Module 4

Concepts and definition of Morbidity

1. Introduction

In this module we will learn about concepts and definition of Morbidity, as well as sources of morbidity statistics, measures of morbidity, along with examples. Some of these measures are common with general measures of health, which you would have encountered in the previous module.

2. Definition of Morbidity:

According to the Multilingual Demographic Dictionary, "the study of morbidity deals with the investigation of illness, sickness, ill-health or disease in a population". (Van de Walle,1982).

According to J B Stallman (1988), "morbidity is the extent of illness (disease), injury, or disability in a defined population".

Recently, life expectancy, a measure of mortality, has been expanded to include morbidity and disability. Therefore, understanding the concepts of morbidity is important to the study of mortality.

Morbidity or sickness can also be understood in terms of departure from "healthy" condition. It is the state between perfect health and death, and identification of morbidity or sickness depends upon criteria used as well as the types of observation related to the sickness. Therefore, a "Morbid condition" is a condition that arises due to one or more "diseases" or due to "injury" (Prakasam 2017).

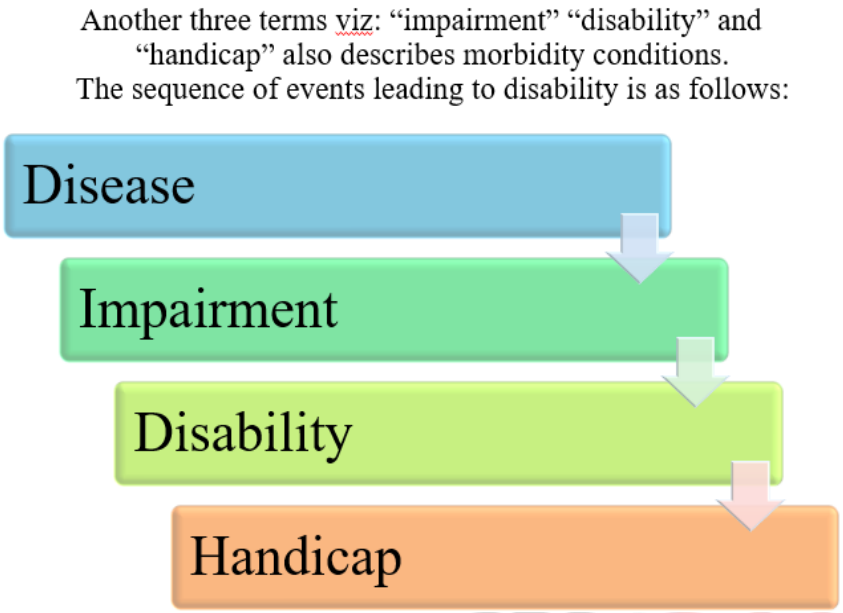
3. Definition of related terms

The term "disease" is a condition that causes morbidity. It refers to a disturbance to normal conditions of physical and mental health, which may not be apparent but may be revealed after special means of investigation of the disease as through serology or radiology.

The term "injury", another condition that causes morbidity. It is produced through external causes such as violence, accidents or poisoning.

There are three other terms that describe morbid conditions – they are, "impairment", "disability" and "handicap".

Figure 1: Terms that describe Morbid Conditions



Source: Data from above

Impairment is defined as, "any loss or abnormality of psychological, physiological or anatomical structure or function."

Disability is defined as, "any restriction or lack of (resulting from impairment) of ability to perform, an activity in the manner or within the range considered normal for a human being."

Handicap is defined as "a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual" (United Nations 2003 – 2004).

4. Events Leading to Disability

The sequence of events leading to disability is as follows:

Disease > impairment > disability > handicap

Example of events leading to disability include the following:

Accident---------- Disease (or disorder)
Loss of foot ------- Impairment (extrinsic or intrinsic)
Cannot walk ------ Disability (objectified)
Unemployed -------Handicap (Socialized) (Prakasam 2017).

