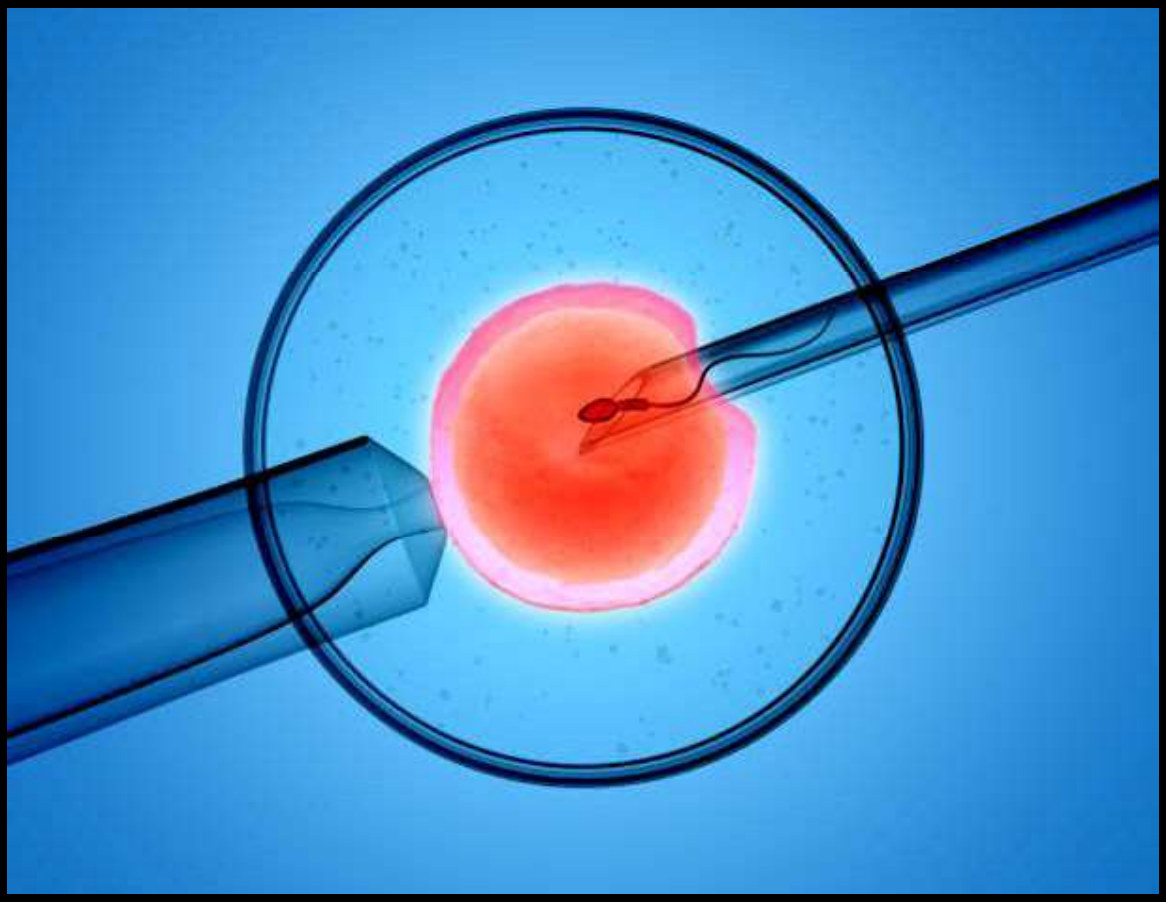
BIOLOGY

for NEET & BOARD

REPRODUCTIVE HEALTH



Key Features

1. All-In One Study Material (For Boards/Medical/Olympiads).
2. Concise, Conceptual & Trick – Based Theory.
3. NTA Based Solved Multiple Choice Questions With Answers.

Human Population & Reproductive Health

Chapter – 4

India's First Trick Based Study Material

1 INTRODUCTION

History of man is only about 50,000 years old. In the course of human history there have been three major explosions, each corresponding to a major changes in the environment. The first population explosion occurring about 20,000 years ago. It was brought about by the use of tools that allowed improvement in hunting and food gathering methods. The second revolution occurred about 6,000 years ago, and was brought by improvements in farming. The third revolution was brought about 300 years ago and was caused by improvement in food production, industry and medicine. If the present birth rate is maintained, it is stated that only one square feet of the earth surface will be available per one person within the next 700 years.

Definition : The term population refers to the total number of individuals of the same species occupying a particular geographic area at a given time. This definition of population was given by **Clark** in 1954.

Demography : The scientific study of human population is called **demography.** It deals with

(i) Change in population i.e. growth or decline in population.

(ii) Composition of population i.e. age groups, sex ratio etc.

(iii) Distribution of population in space.

Census : Census is an official count of the people of a country, state, or district, with statistics as to age, sex, employment, education, etc. In India census started in 1891, and, since then, it has been conducted uninterruptelly every ten years. Census is conducted as per the provision made under the census Act, 1948, as amended.

2 POPULATION DYNAMICS

(i) **Population density :** Population density is the number of individuals present per unit area or volume at a given time. For instance, number of animal per square kilometer, number of trees per area in a forest, or number of plank tonic organism per cubic meter of water. If the total number of individuals is represents by letter N and the number of units of space by Letter S, the population density D can be obtained as D=N/S. Space is indicated in two dimensions (m^2) for land organisms, and in three dimensions (m^3) for aquatic organisms and for the organisms suspended in space.

(ii) **Birth rate or Natality :** The birth rate of a population refers to the average number of young ones produced by birth, hatching or germination per unit time (usually per year). In the case of humans, it is commonly expressed as the number of births per 1000 individuals in the population per year.

The maximum birth rate of a species can achieve under ideal environmental conditions is called potential natality. However, the actual birth rate under the existing conditions is much less. It is termed realised natality. Crude birth rate is the number of births per 1000 persons in the middle of a given year i.e. on July. Natality increases the population size (total number of individuals of a population) and population density.

(iii) **Death rate or mortality :** The death rate of a population is the average number of individuals that die per unit time (usually per year). In humans it is commonly expressed as the number of death per 1000 persons in a population per year. Lowest death rate for a given species in most favourable conditions is called potential mortality, while the actual death rate being observed in existing conditions is called realized mortality. Crude death rate is the number of deaths per 1000 persons in the middle of a given year i.e. on July. Mortality decreases the population size and population density both.

Difference between Natality rate and Mortality rate

Character	Natality rate	Mortality rate
(1) Definition	Number of births per 1,000 individuals of a population per year.	Number of deaths per 1,000 individuals of a population per year.
(2) Population density	Increases population size and population density.	Decreases population size and population density.

(iv) **Vital index :** The percentage ratio of natality over mortality is known as vital index i.e. natality / mortality ×100. It determines the growth of a population.

(v) **Immigration :** It is permanent entry of additional person into the existing population of a country or region from out side. Example; Many Nepalese and Chinese come to settle in India.

(vi) **Emigration :** It is the permanent departure of some persons from the existing population of a region to a different state or a foreign country. Example; Many Indians go to Western countries to settle there.

Immigration and emigration bring about redistribution of population, and are common in animals. These occur for various reasons, such as search for food, escape from competition due to overcrowding, need of shelter etc.

(vii) **Sex ratio :** The number of females in a population per 1000 males is called sex ratio.

$$\text{Sex ratio} = \frac{No.\ of\ females}{1000\ (males)}$$

(viii) **Age structure :** The age structure of a population is the percentage of individual of different ages such as young, adult and old. Age-sex structure of a population can be shown by a pyramid-like diagram by plotting the percentage of population of each sex in each age-group. Figure shows the age-sex structural pyramids for India over the 20-year period from 1971 to 1991. These pyramids show that Indian population may still take many years to be stabilized.

