<center>**Module 1**
Study of Mortality</center>

1. Introduction

In this module, you will learn about the definition and study of mortality as a broad overview. The topics of the module include the definition of mortality, mortality and its relationship to population, the importance and uses of mortality statistics as well as the sources of data for mortality statistics. Also included are examples of the study of trends in mortality data. This module is an introductory module for the paper on mortality, which is expected to provide insight such that it will facilitate further reading on other modules in this paper in general such as concepts and definitions, but also more specific topics as on life tables for calculating life expectancy, and understanding mortality differentials across the world, and by age and sex, as well as other factors that influence or are related to the study of mortality.

2. The study of mortality

The study of mortality involves studying the effect of death on a particular population, where 'death' is an event, but when studied for a particular population in any given geographical areas over a period of time, then the study of mortality involves explaining the 'force of mortality' or the 'process of death' (Prakasam 2017).

According to the United Nations and the World Health Organization, death is defined as, "Death is the permanent disappearance of all evidence of life at any time *after live birth has taken place..*" (United Nations 2017). Therefore, we can say that death is an event that occurs only after *live birth*, and the period of time between birth and death is life.

Death is one of the most important vital events. It is a central component in the calculation and understanding of population change. Aside from migration, death is the only variable that causes change in population balance through reducing population in permanency.

There are a number of factors that influence the health of individuals, and, thereby, affect the mortality rate or death rate of a community. These factors are biological, social, economic, cultural factors, as well as genetic factors. With regard to constitutional and environmental factors, there are many, and which are wide ranging. These factors include physical, physiological, anatomical, psychological factors, as well as factors pertaining to nature, water, sanitation etc. From a demographic perspective, all of these factors are important to the study of mortality (Prakasam 2017).

3. Mortality and Population

A demographer studies mortality so as to determine the size of a particular population, its structure, as well as the variation in population size due to mortality. Thus, mortality is one of the three components of population change. The other two components are Fertility and Migration.

3.1. Mortality and Population Size

In the past, mortality rates play a significant role in determining changes in the size of population, specifically in the growth of population and a decline in population was understood to be a decline in mortality rate (not considering migration).

Mortality rates or death rates and its relation to population size is expressed by the equation:

Natural increase = Birth – Death

This equation helps to understand the impact of death rates on the size of the population at a given point of time, as follows:

a) If the death rate is greater than the birth rate, then the natural increase of population will decline.

b) If the death rate is less than the birth rate, then the natural increase of the population will increase.

Observations in the past have shown that the most important factor to cause a rapid increase in population growth is a sharp decrease in death rates, rather than in fertility rates.

To illustrate, during the Industrial Revolution, many countries in Europe had very high death rates. Post the Industrial Revolution, the high death rates began to decline, but as the decline in birth rates was not at pace with the decline in death rates, there was an increase in population growth.

Several developing countries are currently experiencing this phenomena – that is, where death rates have fallen rapidly, while birth rates have remained for the most part, stable. Therefore, this has led to a sharp increase in population growth in these countries (Prakasam 2017).

Figure 1: Death Rate Equation
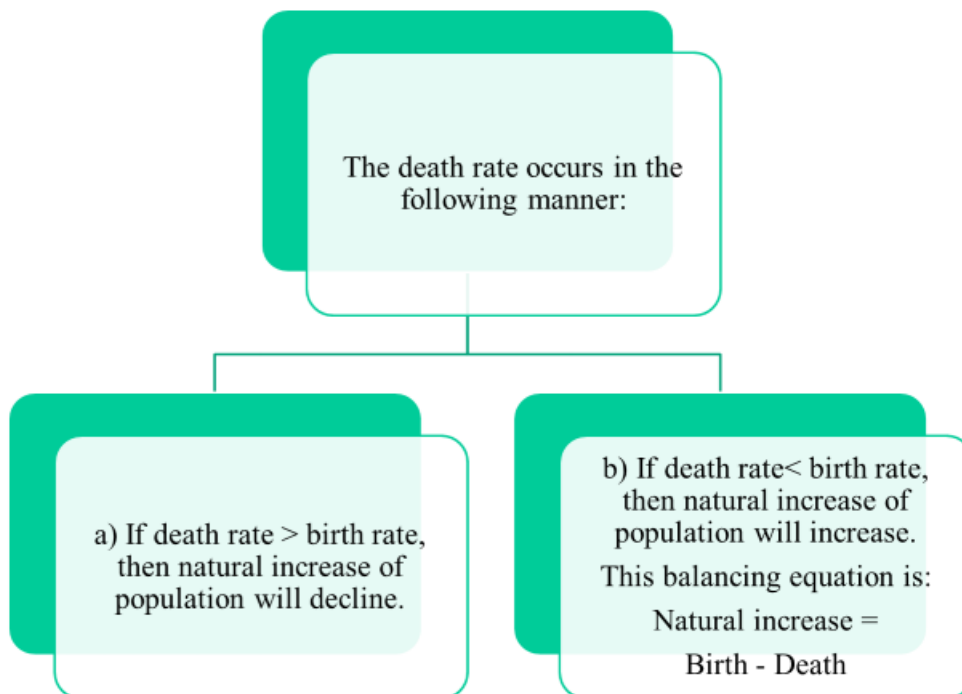
Source: Data from above