5. Sources of Morbidity Statistics

Morbidity statistics are available from the following sources:

1. Hospital records of in-patients together with records of attendance of out-patients in hospitals, clinical and dispensaries.

2. Cases examined by the staff of Primary Health Care Centers, clinics, school medical services, medical services by factory medical staff and other medical staff responsible for special groups of population.
3. Special sickness surveys covering the whole or sample population.
4. Statistics on illness collected in connection with life or sickness insurance.
5. Statistics collected under community medical care programs.
6. National or local registers on cancer, tuberculosis.
7. Statistics of causes of death in relation to knowledge of duration of illness, if recorded.
8. Records from industrial sickness benefit association
9. Records from recruitment to the armed forces or goal records.
10. Screening survey and sero-surveillance of some diseases viz: tuberculosis, venereal diseases and HIV/AIDS infections.
11. Absenteeism and sickness records in educational institutions, civil service examinations and industrial concerns.
12. National Family Health Survey I, II,III, and IV, NSS of selected rounds on disability also provide limited and valuable information on morbidity statistics (Prakasam 2017)

6. Measures of Morbidity

The WHO expert committee on Health Statistics noted in its 6th report that morbidity could be measured in terms of three units:

"a) persons who were ill, b) the illness (periods or spells or illness) that these persons experienced and c) the duration (days, weeks etc) of these illnesses" (WHO 1959)

6.1. Illness: Time Period

Illness exists in a given time period as follows:

- ✓ Illness beginning during the period and ending during the period.
- ✓ Illness beginning during the period and still existing at the end of the period
- ✓ Illnesses existing before the beginning of the period and ending during the period
- ✓ Illnesses existing before the beginning of the period and existing at the end of the period (Prakasam 2017)

6.2. Measures:

Disease, illness or sickness is measured by calculating:

1. Incidence rate,
2. Prevalence rate: Period Prevalence Rate, Point Prevalence Rate.
3. Attack Rate, Secondary Attack Rate.
4. Case fatality Rate
5. Attack Rate

6. Case Fatality Rate
7. Duration of illness or sickness
8. Relative Risk, Attributable Risk and odds ratio
9. Other measures: Disability rates, HALE. QALY, DFLE, DALY (Prakasam 2017)

In this module, the above measures will be discussed with examples:

7. Incidence Rate:

Incidence Rate is given by the following equation:

$$\textbf{Incidence rate (IR)} = \frac{\text{Number of new cases of specific Disease during a given time period}}{\text{Population at risk during that period}} \times 1000$$

This measure is also discussed in the module on concepts of health.

7.1. Example using the incidence rate:

In 2003, in Greater Mumbai, the Midyear population was 11,506,042. The total number of new cases of Malaria detected by different hospitals in Greater Mumbai was 66,402. What was the incidence rate?

As per the above formula:

$$\text{Incidence rate of Malaria in GM} = \frac{66402}{11506042} \times 1000 = 5.77$$

That is, the Incidence rate of Malaria in Greater Mumbai in 2003 year was 5.77 per 1000 population

The time period of study is usually one year, in which case it is called *annual incidence* (Prakasam 2017).

8. Prevalence rate: Point Prevalence, Period Prevalence

The prevalence of a disease is the number of persons with the disease in a particular area at a particular point of time. More on this is discussed in the module on concepts of health. There are two measures of prevalence, one is the point prevalence, and the other is the period prevalence.

Point prevalence refers to the proportion of population with the disease at any given point of time, which may be a particular calendar date.

Period prevalence refers to the proportion of population with a disease during a particular period of time, say a particular year. It includes the number of cases at the start of the period as well the cases that developed during that period of time (Prakasam 2017)

The two equations are expressed below:

8.1. Equations for Prevalence Rate

The equation for point prevalence and period prevalence is given below:

$$\textbf{Point Prevalence} = \frac{\text{Number of existing cases of disease at a point of time}}{\text{Number of total population at the same point of time}}$$

Period Prevalence = Number of existing cases of disease during a period of time / Number of total population

It can be seen that in both of the measures of prevalence, the numerator is a part of the denominator, that is, the total population, whether sick, healthy, at risk or not at risk (Prakasam 2017).