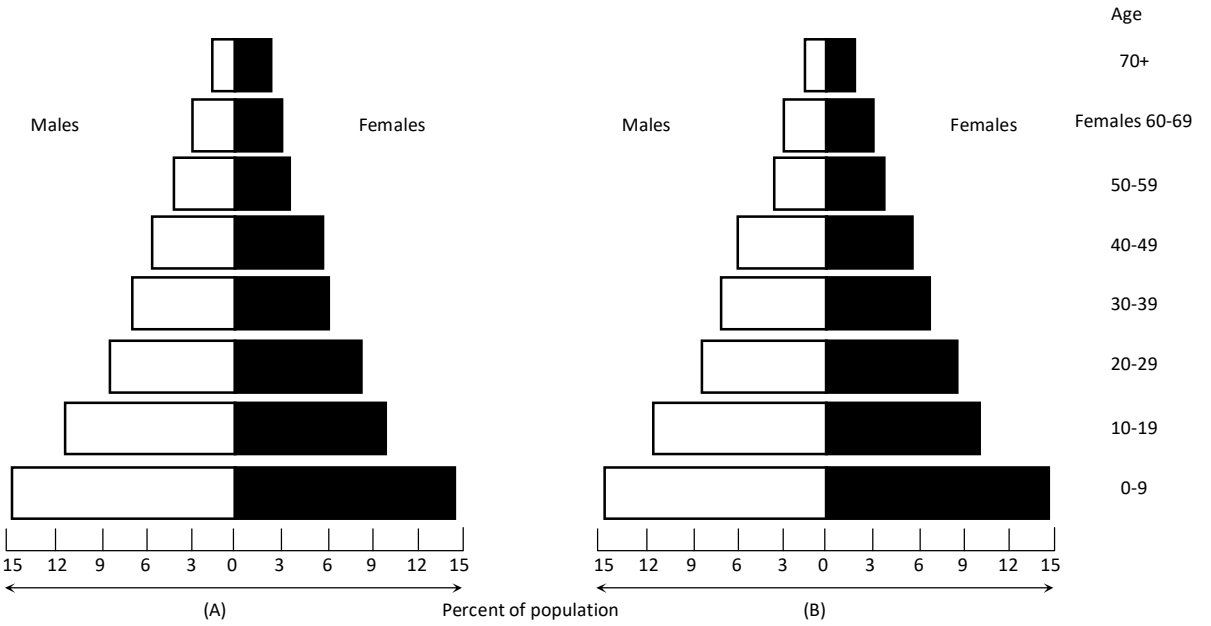


Fig : Comparative age-sex pyramids for India : (A) Year 1971 (B) Year 1991

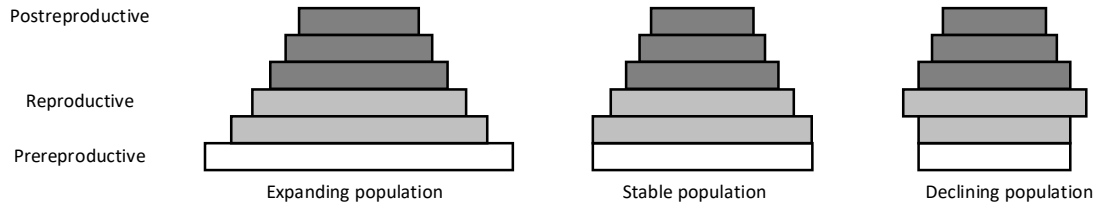
(ix) **Age distribution :** The relative abundance of the organisms of various age groups in the population is called age distribution of population. With regard to age distribution, there are three kinds of population.

(a) **Rapidly growing or Expanding population :** It has high birth rate and low death rate, so there are more number of young individuals in the population.

(b) **Stationary or stable population :** It has equal birth and death rates, so population shows zero population growth.

(c) **Declining population :** It has higher death rate than birth rate, so the population of young members is lower than that of old members e.g. Japan (Ageing population) .

Human population has three age groups : Pre reproductive, Reproductive, and post reproductive.



Factors affecting the age composition

(1) Number of infants below one year of age and the older people as these have higher mortality rate than individuals of other age groups.

(2) Proportion of reproductive active males and females in a population.

(3) Number of females in active reproductive age (i.e. between 15 to 44 years)

(x) **Change in Population Size and Growth Rate :** Whether a population grows, declines or maintains it size depends upon the balance between the above factors:

Change in Population Size during time interval = (Birth + Immigration during time interval) – (Death + Emigration during time interval)

The above expression in words may be represented in a simple way by a mathematical model. suppose N = population size and t = time. The Greek letter delta, Δ, indicates change. We can now represent change in population as ΔN, and time interval as Δt. The verbal equation can

be written as $\Delta N/\Delta t$=(B+I) – (D+E) in which B is absolute number of births in the population during the time interval, and D =the absolute number of deaths during that interval; I means immigrant and E, emigrants. I and E , being insignificant, may be ignored. Then the equation simplifies to $\Delta N/\Delta t$ =B-D.

Migration is a two-way movement of a population for adjusting to seasonal changes. It occurs in some fishes (*Anguilla,* an eel), birds (Siberian crane), and mammals (fur seal). Migration is not considered a determinant of population size.

Annual average growth rate is the percentage of increase in population size per year. It can be calculated with the help of following equation :

$$\text{Annual growth rate (\%)} = \left(\frac{P_2 - P_1}{P_1 \times N} \right) \times 100$$

Where P_1= Population size of previous census. P_2= Population size of present census.

N= Number of years between the two census.

3 GROWTH OF HUMAN POPULATION

Population growth refers to the increase in its size. It is determined by the number of individuals added to the population and the number of individuals lost from the population. Addition occurs by births and immigration. Loss results from deaths and emigration. If more individuals are added than are lost i.e., the vital index is more than 100, the population will increase or show **positive growth.** If more individuals are lost than are added i.e., the vital index is less than 100, the population will decrease or show **negative growth.** If addition and loss are balanced, i.e., the vital index is 100, the population will become stationary or show **zero growth**.

(i) **Malthus Theory of Human Population Growth :** Thomas Malthus, a British political economist, put forward a theory of human population growth in 1778. Malthus in his "Essay on the principle of population" pointed out that population tends to increase in geometric progression while food supply increase only in arithmetic progression. Faster growth of population than of its requirements causes an imbalance between the two. When this imbalance reaches a certain limit, environmental factors like famine, epidemic of a disease, earth quake, flood, war etc reduce the population to a size, the available resources can support. The factors that control the population size were called positive checks by Malthus.

(ii) **Natural Control of Population Growth :** Growth of a population is controlled by an interaction between three factors : biotic potential, environmental resistance and carrying capacity of environment.

(a) **Biotic or reproductive potential :** Biotic potential is the natural capacity of a population to increase at its maximum rate under ideal environmental conditions and stable age and sex ratios. The biotic potential for all animals is very high. If unchecked, the numbers of any species will quickly over run the world. Biotic potential in the human female is estimated to be about 12 per female during its reproductive period between the puberty and the menopause period.

(b) **Environmental Resistance :** In nature full biotic potential of an organism or population is never realized, since conditions are rarely ideal. Various harmful environmental (abiotic) factors like non-availability of food and shelter, natural calamities like drought, cloud bursts, floods, fires, temperature fluctuations, accidents, etc. and certain biotic factors like pathogens, parasites, predators etc. check the biotic potential from being realized. The sum of all these inhibitory factors is called **environmental resistance**. Thus, actual increase is the balance between biotic potential and environmental resistance. Thus environmental resistance does not allow population growth so soar towards infinity**.**

(c) **Carrying capacity :** It is defined as "Feeding capacity of an environment of an ecosystem for a population of a species under provided set of conditions". It is also defined as the "Level beyond which no major increase can occur". This limit is a constant and represented by K. When a population reaches the carrying capacity of its environment, the population has zero growth rate. So the population generally stabilizes around the carrying capacity. The carrying capacity of the earth for human population is considered to be about 8 to15 billions. Carrying capacity of the environment for a population depends upon three major components :

(1) **Productive systems** which produce food and fibre e.g. croplands, orchards, etc.

(2) **Protective systems** which buffer air and water cycles and keep moderate environmental temperatures e.g. ocean etc.

(3) **Assimilative systems** which utilize the wastes produced by human activities e.g. waterways, wetlands, etc.

Productive system and protective systems collectively form the **life-supporting capacity,** while assimilative systems collectively form the **waste assimilative capacity.**

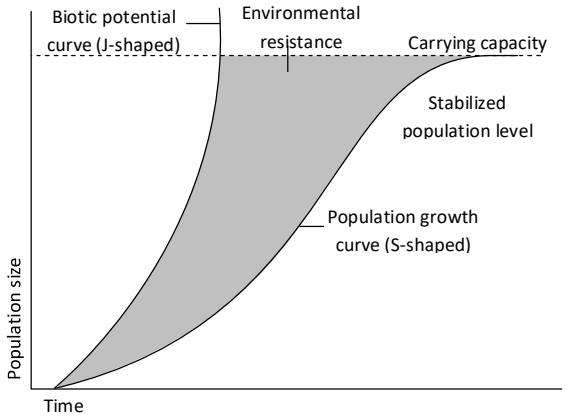


Fig : The theoretical relationships between biotic potential, environmental resistance and carrying capacity

(d) **Population fluctuations and population cycles :** The populations are not stable and do change due to a number of extrinsic as well as intrinsic factors. These variation in the population size are of two types :

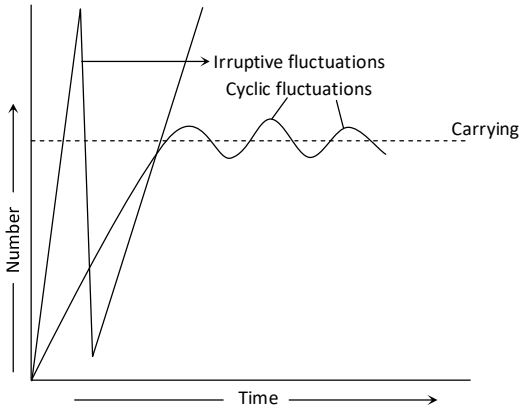


Fig : Cyclic and irruptive fluctuations in populations

(1) **Population fluctuations or irruptive variations :** In these changes, population density tends to fluctuate irregularly above and below some steady-state level. These are characterized by sudden increase in population in short time which is followed by equally quick decrease in population size. These are caused by random seasonal or annual changes in availability of resources (food or energy) or extrinsic factor (e.g. temperature, rainfall etc.) e.g. more birds during early summer due to their hatching period, more insects during summer months and more weeds in rainy season.

