Measures of Mortality

According to WHO (World health Organization): Death is the permanent disappearance of all evidences of life at any time after birth. And mortality is average risk of dying of a person during a time span.

In other words, the studies dealing with the effect of deaths on population is often referred as mortality. It influences demographic characteristics of population like age, sex and household structures, family composition, reproduction behaviour of females, fertility level through: infant's death etc. It is influenced by: natural catastrophes like epidemic diseases, earthquakes, un-natural calamities like war mass-acre etc, health care like immunization of children against fetal diseases, maternal health care, environmental stresses due to air, water, soil, sound etc.

Various mortality rates determine the level, pattern and trend of mortality at national and sub-national levels. It also facilitates in comparison of two or more areas and comparison of an area over different times. Life expectancy (an expected time to live as calculated on the basis of statistical probabilies) also depends upon the mortality level being experienced in

a society. life expectancy is frequently applied in actuarial sciences and in formulating insuring and health policies.

Being an integral component of population change, age-sex specific, mortality rates are useful for projection of population which is quaite helpful in formulating various socio-economic policies and planning.

Before measures of mortality, we have to clear the conceptual issues related mortality:

Concepts:

→ **Infant mortality:** The mortality of live-born children who have not yet reached their first birthday. (D^M_{0-11})

→ **Neo-natal mortality:** The mortality of live-born children who have not yet completed fourth week or one month after birth. (D^W_{0-3} or $D^M_{<1}$)

→ **Post neo-natal mortality:** The mortality of children between age one and 12 months. (D^M_{1-11}).

→ **Maternal mortality:** The mortality of a woman while pregnant or within 42 days of termination of pregnancy from any cause related to pregnancy or its management.

OR

Mortality of a women during their pregnancy or due to due to less health facilities complications.

① Crude Death Rate (CDR):

It is defined as number of deaths in a year per thousand persons.

$$CDR = \frac{D}{P_{mid}} \times 1000$$

D → number of deaths in a year

P_{mid} → mid year population in the same year.

⇒ Advantages:

1- It is easier to compute
2- It is amenable to statistical analysis
3- It provides meaninful conclusions.

⇒ Disadvantages:

1- It is not a good measure because mid year population used as denominator which is not exposed to the risk of events (here is death).
2- It may mislead while compairing mortality levels of two or more regions or countries if these have different age structures.

⇒ Example:

According to pakistan demographic Survey (PDS), the estimated mid year population of 1999 was 12644983 and deaths from 1st January to 31st december of the same year were 1064875.

$$CDR = \frac{1064875}{12644983} \times 1000 = 8.42 \cong 8 \text{ deaths per thousand persons.}$$

(2) Age Specific Mortality Rates (ASMRs):

ASMR can be worked out by dividing number of deaths (D_i) of persons of any specific age group in a year with corresponding number of persons (P_i) of the same age group.

$$ASDR = \frac{D_i}{P_i} \times 1000$$

⇒ Advantages:

1- ASMRs are not affected by age structure so are more refined indicators than the CDR.

2- ASMRs are amenable to statistical analysis for drawing some meaningful conclusions.

3- ASMRs derived from single source at different points of time can help in studing mortality trend.

4- Comparison of ASMRs of two areas, regions or countries facilitates in study of mortality behavior with rising age of people.

5- ASMRs are useful for projection of population by ages.

⇒ Disadvantages:

1- ASMRs are difficult to compute.

2- ASMRs are difficult to compare because of number of values involves in comparison.

⇒ Example:

Given population and deaths by their ages. compute ASMRs.

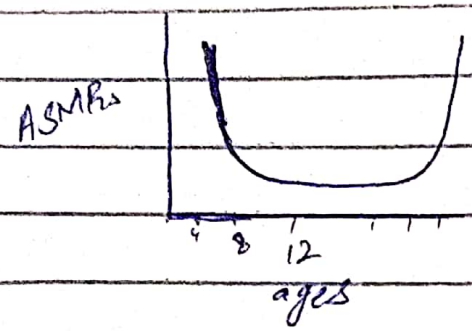
Age	Population (P_i)	Deaths (D_i)	ASMR = $\frac{D_i}{P_i} \times 1000$
0-4	17706121	459192	25.9
5-9	19922153	57444	2.9
10-14	17742189	45765	2.6
15-19	14080593	26597	1.9
20-24	11003528	37946	3.4
25-29	9589788	26046	3.0
30-34	7166489	26692	3.7
35-39	6846727	25587	3.7
40-44	5350685	28351	5.3
45-49	4907447	18696	3.8
50-54	3807976	33970	8.9
55-59	2838098	27173	9.6
60-64	2528384	45286	17.9
65-69	1641578	38720	23.6

Interpretation:

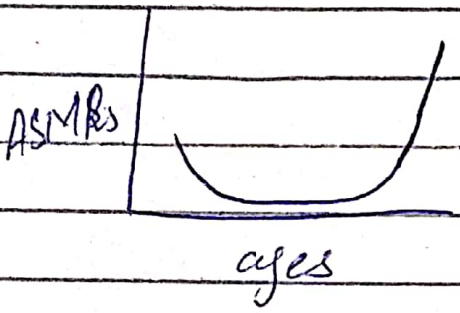
The ASMR decreases sharply from high level of 25.9 deaths per thousand persons aged 0-4 to around 3 by age 5-9 and touches to its minimum somewhere between ages 15-19. Then start increasing slowly with further rise in ages up to age 50 years and then sharply till it reaches again to its maximum level by age all persons died.