8.2 Example using point prevalence:

On 26th December 1996, 1,000 females have hypertension among 10,000 females residing in town A. The prevalence of hypertension among women in town A on this date is calculated as:
1,000/10,000 = 0.1 or 10%

The following is an example of point prevalence as it calculates the number of persons with the condition/disease at a particular point of time - that is, 26th December 1996. (Prakasam 2017).

8.3. Relationship between Prevalence and Incidence

Prevalence depends on the number of new cases that develop in a given period or the rate at which it develops (incidence rate), along with the duration for which persons have the disease. Therefore, the following equation represents the relationship between prevalence of the disease and incidence of the disease:

P/(1-P)= I x D

where P=Proportion of the total population with the disease and I is incidence rate and 1-P is the proportion of the total population without the disease.

In situations where the number of persons with the disease in a population and without the disease are stable, then it is referred to as a steady-state population. In such situations, the point prevalence of the disease (prevalence of the disease at a particular point of time) is approximately equal to the incidence rate X the average duration of the disease.

That is, **P=I x D**

(GOI 2015)

Prevalence is affected by the incidence of the disease (the number of new cases that develop in a given population in a given time period), such that the higher the incidence of the disease, the higher will be the prevalence. But it is also affected by the duration of the morbidity. Some illnesses are of very long duration, decades even, for which cases accumulate over a period of time, which also affects prevalence. Thus, if the incidence is the same for two diseases, but the duration of one disease is a few days and the duration of the other disease is of much longer, then the resulting prevalence will be much higher for the second disease of longer duration. Therefore, duration of the disease has a significant effect on prevalence.

Example: if the incidence of malaria in an area is 600 per 100,000 population per year, and the average duration of the malaria is 7 days (or 1/52 years to keep the units the same), then the prevalence can be calculated by the equation above to be:

P = 600/52 = 11.54 per 100,000.

Therefore, we can expect that at any given point of time, there will be 12 persons with malaria per 100,000 population in the area (Indrayan N.D.).

9. Attack Rate

The attack rate the number of new cases of a particular disease during a particular time interval, to the total population at risk of that particular disease in the same period of time, multiplied by 100. It is given by the equation:

$$\textbf{Attack rate} = \frac{Numberofnewcasesofspecifieddiseaseduringitsspecifiedtimeinterv\ l}{Totalpopulationatriskduringthesameinterval} \text{x}100$$

(Prakasam 2017). Further discussion is in the module on concepts in health in this paper.

9.1. Secondary attack Rate:

The secondary attack rate can be defined as, "the number of exposed persons developing the disease within the range of the incubation period, following exposure to the primary case" (GOI 2015).

The attack rate is based on spells of the disease rather than persons. It is generally used for infections of short period of time as during an epidemic. It usually measures the spread of the infection after exposure to an initial case (Indrayan N.D.).

The secondary attack rate is the number of exposed persons developing the disease within the range of the incubation period to the total number of exposed to susceptible contact, multiplied by 100.

$$\text{Secondary attack} = \frac{Numberofexposedpersonsdevelopingthe\ diseasewithintherangeoftheincubationperiod}{Totalnumberofexposedsusceptiblecontact} \text{x}100$$

(Prakasam 2017).

10. Duration of Illness:

The duration of illness can be calculated in terms of the average duration of illness per person, per person sick, or spell, and these are expressed by the following equations:

a) Average duration of illness Per **person** = $\frac{\text{Total days of illness of all sick persons}}{\text{Total Population Exposed}}$

b) Average duration of illness Per person **sick** = $\frac{\text{Total days of illness of all sick persons}}{\text{Number of persons fell ill}}$

c) Average duration of illness Per **spell** = $\frac{\text{Total days of illness of all sick persons}}{\text{Number of spell of illness}}$

(GOI 2015).