3.2. Mortality and Age Distribution of Population

Mortality or death rates also affects the age distribution of the population. The impact of mortality on the age distribution of the population is different than the impact of fertility. Fertility affects the age distribution of the population at initial stages, that is, at birth. However, mortality affects the age distribution of the population at all ages and varies according to various other factors.

Therefore, if a population were to have a high level of fertility, alongside a low level of mortality, then there would be a relatively larger percentage of population in ages of early childhood and at older ages, and, as a result, reduced percentages in the middle age groups.

The risk of mortality is always greater in the initial phase of life (0-4 years) and at advanced ages (above 60 years), than in the phase of adolescence and adulthood.

Patterns of mortality can be understood by studying the mortality statistics across country by age. In those countries which have high rates of childhood mortality, then a significant decline in mortality at early ages is likely to have an impact on the median age of the population, through a decline. This is a result of improvements in mortality levels at younger ages, which contributes to a decline in the median age of the population. The phenomena of declining median age due to improvements in the mortality rates at younger ages has been observed in most developing countries, including that of India (Prakasam 2017).

Figure 2: Mortality Influences Age Structure
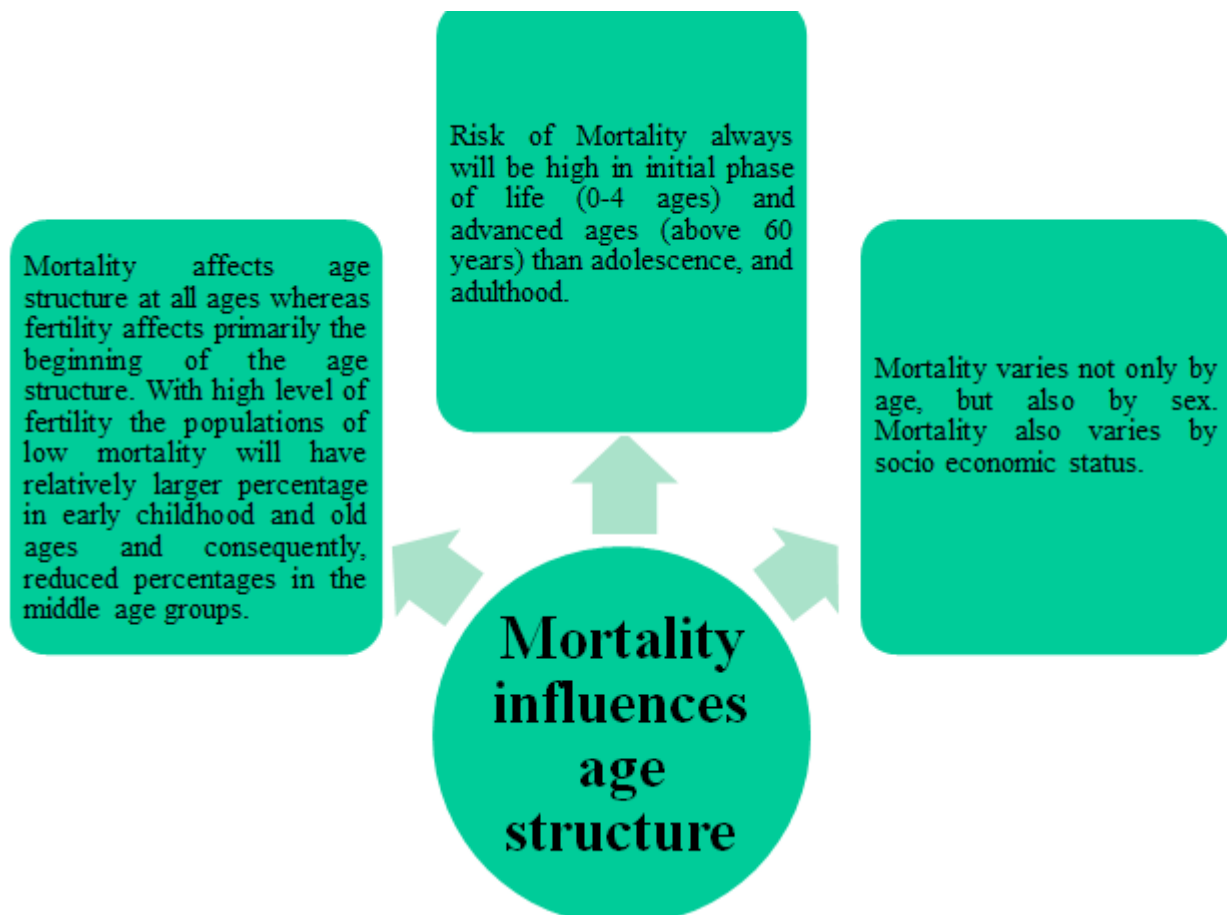
Source: Data from above

