conducted since NSS 36th round(1981) an extended definition was used to cover all persons with one or more of the three physical disabilities – visual, communication (i.e. hearing and/ or speech) and locomotor.
- Also, data on developmental milestones and behavioural pattern of all children of age 5-14 years were collected,regardless of whether they were physically handicapped or not.

- Again, after a gap of eleven years, the survey on the persons with disabilities was carried out in the 58th round during July-December, 2002.
- This round also maintained the same definitions and procedures for physical disabilities as were adopted in earlier two rounds.
- This round, however, extended the coverage by including the mental disability.
- Along with the particulars of physical and mental disabilities, the socioeconomic characteristics of the disabled persons such as their age, literacy, employment, vocational training etc. were collected.

Prevalence data according to NSSO 2002

- The prevalence rate was higher in rural India (310) as compared to that in urban India (236) for males as well as females.
- Between the two sexes,the prevalence of hearing disability was marginally higher among males (319) than among females (301) in rural India while in urban India it was nearly of the same order (234 to 238).
- The male-female and rural–urban patterns observed above for all-India may be noticed in most of the states.

THANK-YOU