11. Relative Risk (RR)

The relative risk is the incidence of the disease among the exposed to the incidence of disease or death among the non-exposed to the disease. It is given by the following equation:

Relative Risk (RR) = Incidence of disease (or death) among exposed / Incidence of disease (or death) among non-exposed

(Prakasam 2017).

11.1. Example using relative risk:

An example of using the Relative Risk, is with a measure of the association between Cancer and smoking. It is given in the table below, wherein those who smoke cigarettes are compared with those who do not smoke cigarettes, in relation to having developed cancer:

Cigarette Smoking	**Developed Cancer**	**Not Developed Cancer**	**Total**
Yes	80 (a)	3200 (b)	4000 (a+b)
No	6 (c)	4994 (d)	5000 (c+d)

Here, the relative risk for each group is calculated as follows:

Relative Risk of those who smoke to get cancer= (a/a+b) = Those who smoke who developed cancer/ the total persons who smoke = 80/4000 x 1000= 2.0

Relative Risk of those who do not smoke to get cancer= (c/c+d) = Those who do not smoke who developed cancer/ the total number of persons who do not smoke = 6/5000 x 1000= 1.2

Relative Risk (cigarette smoking causes cancer) = (a/a+b) / (c/c+d) == 2.0/1.2 = 1.67

Relative risk (RR) is a ratio. It directly measures the strength of association between the studied cause and the effect – in the example above, the association between cigarette smoking and developed cancer. If the RR ratio is more than 1, then it suggests a "positive" association.

In the example given above, the RR is 1.67. This tells us that cancer is 1.67 times more likely to occur among smokers than among non-smokers, telling us of the strength of association between cigarette smoking and cancer (GOI 2015).

12. Disability Rates:

In recent times, there has been no marked change in death rates, and as a result, disability rates as with regard to illness and injury have come to be used in order to supplement the mortality and morbidity indicators.

There are two common groups of indicators of disability rates:

a) Event type indicators, and b) person type indicators.

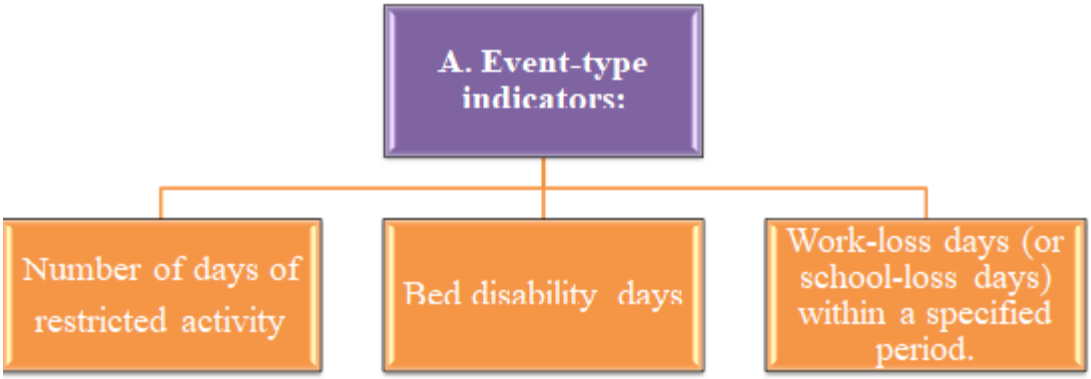
a) Event-type indicators:

i. Number of days of restricted activity

ii. Bed disability days

iii. Work-loss days (or school-loss days) within a specified period.