(2) **Population cycles :** These are regular changes in the population size. In these, population size is nearly constant over long period of time. These are caused by seasonal changes in environment e.g. population cycles (of 3 to 4 years) of lemmings of Tundras (Elton, 1942) Lemmings (*Lemmus lemmus*) (small mouse-like rodents found in arctic regions of Canada and

Norway) increase in their number for a period of about 3 years when it reaches a peak beyond the carrying capacity of that area. They eat up all the available food. In the winter months, the lemmings migrate in large numbers in the sea and swim till they are drowned due to exhaustion. The surviving lemmings multiply and repeat the process.

(iii) **Patterns of Population Growth :** Growth of a population can be expressed by a mathematical expression, called growth curve in which logarithm of total number of individuals in a population is plotted against the time factor. Growth curves represent interaction between biotic potential and the environmental resistance.

Two basic types of growth curves :

(a) **Sigmoid or S-shaped growth curve :** It is shown by yeast cells and most of organisms. It is formed of five phases :

(1) **Lag phase.** In which the individuals adapt themselves to the new environment, so there is no or very little increase in population.

(2) **Positive Acceleration phase.** It is the period of slow increase in population in the beginning.

(3) **Logarithmic** or **Exponential phase :** It is the period of rapid rise in population due to availability of food and requirements of life in plenty and there being no competition.

(4) **Negative Acceleration phase :** In which again there is slow rise in population as the environmental resistance increases.

(5) **Stationary (Plateau) phase :** Finally, growth rate becomes stable because mortality and natality rates become equal to each other. So there is zero growth rate. A stable population is said to be in equilibrium, or at saturation level. This limit in population is a constant *K* and is imposed by the carrying capacity of the environment. S-shaped curve is also called logistic curve. Sigmoid growth curve was described by **Verhulst, (1839)**

(b) **J-shaped Growth curve :** It is shown by small population of **Reindeer** experimentally reared in a natural environment with plenty of food but no predators. It has only two phases:

(1) **Lag phase :** It is period of adaptation of animals to new environment so is characterized by slow or no growth in population.

(2) **Logarithmic or Exponential phase :** It is characterized by rapid growth in population which continues till enough food is available. But with the increase in reindeer population, there is corresponding decrease in the availability of food and space, which finally become exhausted, which leads to mass starvation and mortality. This sudden increase in mortality is called **population crash.** Lemming of Tundra, some insect, algal blooms and annual plants also show J-shaped curves. The population growth curve is S- shaped in most of the organisms, Human population also shows S-shaped curve.

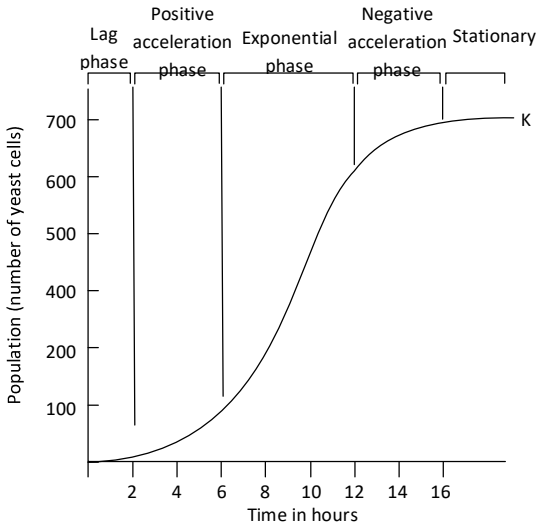


Fig : The S-shaped growth curve of yeast cells

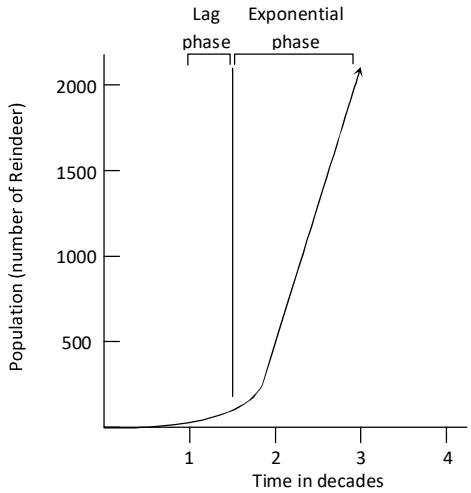
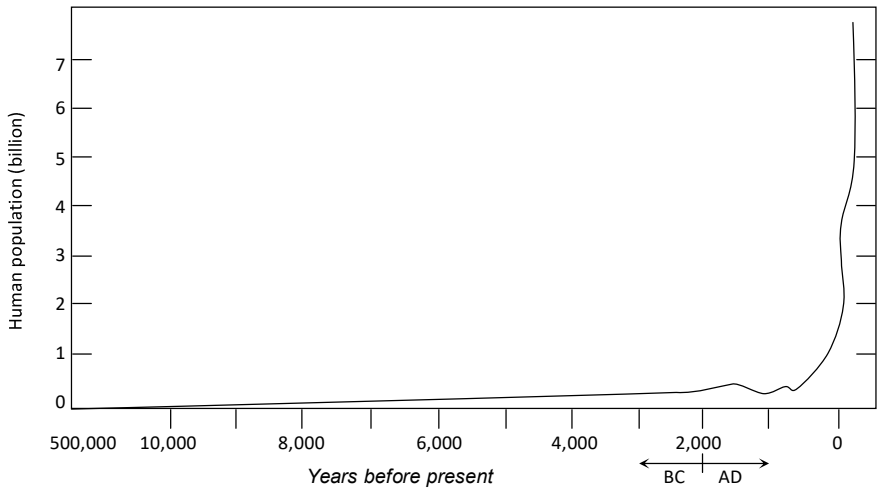


Fig : The J-shaped growth curve of reindeer

Difference between S-shaped and J-shaped Growth curves.

S.No.	S-shaped Growth Curve		J-shaped Growth Curve
(1)	It is formed of 5 phases : lag phase, positive acceleration phase, exponential phase, negative acceleration phase and stationary phase.	(1)	It is formed of 2 phases : lag phase and exponential phase.
(2)	Finally the population shows zero growth rate as birth rate equals death rate.	(2)	Finally, the population shows a population crash due to rapid increase in mortality rate.
(3)	*Examples.* Yeast cells in a culture medium.	(3)	*Examples.* Reindeers, algae blooms, lemmings of Tundras

(c) **Human Population Growth Curve :** The modern man (*Homo sapiens sapiens)* appeared about 25,000 years ago. For a very long time, the human population remained in the lag phase, having little or very slow growth. By the year 1 A.D., there were about 0.25 billion people in the world, and by 1600 about 0.5 billion. Thus, it took 1600 years for the population to become double. The exponential phase of growth of the human population started about 1750. Since then, the time taken by the population to become double has considerably shortened. It doubled in 200 years (1600-1800 A.D.), becoming 1 billion; then doubled in 130 years (1800-1930 A.D.), growing to 2 billion; then doubled in only 45 years (1930-1975 A.D.), reaching about 4 billion. At present, the world human population grows at a rate of 2 percent a year, and it has now reached 6 billion. If the present growth rate persists, there would be 8 billion people on earth by the year 2017



World population gain is 2 persons every second; 200,000 people every day; 8 million every month; and 70 million every year. The high rate of growth is often referred to as "**population explosion"** The word "explosion" may be defined as a rapid and expansive change of state.

The future of human population is difficult to predict. It may stabilize and have S-shaped growth curve or decline rapidly and have J-shaped growth curve. The population will stabilize if the birth and death rates are balanced in the near future. It will rapidly decline if it overgrows the carrying capacity of the environment.