3.3. Mortality and Other Characteristics of Population

Mortality of a population also varies by sex, by socio-economic status, by community and by time period. Often mortality is discussed in terms of crude death rates, which is a measure of mortality based on averages, which does not reflect the many differences that may occur within subgroups of a population. Any given population is heterogenous, with differences amongst the different sub-groups in many respects, and the mortality rates amongst sub-groups will also have differences, which can be studied closely. To express and understand the differing mortality rates by each variable such as by age or by sex, is often studied in measures of mortality such as age specific death rates or sex specific death rates, or, when combined, it is the age-specific death rates. Other measures include that of, for instance, occupational mortality. These measures of mortality allow for the study of differing mortality rates amongst sub groups in any given population (Demopaedia 2017).

For example, there are sex differentials in mortality rates as with regard to infant mortality. The sex differentials in infant mortality is seen through the measure of the sex ratio at birth, where in many countries,

there are higher number of boys born than girls. This is also true in India, and is partly due to a number of sex discrimination practices even prior to birth that lead to this disproportionate sex ratio at birth.

And although studies cite that newborn girls are biologically stronger than newborn boys due to factors such as better resistance and other factors, discrimination affects the mortality rates of girls. In India, the mortality rates amongst girls is higher than that of boys (SEARO 2017).

Differences in mortality rates across the population is complex, which needs to be better understood, particularly with regard to sex-wise differences. Differences in mortality rates by sex are also seen in the life expectancy measures across countries, where universally studies reveal that males tend to live shorter lives than females, given higher longevity for females (PRB 2007). These measures of mortality have, however, to be understood in relation to other measures such as the sex ratio at birth and also understood over the life span so as to better understand the differentials in mortality, and these differences should be interpreted cautiously (Prakasam 2017).

4. Importance and use of Mortality Data

Mortality statistics, if considered in the short run, are important indicators of health and well-being of any given population. To estimate summary measures of population health, mortality statistics are needed, such as, for example, the life expectancy at birth. Mortality statistics can also help to understand differentials amongst sub-groups of a population with regard to population health.

The data obtained from an analysis of mortality is useful for public health agencies with regard to the development, implementation and evaluation of various public health programs. It is also useful for disease control programs, where local authorities use mortality data to determine what action needs to be taken towards improving public health in local areas. For example, knowing the number of deaths due to a particular disease in any given area will indicate the health status of the community, data which can be used by health planners. So death due to diarrhoel disease among children in a given area is indicative of the prevalence of waterborne diseases in the community. The data of number of deaths due to diarrhoel disease would enable health workers to take up interventions of water purification and improvement of sanitation facilities, as well as other measures to create awareness in the community towards using purified water at the household level.

Mortality statistics also provide information about the nature and efficiency of systems of health care delivery. For example, if there are high levels of child mortality observed for any given population during a period of time, then health care personnel may take up interventions to improve child health such as through improving access to and availability of immunisation programmes. But the data necessary for analysis is not only that pertaining to number of deaths by age and by sex, but also with regard to the underlying cause of death.