Figure 2: Event-Type Indicators



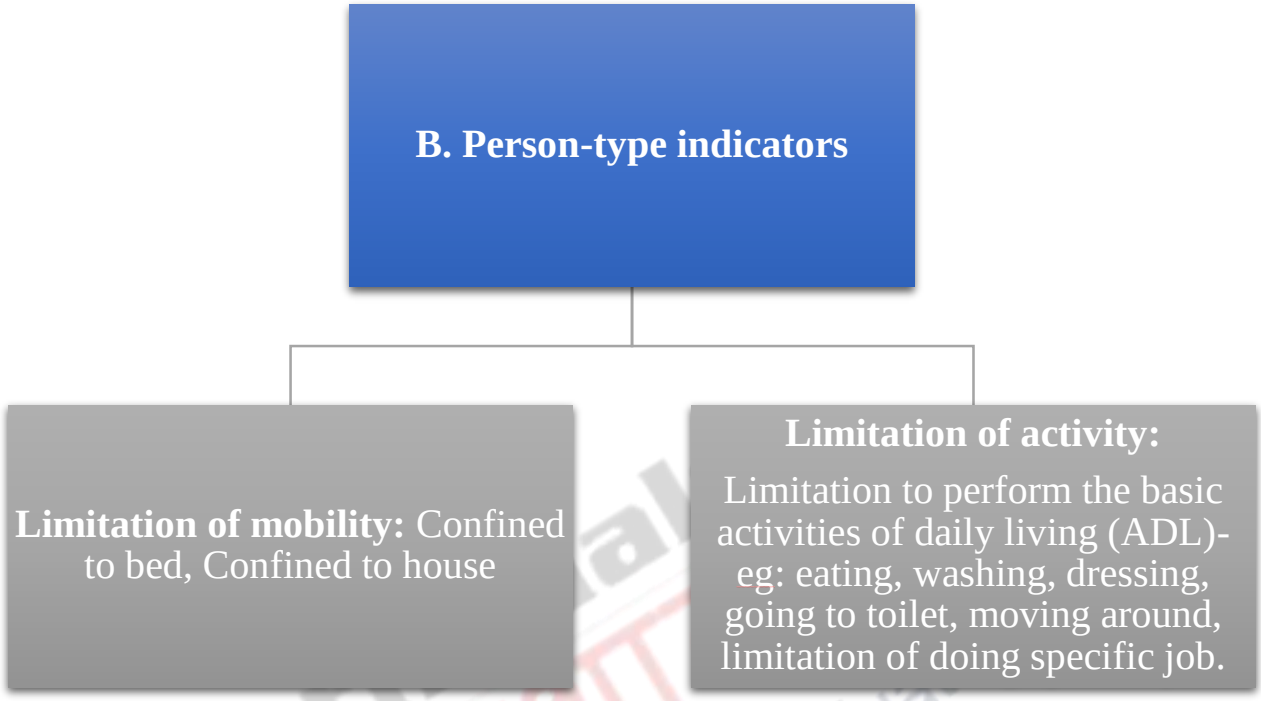
Source: Data from above

b) Person-type indicators

i. Limitation of mobility: Confined to bed, Confine to house

ii. Limitation of activity: Limitation to perform the basic activities of daily living (ADL)- eg: eating, washing, dressing, going to toilet, moving around , limitation of doing specific job (Prakasam 2017).

Figure 3: Person-type Indicators



Source: Data from above

13. Health-Adjusted Life Expectancy (HALE):

HALE stands for health-adjusted life expectancy. It is based on what was previously the disability-adjusted life expectancy (DALE), changed in order to represent all states of health.

The HALE measure is based on life expectancy at birth but is includes an adjustment for time of life spent in poor health.

HALE is based on life expectancy at birth but includes an adjustment for time spent in poor health.

HALE is the number of years in full health that a newborn can expected to live based on current rate of ill-health and mortality (WHO 2002).

HALE is defined as, "Average number of years that a person can expect to live in "full health" by taking into account years lived in less than full health due to disease and/or injury." (WHO 2017).

The measure takes into account different measures of population health, and it is adjusted for severity distribution, and is sensitive to changes over time and to differences across countries in severity in state of health (WHO 2017).

14. Quality-adjusted life years (QALY):

QALY or Quality-adjusted life years measures the burden of disease including both quantity of live lives as well as the quality of life lived. It is used to assess a medical intervention in terms of value for money.

QALY is thus based on estimating the "number of years of life that would have been lived with perfect life with the medical intervention" (Prieto et.al. 2003).