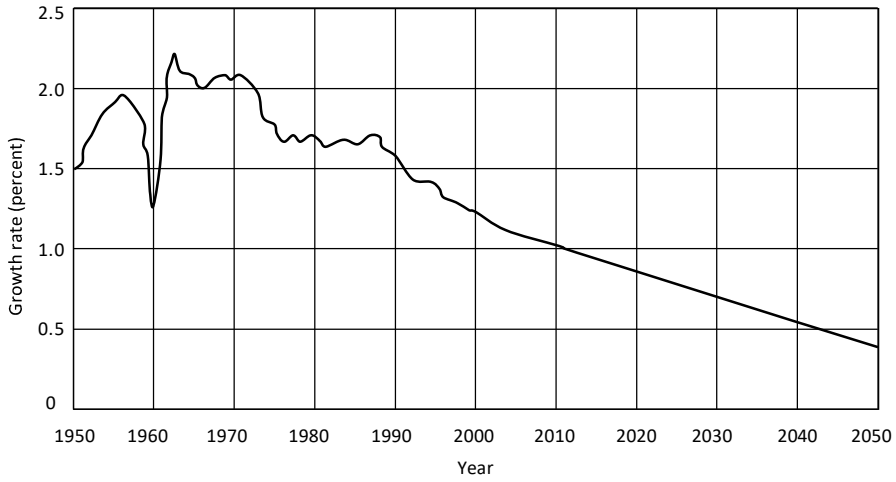


Fig : Projected world population growth rate between 1950 and 2050 (based on United States census bureau, international data)

A demographic cycle is formed of 5 stages

(a) First stage (High stationary)	*High birth rate and high death rate. Population stationary.*	*India till 1920.*
(b) Second stage (Early expanding)	*Declining death rate but high birth rate.*	*Many countries in S. Asia and Africa.*
(c) Third stage (Late expanding)	*Declining birth and death rates but still birth rate higher than death rate.*	*India, China and Singapore.*
(d) Fourth stage (Low	*Low birth rate and low death rate.*	*Austria (with zero growth*

stationary)	*Population stationary.*	*rate during 1980-85) Denmark, Sweden, Belgium etc.*
(e) Fifth stage (Declining)	*Birth rate lower than death rate.*	*Germany and Hungary.*

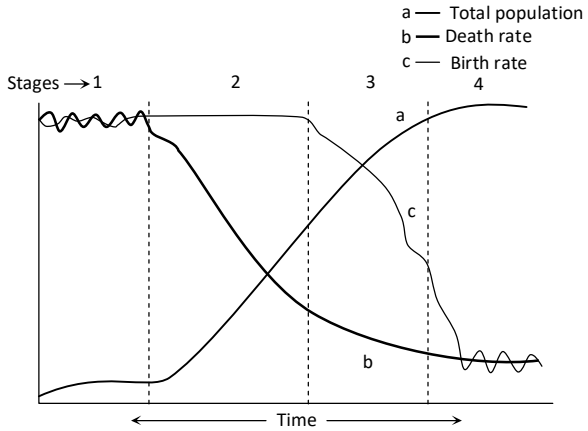


Fig : Different stages of the demographic transition
1. High birth rate but fluctuating death rate
2. Declining death rate and continuing high birth rate
3. Declining birth and death rate
4. Low death rate but fluctuating birth rate

4 POPULATION TRENDS IN THE WORLD AND INDIA

(i) Population Trends in the World

The distribution of human population is not uniform throughout the world. Only about one third of the total land area is inhabited. Of the inhabited areas, some are thickly populated, others sparsely. This depends upon the availability of the requirements of life. About 56% of the total world population resides in Asia alone. Bangladesh is the most thickly populated country, and Australia, the most thinly populated.

Annual Birth, Death and Growth Rates for Human Population in 1973

S. No	Region	Population (Millions)	Average Annual Birth Rate per 1,000 Individuals	Average Annual Death Rate per 1,000 Individuals	Annual Growth Rate Percent
(1)	World	3860	33	13	2.0
(2)	Developed Countries	1120	17	9	0.8
(3)	Developing Countries	2740	39	14	2.5

Birth and Death rates in selected countries in 1979

S.No.	Country	Birth Rate	Death Rate
(1)	Sweden	11.6	11.0
(2)	England	13.0	12.1
(3)	Japan	14.6	6.0
(4)	Canada	15.5	8.3
(5)	USA	15.8	8.7
(6)	China	18.0	6.0
(7)	India	35.0	13.6
(8)	Bangladesh	45.7	14.2
(9)	Pakistan	45.7	14.2

(ii) **Population Trends in India**

(a) **Population :** India with a population of 1027 million as 2001 census stands second in the world. The world leader in the matter of population is China with a population of 1160 million. India has only 2.42% of the world's land area but supports over 15.5% of the world's population. Thus, one in every 6 persons in the world is an Indian. India's population has been steadily rising since 1921. However, from the year 1921, often called the "big divide", its population started to swell up sharply. India's population has increased 3 times since independence (1947) when its population was 340 million. About 1800 individuals are born every hour, 17 million every year. India's population crossed one billion (100 crores) mark on May 11, 2000.

(b) **Sex Ratio :** Sex ratio is defined as the number of females per thousand males in a country or state. Sex composition is affected by three factors : (i) differentials in male-female ratio at birth, (ii) differentials in mortality conditions of males and females, and (iii) sex-selective migration. India is one of the few countries where the males are more than the females. There has been a steady decrease in the female population since 1901 except during the period 1971-81 when there was some increase. There are at present 531,277,078 males and 495,738,169 females in our country. The sex ration is 933 females per 1,000 males. In Kerala, there are 1058 females per 1000 males, highest sex ratio among the states, In Daman & Diu, there are only 709 females per 1000 males. In Haryana, there are 861 females per 1000 males, lowest sex ratio among the states.

(c) **Literacy Rate :** The literacy rate was 65.28% according to the 2001 census. It was 76.40 % for males and 54.16% for females. The literacy rate has been steadily increasing since 1951. Among the Union Territories, Lakshadweep has the highest literacy rate of 87.52%. Literacy rate is highest in Kerala (90.92%) and lowest in Bihar (47.53%). Any person who can read and write with understanding in any language is recorded as literate in census. All children below 7 years are shown as illiterate in the census.

(d) **Factors Favouring Population Growth**

(1) Decrease in death rate.

(2) Increase in average life span.

(3) Better medical facilities.

(4) Control of insect vector's of fatal diseases and epidemics.

(5) Better sanitation.

(6) Proper care of new-born children and their mothers.

(7) Better nutrition and life amenities.

(8) Protection against wild life and adverse whether through living in houses.

Density of Population India, 1901-2001

Year	Density per Km^2
1901	77
1911	82
1921	81
1931	90
1941	103
1951	117
1961	142
1971	177
1981	216
1991	267
2001	324

Sex Ratio (Females per 1000 Males) In India, 1901-2001

Year	Sex Ratio
1901	972
1911	964
1921	955
1931	950
1941	945
1951	946
1961	941
1971	930
1981	934
1991	927
2001	933

Percentage Age Groups in India

	0-14 Years	15-59 Years	60 plus Years
1970	42	54.5	3.5
1980	40	54.8	6.2
1990	36	57.5	6.5
2000	31.7	60.8	7.6

Parameters of 2001 census

- **Population** 1027.015
  (+183 million)
  Males =531.277 million
  Females = 495.738 million
- **Population density**..... 324 persons/sq. Km. (+60 persons/sq. Km.).
- **Sex ratio**..... 933 F : 1,000 M.
- **Absolute decennial population growth .....** +183 million.
- **Percent decennial population growth**..... 21.34%(-2.52).
- **Literacy rate**..... 65.38%(+13.27%).

- **Male literacy**..... 75.85%.
- **Female literacy..**..... 54.16%(+14.74%).
- **Birth rate**..... 26 per 1,000.
- **Death rate**..... 8 per 1,000.

Other Information about Census 2001 :

- Most populous state of India = **Uttar Pradesh** (166 millions) (18.17%).
- Second Most populous state of India = **Maharashtra** (95 millions).
- Least populous state of India = **Sikkim** (5.40 lakh).
- Most densely populated state of India = **West Bengal** (904 persons per sq. Km.).
- Second most densely populated state of India = **Bihar** (880 persons per sq. Km.).
- Least densely populated state = **Arunachal Pradesh** (13 persons per sq. Km.).
- Union territory with maximum population density = **Delhi** (9,294 persons per sq. Km.).
- Union territory with minimum population density = **Andaman and Nicobar** (43 persons per sq. Km.).
- State with highest Decennial population growth = **Nagaland** (64.41%).
- State with lowest Decennial population growth = **Kerala** (9.42%).
- Average life expectancy in India = **64 years.**
- Sex ratio in Kerala state = **1,058 F :1,000 M.**
- State with highest literacy rate = **Kerala 90.92%** (94.2% in males and 88% in females).