⇒ Note:

In societies where mortality level is very high have more or less reverse "U" shaped curve as compare to societies where mortality level is low form more or less reverse "J" shaped curve.



High level of mortality.



low level of mortality.

3) Infant Mortality Rate (IMR):

IMR is defined as number of deaths of children less than one year or 12 months of age in a year per thousand live births.

$$IMR = \frac{D^{m}_{0-11}}{B} \times 1000$$

D^{m}_{0-11} → number of deaths of children less than 12 months of age in a year.

B → Number of births in the same year

It is an important indicator of health status of the population. High IMR in a society reflects presence of poor health facilities for infants, mothers and pubic in general. Whereas low IMR shows good health facilities for them.

⇒ Advantage:

It is simple to define.

⇒ Disadvantages

It is difficult to compute because reported births in a year usually do not correspond to reported deaths during the same year. Infact some of the deaths of infants belong to births occuring in the previous year. Thus necessary adjustment is required before computation of the rate.

⇒ Example:

According to PDS, 1999 about 3876658 births and 315923 deaths of infants were occurred in 1999, Calculate IMR.

$$IMR = \frac{D_{0-1}^{m}}{B} \times 1000$$

$$= \frac{315923}{3876658} \times 1000 = 81.49 \cong 81$$

deaths of children less than one year of age per thousand live births

⇒ Note:

There is lot of variation in mortality of children less than one year of age particularly during first month and more so during first week, first day and first few hours after delivery. Such variation in mortality pattern suggests decomposing IMR into its components that are neo-natal mortality and post neonatal mortality.

$$\boxed{IMR = NMR + PNMR}$$

(4) Neo-natal Mortality Rate (NMR):

NMR can be defined as number of deaths of infants aged less than 4 weeks (D^{w}_{0-3}) or one month ($D^{m}_{<1}$) in a year per thousand live births (B) occurring during the same year.

$$\boxed{NMR = \frac{D^{w}_{0-3}}{B} \times 1000} \quad \text{or} \quad \boxed{NMR = \frac{D^{m}_{<1}}{B} \times 1000}$$

Example: From 1999 PDS number of births registered in a year was 3876658 and number of deaths of infants less than four weeks or one month during the same year was 197532. Calculate NMR

$$NMR = \frac{D^{w}_{0-3}}{B} \times 1000 = \frac{197532}{3876658} \times 1000$$

$$= 50.95 \cong 51$$

About 51 infants deaths aged less than one month per thousand live births during the year 1999.

(5) Post Neo-natal Mortality Rate (PNMR):

PNMR is the number of deaths of infants between ages one month and 12 months (D_{1-11}) in a year per thousand live births during the same year.

$$PNMR = \frac{D_{1-11}}{B} \times 1000$$

Example: Given number of births in 1999 from PDS as 3876658 and deaths of infants ages one month but less than 12 months as 118391.

$$PNMR = \frac{D_{1-11}}{B} \times 1000 = \frac{118391}{3876658} \times 1000 = 30.54$$

$\cong 31$

About 31 infants deaths aged one month but less than 12 months per thousand infants born during the year 1999.

$\Rightarrow$ From the above three examples

$$IMR = NMR + PNMR$$

NMR + PNMR

$= 50.95 + 30.54 = 81.49 = IMR$

⑥ Maternal Mortality Rate (MMR):

MMR is the most widely used type of a cause specific mortality ratio representing risk of dying due to puerperal (caused) like complications of pregnancy, delivery, labour and puerperium.

It can be work out by dividing the number of deaths of mothers (D_P) in a year due to puerperal causes with number of live births (B) of the same year.

$$MMR = \frac{D_P}{B} \times 100,000$$

Example: Number of deaths of mothers within 42 days of delivery in 1991 due to puerperal reasons in Kerala State was 1054 and number of children born alive during that year in the same state was 532503 then MMR can be worked out as:

$$MMR = \frac{D_P}{B} \times 100,000$$

$$= \frac{1054}{532503} \times 100,000 = 197.93 \cong 198$$

About 198 deaths of mothers owing to puerperal causes in relation to 100,000 live births.