In other words, it can be said to be an indicator that assesses both the quantity and quality of life in the health of a population. Therefore, an extension of life expectancy can also be measured in terms of whether they are years of healthy life.

One example is that a person may be taking an intervention to address the problem of hypertension for about 3 decades, which adds a decade more to his life, at a slightly reduced level of quality. He would also need further intervention, which reduces his quality of life further by a given amount. The QALY would then be calculated to see how many years in total would be gained – say, around 8 years after adjusting above.

There are many other ways in which QALYs can be applied (uOttawa 2014)

15. DALY: Basic facts:

There are a few basic facts to DALY mentioned below:

1. DALYs were first reported in the World Development report in 1993
2. DALYs are a new composite indicator of population health status and express the burden of morbidity and mortality.
3. DALYs were designed with cost-effectiveness analysis in mind.

DALY measures overall disease burden. It is expressed as the number of years lost due to ill-health, disability or early death. The measure enables capturing the impact of both important fatal and non-fatal disabling conditions on a population. The DALY combines two measures, the Years of Lost Life (YLL) and Years Lost to Disability (YLD) as:

---Years of lost life (YLL): This measure is calculated from the number of deaths occurring at each age, which is multiplied by the expected remaining years of life, according to a global standard of life expectancy.

---Years lost to disability (YLD): This measure is calculated as the number of incident cases of disability due to injury and illness, multiplied by the average duration of the diseas and a weighting factor which reflects disease severity on a scale from 0 (perfect health) to 1 (dead) (Prakasam 2017).

The equations for both are given below:

$$YLL = N \times L$$

where:

- N = number of deaths
- L = standard life expectancy at age of death in years

And,

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

where:

- I = number of incident cases
- DW = disability weight
- L = average duration of the case until remission or death (years)

Where,

DALY = YLL + YLD

(WHO 2018)

There are limitations to the DALY as a measure, as a single number is intended to reflect all health costs of a disease or the health costs that have been averted by a program or intervention. However, it is difficult to know how many DALYs an intervention may have averted, whether it involved saving lives or whether it succeeded in preventing health related problems on a minor scale, or a combination of these (Give Well.org 2017).

16. Disability-free life expectancy (DFLE):

Disability-free life expectancy (DFLE) is the average number of years an individual is expected to live free of disability if the current pattern of mortality and disability continues to apply.

The DFLE indicator has been developed and used in many countries since the 1970s. The definition is a derivation from statistical sources of organisations as the IMF and OECD. As per the OECD, can be considered in terms of functional limitation-free life expectancy, and activity restriction-free life expectancy (OECD 2003).

17. Reproductive Morbidity

Apart from the above rates, in the recent period morbidity related to pregnancy and contraception is measured under Reproductive morbidity.

Reproductive morbidity:

Reproductive morbidities are morbidities that occur during pregnancy, during childbirth or within a period of 42 days of giving birth (Prakasam 2017).

WHO (1990) has defined reproductive morbidity broadly as,

“any morbidity or dysfunction of the reproductive tract or any morbidity which is a consequence of reproductive behavior including pregnancy, abortion, childbirth or sexual behavior. Morbidities may include those of a psychological nature”

These are broad definitions and definitions may vary by researcher as with regard to the research interests. And may be expressed as a function of time as given above.

The WHO has spelled reproductive morbidity as consisting of three types of morbidity: Obstetric, Gynecological and contraceptive morbidity.

“Obstetric morbidity: Morbidity in a women who has been pregnant (regardless of the duration of pregnancy) from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.

Gynecological morbidity: includes any condition, disease or dysfunction of the reproductive system, which is not related to pregnancy, abortion, or childbirth but may be related to sexual behavior.

Contraceptive morbidity includes condition, which result from efforts (other than abortion) to limit family size, whether they are traditional or modern methods" (WHO 1990).

18. Summary

The above module provided an introduction to some of the different concepts used in the study of morbidity, as well some example to illustrate how they have been used. Further readings on the concepts of health module and the concepts of mortality in this paper will also be useful.

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