National Population Policy-2000 : Main objective

- ✍ *Aims for population stabilization by 2045 A.D.*
- ✍ *Compulsory school education upto 14 years of age.*
- ✍ *Reduction of infant mortality rate from the current 72 per 1,000 live births to 30 by 2010.*
- ✍ *Reduction of maternal mortality rate from 407 per 100,000 live births to 100.*
- ✍ *Reduction of TFR from 3.3 to 2.1 by 2010.*
- ✍ *To promote delayed marriage for girls, not earlier than age 18 preferably after age 20.*
- ✍ *100 per cent registration of births, death, marriage and even pregnancy.*
- ✍ *Promotion of small family norms*
- ✍ *A people-centered family welfare program.*
- ✍ *Promoting the two-child norm.*
- ✍ *Freeze on current Lok Sabha strength to be extended from 2001 to 2026.*
- ✍ *Facilities for safe abortion to be increased.*
- ✍ *Strict enforcement of Child Marriage Restraint Act and Pre-Natal Diagnostic Technique Act.*
- ✍ *A National Commission of Population chaired by the Prime Minister has been announced to guide and implementation of the policy.*

Memories

5 FIRST HUMAN DEVELOPMENT REPORT (APRIL, 2002)

- *Best stated to live in : Kerala (1); Punjab(2); Tamil Nadu(3); Maharashtra(4) and Haryana(5).*
- *Human development index improved by 3% a year from 1993-94 to 2001. Urban-rural disparities declined.*
- *Percent of people below the poverty line declined from 44.5% in 1983 to 36% in 1993-94.*
- *Gender equality index moved from 62% in the 1980s to 67.6% in the 1990s.*
- *Kerala has been declared as the "**First baby-friendly state of world"**.*
- *In 1991-2001 decade, Andhra Pradesh achieved the sharpest decline in the annual growth rate of population (from 2.2 per cent in 1981 –91 to 1.3 per cent).*
- *In India, Tamil Nadu and Karnataka state have attained replacement levels of fertility.*
- *Government of India is planning to introduce a Bill in Parliament to make education upto eight standard compulsory.*
- *In India, marriageable age is 18 years for female and 21 years for males.*

6 REPRODUCTIVE HEALTH

- According to World Health Organisation (WHO), reproductive health means a total well-being in all aspects of reproduction, i.e., physical, emotional, social and behavioural.
- Thus, a society with people who have physically and functionally normal reproductive organs and normal emotional and behavioural interactions among them in all sex-related aspects might be called **reproductively healthy**.

7 REPRODUCTIVE HEALTH – PROBLEMS AND STRATEGIES

Problems and strategies of reproductive health in human beings are explained as follows.

(i) Over population :

- Main problem of India is its excess population which is directly connected with reproductive health.
- To achieve total reproductive health, some plans and programmes were started.
- **Family planning programme** was initiated in 1951 and was periodically assessed.
- These programmes were popularly named **Reproductive and Child Health-care** (RCH).
- The major tasks carried out under these programmes are to provide facilities and support for building up a reproductive healthy society.

(ii) Awareness about reproduction :

- Audio-visual and print media, governmental and non-governmental agencies are doing good job to create awareness among people about reproduction in humans
- Parents, close relatives, friends and teachers also have a major role in giving the above information.

(iii) Sex Education :

- ✍ Sex education in schools should also be introduced and encouraged to provide right information about myths and misconceptions about sex-related aspects.

(iv) Knowledge of growth of reproductive organs and STDs :

- ✍ Proper information about reproductive organs, adolescence (period of rapid growth between childhood and adulthood), safe and hygienic sexual practices, sexually transmitted diseases (STDs), *e.g.,* AIDS etc., would help to lead a reproductive healthy life.

(v) Birth control devices and care of mother and child (Prenatal, Natal and Post-natal Care) :

- ✍ Fertile couples and people of marriageable age group should know about available birth control devices, care of pregnant mothers, postnatal (after birth) care of the mother and child, importance of breast feeding, equal importance for the male and female child, etc.

(vi) Prevention of sex abuse and sex related crime:

- ✍ Awareness of problems due to uncontrolled population growth, social evils like sex abuse and sex-related crimes, etc. need to be created so that people should think and take up necessary steps to prevent them and thereby build up a reproductively healthy society.

(vii) lnformation about reproduction related problems:

- ✍ For successful action plans to attain reproductive health, requires good infrastructural facilities, professional expert knowledge and material support.
- ✍ These are necessary to provide medical help and care for reproduction related problems like menstrual problems, infertility, pregnancy, delivery, contraception, abortions, sexually transmitted diseases (STDs).
- ✍ Implementation of better techniques and new strategies are also required to provide better care and help to people for reproductive health

8 METHODS OF BIRTH CONTROL

Meaning : The regulation of conception by preventive methods or devices to limit the number of offspring is called birth control.

Methods : A variety of methods are known for birth control. The birth control methods which deliberately prevent fertilization are referred to as contraception. These methods are of 2 main types : temporary and permanent.

(i) **Temporary Methods :** These are further of many types –

(a) **Safe Period (Rhythm Methods) :** A week before and a week after menses is considered the safe period for sexual intercourse. The idea is based on the following facts-

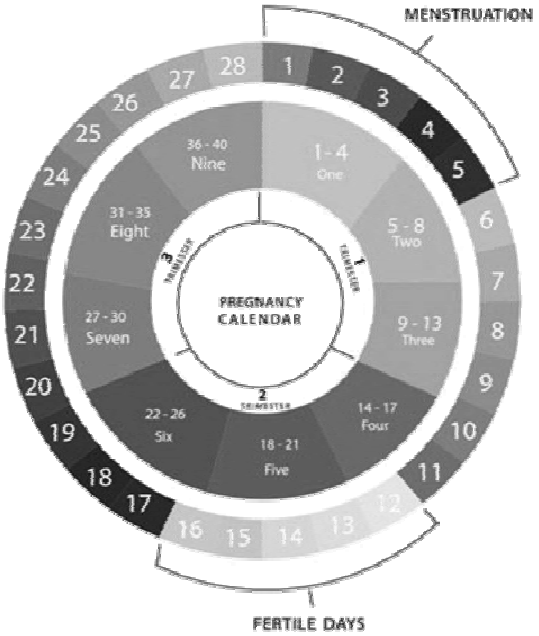
(1) Ovulation occurs on about the 14^{th} day (may be 13^{th} to 16^{th} day) of menstruation.

(2) Ovum survives for about 1-2 days.

(3) Sperms remain alive for about 3 days.

This method may reduce the chances of pregnancy by about 80 percent. However, a great care is needed in its use. Rhythm method is also called natural family planning. It is also termed temporary abstinence because it requires refraining from sexual intercourse when conception is most likely, *i.e.,* a few days before and a few days after ovulation. Changes in cervical mucus and body temperature during the menstrual cycle mark the ovulation time. Thus, the

natural family planning requires adequate knowledge of these physiological signs. Some couples use the natural family planning method of increase the chances of conception so that unplanned pregnancies are avoided.



(b) **Coitus Interruptus :** This is the oldest method of birth control. It was in use over 2,000 years ago. It involves withdrawal of the penis from the vagina by the male before ejaculation so that semen is not deposited in the vagina and there is no fertilization. This method also has some drawbacks. Male produces some lubricating fluid from his Cowper's glands before ejaculation. This fluid contains many sperms. A lapse in timing or willpower may result in late withdrawal and hence pregnancy.

(c) **Spermicides :** Foam, tablets, jellies, pastes and creams, if introduced into the vagina before sexual intercourse, adhere to the mucous membrane and immobilise and kill the sperms. These contain seprmicides such as lactic acid, citric acid, boric acid, potassium permanganate and Zinc sulphate.

(d) **Mechanical Means :**

1. Barrier Methods :

- ✍ These are mechanical devices which prevent the deposition of sperms into vagina and their passage into the uterus.
- ✍ Further, they can be self inserted by the user in complete privacy.
- ✍ The common barrier methods are condoms, diaphragm, fem shield and cervical cap.

(i) Condom:

- ✍ It is tubular latex sheath which is rolled over the male copulatory organ during sex.
- ✍ The common brand provided by family welfare services is **Nirodh**.
- ✍ The device also provides protection against sexually transmitted diseases including AIDS.

Condom for male

(ii) Fem Shield (Female Condom) :

- ✍ The device is polyurethane pouch with a ring at either end

- ✍ The inner ring is smaller and present at the inner closed end.
- ✍ The device covers the external genitalia as well as lines the vagina.
- ✍ Fem shield provides protection from sexually transmitted diseases also.