Mortality statistics, particularly regarding cause of death, can enable policy makers to understand a country's movement through the epidemiological transition, or the transition through different stages…. Therefore, mortality records in a country usually pertains not just to basic demographic characteristics, but also regarding occupation and cause of death data.

Overall, data regarding mortality of a population enables analysis of the current demographics of a population and potential changes in mortality patterns in the future as through population projections (Prakasam 2017).

5. Sources of Mortality Statistics

There are different sources of mortality statistics. One primary source of mortality data is the Vital Statistics Registration Systems. Accuracy of the Vital Statistics Registration Systems will affect the quality regarding analysis of mortality patterns. In most developing countries, India included, the data from the Vital Registration System has many deficiencies but is a very important source of mortality data.

A second important source of mortality data is the National Census and National Sample Surveys, which provide data regarding the age composition of the population. The mortality rates can be estimated from this data using indirect methods of estimation.

Other sources of mortality data include the Statistical Year Books and the Demographic Year Book, which are published by the United Nations. These provide information about mortality at the national level, and detailed data regarding mortality and foetal deaths are in the Demographic Year Book.
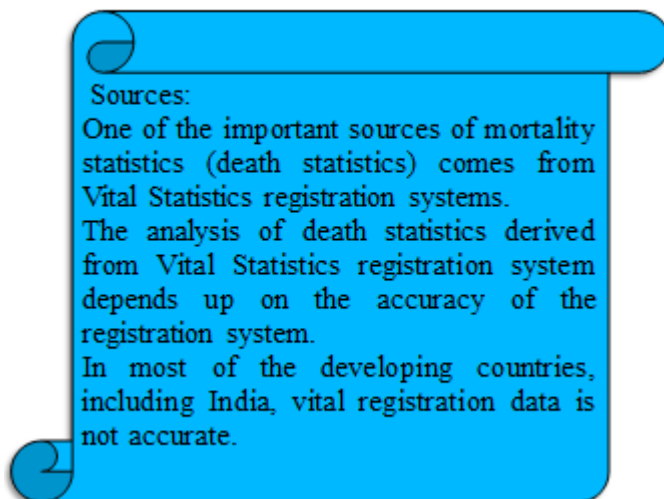
Another important publication is the Annual Epidemiological and Vital Statistics and World Health Statistics, which is published by the World Health Organization (WHO).

The Civil Registration System in India is a continuous source of data on births and deaths, but is inadequate as it suffers from under-registration and deficiencies. In order to promote and to strengthen the civil registration system, The Registration of Births and Deaths Act, 1964 was enacted. However, registration of birth and deaths in many states and union territories (UTs) is still not adequate.

In the period of 1964-65, the Office of the Registrar General of India started a scheme to register births and deaths in India, which is known as the Sample Registration System (SRS). It was implemented on a pilot basis initially and then on a large scale from 1969-1970, when it began to provide state level data annually.

Other sources of data include the large scale surveys such as the National Family Health Survey (NFHS), National Sample Survey (NSS) and,the District Level Household and Facility Survey (DLHS). There are also reports such as Health Management Information System (HMIS), the annual reports of the Department of Health and Family Welfare, the Central Bureau of Health Intelligence (CBHI), Rural Health Statistics, and Medical Certification of Causes of Death (MCCD) and Crime Statistics, which also provide mortality data annually, which are collected from other agencies (Prakasam 2017).

Figure 3: Sources of Mortality Data

Sources:
One of the important sources of mortality statistics (death statistics) comes from Vital Statistics registration systems.
The analysis of death statistics derived from Vital Statistics registration system depends up on the accuracy of the registration system.
In most of the developing countries, including India, vital registration data is not accurate.

Source: Data from above

6. Study of Trends in Mortality Data

Examining the mortality data of developed countries, will reveal that the developed countries achieved very low levels of mortality in the past, and while death after very early years until older ages have become a common phenomena, mortality at infancy and childhood have not stayed as significant as is with developing countries.

The levels of mortality across the world widely differ, by region, whether it is developed or developing, but also across countries and within countries as well. These differences are often a result of disparities with regard to access to basic services such as food, sanitation, clean and safe drinking water, as well as access to medical and health care. The risk factors, behavioural patterns and differing social contexts all affect individuals and the overall mortality patterns in any given region.