(iii) Diaphragm:

- ✍ It is a tubular rubber sheath with a flexible metal or spring ring at the margin which is fitted inside the vagina.

(iv) Cervical Cap:

- ✍ It is rubber nipple which is fitted over the cervix and is designed to remain there by suction.
- ✍ The device prevents the entry of sperms into the uterus.

(v) Vault Cap :

- ✍ It is hemispheric dome like rubber or plastic cap with a thick rim which is meant for fitting over the vaginal vault over the cervix.

(e) **Physiological (Oral) Devices :** Birth control pills (oral contraceptives) check ovulation by inhibiting the secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) that are necessary for ovulation. Hence, no eggs are released in a woman on the pill and conception cannot occur. The birth control pills have side effects such as nausea, breast tenderness, weight gain and break-through bleeding (slight blood loss between menstrual periods) and high blood pressure. On the other hand, the oral contraceptives reduce the chances of certain types of cancer to occur in their users. A combined pill is the most commonly used birth control pill. It contains synthetic progesterone and estrogen in doses high enough to check ovulation. Pill Mala D is taken daily, and the pill Saheli is taken weekly. Oral contraceptives have pregnancy rates less than 1%. Birth control pills are likely to cause cardiovascular problems.

- ✍ (f) **Other Contraceptives :** These are contraceptives which contain spermicidal chemicals.
- ✍ The chemical contraceptives are available in the form of creams (*e.g.,* delfen), jelly (perceptin, volpar paste), foam tablets (*e.g., aerosol foam, chlorimin T or contab*) etc.
- ✍ These commonly contain lactic acid, boric acid, citric acid, zinc sulphate and potassium permanganate.
- ✍ The contraceptives are introduced in vagina prior to sex.
- ✍ Sponge (Today) is a foam suppository or tablet containing nonoxynol-9 as spermicide. It kills the sperm by disrupting the membrane. It is moistened before use to activate the spermicide. The device also absorbs the male ejaculate
- ✍ Are preparations containing either progestin (= progestogen = progesterone) alone or a combination of progestogen and oestrogen (= estrogen).
- ✍ The pills are taken orally for 21 days in a menstrual cycle starting from 5^{th} day and ending on 25^{th} day.

- ✍ However, it is advisable to restart the course after a gap of 7 days irrespective of the onset or nonset of menstruation during the pill free days.
- ✍ When a pill is missed, it should be taken whenever one remembers, sometimes two at a time.
- ✍ This helps in keeping the hormonal level optimum for contraception.
- ✍ Hormonal pills act by four ways :

(a) Inhibition of ovulation.

(b) Alternation in uterine endometrium to make it unsuitable for implantation.

(c) Changes in cervical mucus impairing its ability to allow passage and transport of sperms.

(d) Inhibition of motility and secretory activity of fallopian tubes.

- ✍ Oral pills are of two types, combined and minipills.
- ✍ **Combined pills** contain both oestrogen and progestin.
- ✍ They are synthetic products.
- ✍ Oestrogen is an ovulatory, that inhibits FSH production. Progestin is anovulatory that inhibits LH production.
- ✍ It protects the endometrial lining from adverse effect of oestrogen.
- ✍ The hormone also changes cervical mucus.
- ✍ The most commonly used progestin is levonorgestrel or desogestrel.
- ✍ The most common oestrogen is ethinyl oestradiol or menstranol.
- ✍ In monophasic combined pill, both oestrogen and progestin are present in nearly the same amount, *e.g.,* Mala D, Mala L
- ✍ In multiphasic combined pills, oestrogen is maintained at the same level throughout the 21 day course (0.03 mg). But the amount of progestin is increased (0.05 mg for first six days, 0.075 for next 5 days and 0.125 mg for last ten days), *e.g.,* triquilar, orthonovum.
- ✍ **Minipills** are progestin pills only (with no estrogen). They are taken daily without break.
- ✍ **Saheli**, a nonsteroidal preparation, is taken once a week after an initial intake of twice a week dose for 3 months.

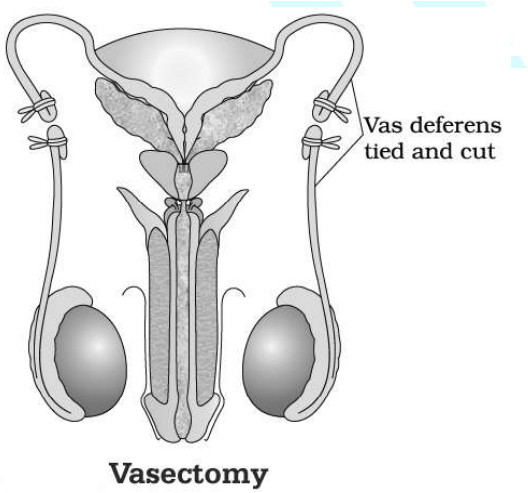
(g) **Abortion :** Abortion is the medical termination of pregnancy (MTP) before the foetus becomes viable. It is one of the most widely used methods of fertility control in world. Certain pills act as abortants. They function by inducing menstruation which checks the implantation of the zygote or detaches the implanted egg. There are movements against abortion practically all over the world. A drug named RU-486, an analogue of progesterone, developed in France terminates pregnancy within the first few weeks, It blocks the progesterone receptors in the uterus, thereby preventing progesterone from maintaining pregnancy.

(h) **Abstinence :** The best and 100% reliable way to avoid conception is to abstain from sexual intercourse. It is an unnatural mode of birth control, and seems impracticable. Some couples practice abstinence at certain times with success.

(ii) **Permanent Method :** Sterilization provides a permanent and sure birth control. It is called **vasectomy** in man and **tubectomy** in woman. It involves the removal of a short segment of each vas deferens or oviduct and tying up of the remaining ends tightly with surgical thread. The operations are minor, usually performed under local anesthesia, give very little discomfort, and do not affect the sexual life. Contrary to common belief, man with vasectomy is still capable of ejaculation, but the latter consists only of secretions of various glands, and has no sperms. sperms are still produced but reabsorbed into the body. Production of testosterone continues and its distribution does not need the ducts.

Vasectomy (L. vas-vessel, *ektome-excision*) *:*

- It is a surgical method of sterilisation of males.
- Vasa deferentia are blocked by cutting and occluding them so that sperms are unable to pass down the male reproductive system.



Vasectomy

(i) Conventional Vasectomy (Scalpel Surgery)

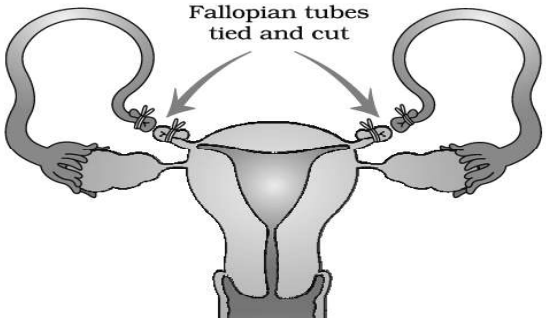
- Under local anaesthesia, transverse 1cm incision is made through the skin of the scrotum with the help of the scalpel over the area of vasa deferentia.
- Each vas deferense is exposed and cut.
- The two ends are separated and tied.
- A gap of 1-4cm is must between the two ends otherwise reunion can occur.

(ii) No-scalpel Vasectomy:

- Here instead of scalpel, a dissecting forceps and a ringed forceps are required.
- The skin is punctured and the vas deferense is taken out.
- It is occluded by removal of 1-2 cm followed by ligation of ends.
- Occlusion can also be achieved by heat and clips.
- Vasectomy is a reversible procedure as the cut ends can be joined together to open to sperm passage.

Tubectomy (L. tubes-pipe, *ektome-excision*):

- It is a surgical procedure of female sterilisation where a portion of both the fallopian tubes is excised or ligated to block the passage of ovum through them.



- Tubectomy is performed by

conventional transabdominal surgery, conventional laparotomy and minilaparotomy.

- ✍ In surgical procedures, the fallopian tubes are cut and the cut ends are tied to prevent reunion.
- ✍ The procedure is reversible as the cut ends can be rejoined.
- ✍ In laparoscopic procedure, sterlisation is achieved by loop development and constricting the basal region of loop with the help of elastic ring either through a small incision in the abdomen or through vagina.

(a) **Laparoscopy :** Now a telescopic instrument called laparoscope is used in tubal ligation. This blocks the fallopian tubes. Eggs continues to be produced because the ovaries are intact, but they fail to pass into the uterus and sperms fail to reach the eggs for fertilization.

(b) **Most Effective Birth Control :** Sterilization is at present the most effective means of birth control. It is difficult to reverse.

(c) **Extent of Contraceptive Use :** According to a UN report in the Tribune dated 24.8.87, half of the world couples use contraception and one in three chooses, sterilization.

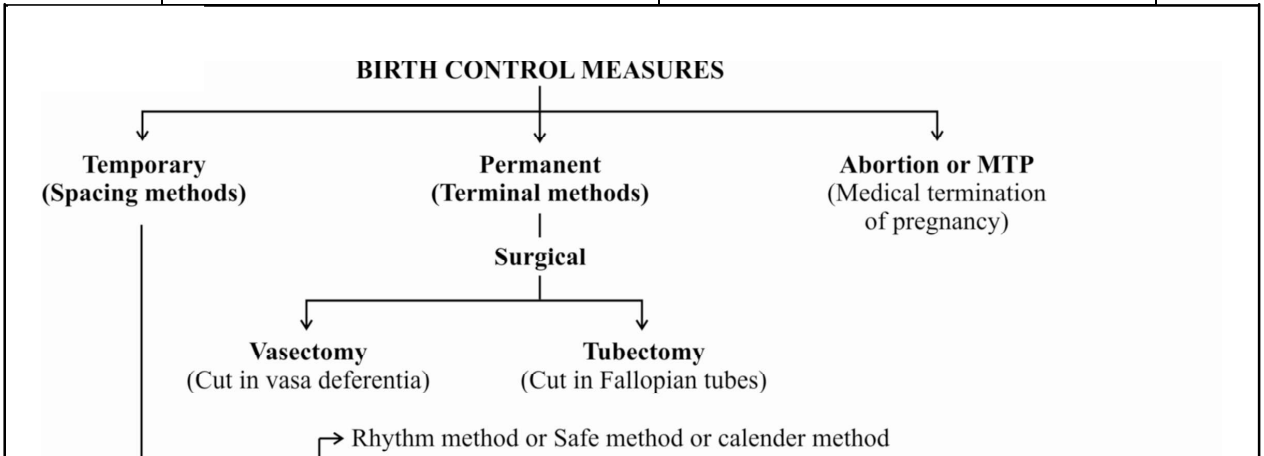
(d) **Medical Advice :** The birth control measures should be used with the guidance of qualified doctors. The government provides these facilities free at the family planning centres. Contraceptives are given free or at nominal prices at these centres to the couples of reproductive age desirous of preventing conception.

(e) **Advice for Fertility :** The couples who are not getting children can also seek advice and remedy at the family planning centres.

(f) **Abortion or Medical Termination Pregnancy (MTP) :** has now been legalised in India.

Difference between Vasectomy and Tubectomy

Vasectomy	Tubectomy
1. It is surgical sterlisation technique for the males.	1. It is surgical sterlisation technique for the females.
2. The two vasa deferentia are interrupted by giving cuts.	2. The two oviducts are interrupted by either ligation or cuts.
3. Passage of sperms is prevented.	3. Passage of ova is prevented.



S. No	Method	Action
(1)	Rhythm method	No intercourse during woman's fertile period (day 12-20).
(2)	With drawl	Penis is withdrawn before ejaculation.
(3)	Tubectomy / Tubal ligation	Woman's fallopian tubes are cut and tied, permanently blocking sperm release.
(4)	Vasectomy	Man's vasa deferentia are cut and tied permanently blocking sperm passage.
(5)	Intrauterine device (IUD)	Small plastic or metal device placed in the uterus, prevents implantation. Some contain copper, other release hormones
(6)	Oral contraceptive	Synthetic estrogens and progesterones prevent normal menstrural cycle; primarily prevent ovulation.
(7)	Male condom	Thin rubber sheath on erect penis collects ejaculated semen.
(8)	Female condom	Plastic pouch inserted into vagina catches semen.
(9)	Diaphargm	Soft rubber cup covers entrance to uterus, prevents sperm from reaching egg and holds spermicide.
(10)	Cervical cap	Miniature diaphragm covers cervix closely, prevents sperm from reaching egg and holds spermicide.
(11)	Foams, creams, jellies, etc.	Chemical spermicides inserted in vagina before intercourse, prevent sperm from entering uterus.
(12)	Implant (Norplant)	Capsules surgically implanted under skin, slowly release hormone that blocks ovulation.
(13)	Injectable contraceptive (Depo-Provera)	Injection every 3 months of a hormone that is slowly released and prevents ovulation.

Measures to control Over Population

1. **Education:**

- ✍ People, particularly those in the reproductive age group, should be educated about the advantages of a small family.
- ✍ Mass media and educational institutions can play an important role in this campaign.
- ✍ Posters showing a happy couple and two children with a slogan "Hum Do Humare Do" should be displayed.
- ✍ Many couples even adopted "one child norm".

2. **Marriageable Age** :

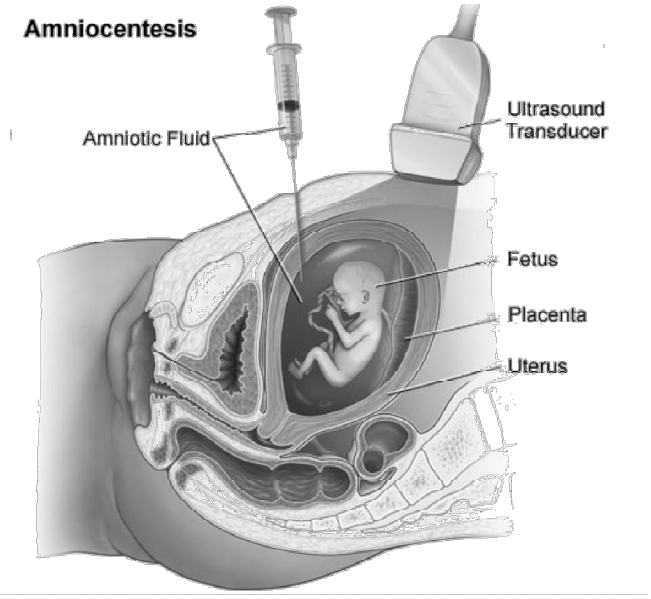
- ✍ Raising of the age of marriage is more effective means to control the population (now marriageable age of female is 18 years and that of male is 21 years).

3. **Incentives:** Couples with small families should be given incentives.
4. **Family planning:** There are many birth control measures which can check birth rate

9 AMNIOCENTESIS

(i) **Aim :** It is a technique to determine :

(a) Sex of the developing baby.
(b) Genetically controlled congenital diseases.
(c) Metabolic disorders in foetus.
So amniocentesis is a **pre-natal diagnostic technique.**



(ii) **Procedure :** It involves following steps :

(a) Location of the foetus is determined by a technique called **sonography** (using high frequency ultrasound waves) to prevent accidental damage to the foetus.

(b) A fine hollow needle is passed through the abdominal and uterine wall of a pregnant female (about 14^{th} to 15^{th} week after conception) into the amniotic cavity.

(c) A small amount of amniotic fluid is withdrawn. It contains foetal skin cells and a number of proteins, especially enzymes. The cells can be cultured *in vitro* for further examination.

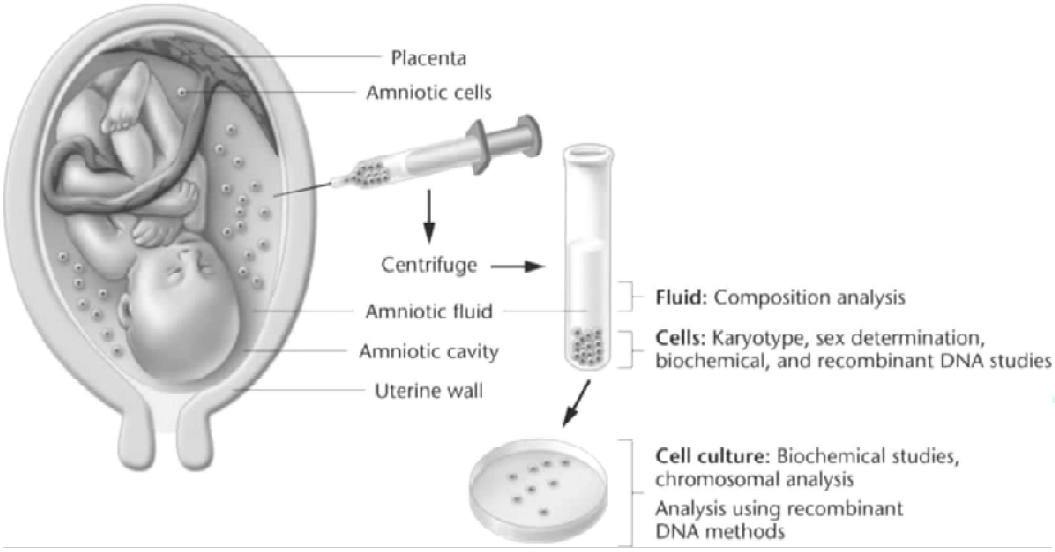


Fig : Amniocentesis

(iii) **Significance**

(a) **Sex determination :** The somatic cells of foetal skin drawn with the amniotic fluid are stained to determine the presence of sex chromatin (barr body). Presence of barr body indicates that the developing foetus in female as female is with 2 X-chromosomes out of which one X-chromosome is active, while other X-chromosome is heterochromatised into a darkly stained barr body.