Across the world, countries aim to reduce mortality, and mortality rates over the centuries have been declining in both developed and developing regions. However, the timing as well as the pace of the decline in mortality rates has varied across regions over this time period. Historically, the mortality decline has been part of the ongoing demographic transition, a process whereby a population moves from a state of high birth and death rates to a state of low birth and death rates, affecting population size. The process of demographic transition was first observed based on the experiences in countries in Europe in the late 18th early 19th century during the Industrial Revolution, and it is expected that all countries in the world will go through the transition. Mortality rates also go through a transition during this process of demographic transition, sometimes referred to as the mortality transition. This transition is discussed in other modules in this paper.

In order to bring about declines in mortality levels across the world, the international community has looked to address some of the challenges of development through policies at the global and regional levels. Towards this end, trends in life expectancy at birth and other variables are studied. The Millenium Development Goals and the Sustainable Development Goals are responses to development challenges from the international community for direct impact on measures of mortality including maternal mortality and infant mortality.

In order to examine the trends in mortality across the world, the UN and WHO have developed data bases of mortality statistics over time, drawn from country data of mortality patterns and applying different estimation techniques. Study of mortality patterns across countries enables analysis of age, sex differentials over time, as well as other differences in mortality patterns. It also enables identification of cause of death, as with regard to communicable, non-communicable diseases, injuries and other causes that produce the mortality patterns over the studied period. The data enables comparison across countries and also aggregates by region or other classification to facilitate the study and understanding of mortality patterns worldwide (UN 2012).

6.1. Example 1: Mortality Statistics: Crude Death Rate (CDR)

Given below, an example of mortality statistics is presented. The crude death rates, which are the death rates per 1000 of population is given for the world by years in the following table, including projections.

In Table 1 given below, the crude death rate (historical and predicted) for the world is given for the period between 1960-2050. As per the data given in the table, it reveals that the death rate declines fast between 1950, 1985. Later, the decline is very slow up to 2035 and then, a slight increase in CDR is observed.

Years	CDR	Years	CDR
1950–1955	19.1	2000–2005	8.4
1955–1960	17.3	2005–2010	8.1
1960–1965	16.2	2010–2015	8.1
1965–1970	12.9	2015–2020	8.1
1970–1975	11.6	2020–2025	8.1
1975–1980	10.6	2025–2030	8.3
1980–1985	10.0	2030–2035	8.6
1985–1990	9.4	2035–2040	9.0
1990–1995	9.1	2040–2045	9.4
1995–2000	8.8	2045–2050	9.7

Table 1: World historical and predicted crude death rates (1950–2050)

Ref: UN, medium variant, 2012, rev;
http://data.un.org/Data.aspx?d=PopDiv&f=variableID%3A65

6.2. Example 2: Mortality Statistics

The Table given below, Table 2, gives data regarding Infant Mortality in India by place of residence: 1971-1985. The Infant Mortality Rate is a measure of the number of infant deaths per 1000 live births of population in a given year. From the data in Table 2, it is evident that: infant mortality declined from 129 in 1971 to 97 in 1985 in India during this period of time. It is also seen from the data that rural infant mortality was much higher than that in urban areas. The decline in infant mortality in rural areas of India was faster during the period of 1971-85, from 138 to 107, whereas, in urban areas the decline was comparatively slower, from 82 to 59 during that same period.

Table 2: Infant Mortality rate in India from 1971-85			
Year	**Infant mortality rate**		
	Total	**Rural**	**Urban**
1	**2**	**3**	**4**
1971	129	138	82
1972	139	150	85
1973	134	143	89
1974	126	136	74
1975	140	151	84
1976	129	139	80
1977	130	140	81
1978	127	137	74
1979	120	130	72
1980	114	124	65
1981	110	119	62
1982	105	114	65
1983	105	114	66
1984	104	113	66
1985	97	107	59
Source: RG:SRS reports			

7. Summary

In the above module, the study of mortality was discussed in order to give an introduction to the current paper on mortality. The definition of mortality, the relationship of mortality to population and its characteristics, the importance of mortality statistics and use is discussed. Sources of data on mortality are also discussed, some limitations of the sources of data, the study of mortality trends as well as some examples of trends in measures of mortality in India. The module provides a platform for additional reading of the modules ahead, which deal with more specific topics related to the study of mortality.

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