(b) **Congential disease :** By Karyotypic studies of somatic cells, abnormalities due to changes in chromosome number like Down's syndrome, Turner's syndrome, Klinefelter's syndrome etc. can be determined.

(c) **Metabolic disorder :** By the enzyme analysis of amniotic fluid, different types of inborn metabolic disorders like phenylketonuria, alcaptonuria etc. can be detected. These inborn errors are caused by the absence or inactivity of specific enzymes due to gene mutations. So with the help of amniocentesis, if it is confirmed that the child is likely to suffer from some incurable, congenital defect, the mother can go for abortion.

(iv) **Drawback :** However, these days, the amniocentesis is being misused also. Mothers even get their normal foetus aborted if it is a female. This is just equivalent to killing of a normal child. So Govt. of India enforced the **Pre-natal Diagnostic Techniques (Regulation and Prevention of Misuse) Act, 1994,** since January 1, 1994 under which all genetic counselling centres and laboratories are required to apply for registration. The violation of this Act can bring a fine of Rs. 50,000 and imprisonment for two years. The doctor's registration is also cancelled till the complaint is disposed of.

(v) **Chorionic Villus Sampling (CVS) :** Amniocentesis is possible without a chance of injuring the foetus with the needle only after the sixteenth week of pregnancy. At this time, abortion is not safe. A new technique, named Chorionic Villus Sampling (CVS), can be done during the eighth to tenth week of pregnancy when abortion is safe for the woman. For CVS, cells are sucked into a catheter passed through the cervix. CVS technique provides a mass of rapidly dividing foetal cells, thus facilitating the examination of chromosomal disorders.

IMPORTANT POINTS

- ***China*** *(1234 million) and* ***India*** *(953 million) are two most populous countries;* ***USA*** *(265.8 million) and* ***Indonesia*** *(200.6) come next.*
- *India's population growth rate is about 2% a year and China's 1.4%.*
- *Maximum population growth rate in the world is in* ***Kenya*** *(5.5%).*
- ***Austria*** *has shown a negative growth rate.*
- *The most thickly populated country of the world is* ***Bangladesh.***
- ***Greenland*** *is the most thinly populated country (45/Km^2) followed by Australia.*
- *The International Conference of Population and Development (ICPD) was held at* ***Cairo*** *in September 1994.*
- ***Mumbai*** *will become the second largest megapolis in the world by the turn of the century with a population of 18.9 million.*
- ***Tokyo*** *is the largest city with 26.5 million people.*
- *The first census in India was carried out in 1891.*
- *In last census* ***Nagaland*** *registered the highest growth rate of 56.86% while Kerala the lowest, 13.98%.*
- *The most thickly populated state of India is* ***West Bengal*** *(766/Km^2); the most sparsely populated area of the country is* ***Arunachal Pradesh*** *(10 Km^2).*
- *The first district to become 100% literate is* ***Ernakulam*** *in Kerala.*
- *The first state to become 100% literate is also Kerala.*
- ***Chandigarh*** *has the lowest number of females per 1000 males with 790.*
- ***Bihar*** *stood at the bottom with a literacy rate of 38.48% with* ***Rajasthan*** *being close to it having 38.55 literacy percentage.*
- ***National average of infant mortality rate is 72,*** *where as U.P., It was 86, in Bihar 73, In Rajasthan 85 and In M.P. 89 while that of Kerala is only 15.*
- *Indian population is a young population, while the population of USA, England, Germany, etc. is* ***ageing population.***
- *In china, more than 8,000 live for more than 100 years, about 8 million above 80 years, about 20 million above 70 years and about 120 millions people above the age of 60 years.*
- ***Population explosion :*** *Also called* ***Population holocaust.*** *It is high growth rate of human population.*
- *Nearly half of the world population is distributed in four countries :* ***China*** *(1120 million),* ***India*** *(844 million-1991 census),****USSR****(291 million) and* ***USA*** *(251 million).*
- *World Population Day : 11 July. (since 1987 when on 11 July on that year, the world population crossed five billion).*
- *In* ***July, 1997,*** *Indian population was growing at the rate of* ***16 million per year*** *which means* ***45,000 per day*** *and* ***31 per minute.***
- *Minimal decennial growth is reported from Kerala (13.98%) while maximal decennial growth is reported from* ***Nagaland*** *(58.86%). It was due to better fertility awareness among rural women folk.*
- ***Indian Population Project-VI (IPP-6)*** *ended in March, 1997.*
- *According to revised estimates, if the present trend continues,* ***India will surpass China in 2050 A.D.*** *With population of 2160 million.*
- *China's birth rate is 18 births per 1,000 population and its TFR is 2.2 children per woman. Conversely, India's birth rate and TFR are 30.5 per 1,000 persons and 3.5 per women respectively (1991 census).*

- *After 40 years of age, contraceptive pills increase the chances of cardiovascular diseases.*
- ***Matez Gasper : World's fifth billion child,*** *a male infant born in* ***Zagreb*** *(Yugoslavia) on July 11,1987.*
- ***Fatima : World's 6th billion child,*** *a female infant born in* ***Sarajevo*** *(Kosovo) on October 14, 1999.*
- *India till 1920 was in the first stage* ***(****high stationary****)*** *of demographic cycle but now India has entered third stage* ***(****late expanding****)*** *of the cycle.*
- *In* ***China,*** *person is considered as of "one year age" at the time of birth.*
- *Most natural population is an* ***open population*** *in which individuals undergo immigration or emigration, while yeast population in a test tube is a* ***closed population*** *in which individual do not undergo immigration or emigration.*
- ***Couple protection rate :*** *Bringing eligible couples under the umbrella of various modes of contraception.*
- *Family Planning Programme was adopted as a National Programme in 1995 A.D. Now it has been renamed as* ***Family Welfare Programme.***
- *Government-sponsored Family Planning Programme was started in India in 1951.*
- ***Mirena :*** *A new contraceptive plastic coil coated in copper and is fitted in the uterus. Copper acts as a spermicide while coil releases small amounts of an artificial hormone,* ***gastrogen,*** *which further increase the spermicidal effect of copper. It combines both mechanical and hormonal contraceptive methods and has been found to have more than 99% efficary. It is introduced by a German company.*
- *Central Drug Research Institute (Lucknow) has developed a plant-based spermicidal cream "****Consap****" from Reetha (Sapindus mukrosii).*
- ***NIm-76 :*** *It is neem-based, pre-coital vaginal contraceptive cream having spermicidal properties. It has been developed by* ***Defence Institute of Physiology and Allied Sciences (DIPAS), New Delhi.*** *It has been found to be safe, non-hormonal and non-toxic with no side effects. Nim-76 punctures the sperm skin causing leakage of cellular contents so preventing the capacitation of sperms. It also has both anti-bacterial and anti-fungal properties.*
- ***Contraception :*** *Method of birth control to check fertilization.*
- ***Sterilization*** *is the most effective method of birth control.*
- ***Laparoscope :*** *Instrument to aspirate the oocytes from the ovary for IVF (In Vitro Fertilization)*
- ***UN Population Award, 1992*** *was awarded to an Indian Industrialist,* ***J.R.D. Tata,*** *for his efforts to stabilize Indian population.*
- ***UN Population Award, 1998 :*** *It was jointly awarded to a group of* ***Ugandan Elders*** *(credited to reduce the practice of female genital mutilation) and* ***head of Jamacia's Family Planning Board***
- *India's first test baby was "****kanpuriya Aggarwal****". India's second test tube baby was "****Kumari Harsha****" She was born on August 6, 1986.*
- ***Vas aplasia :*** *Absence of both vasa deferentia.*
- ***Ogino (1930) :*** *Described "****Safe period****" or "****Calander period****" to control pregnancy .*
- *Success rate of test tube baby is* ***less than 20%.***
- ***Literacy rate : 2001*** *= 65.38%;* ***1991*** *= 52.11%;* ***1997*** *=62% (+10%).*
- ***G.I.F.T. –*** *Gametic Intra- Fallopian Transfer is the latest technique to produce the child.*
- ***Gamete-Intra Fallopian tube transfer :*** *Sperm (obtained by masturbation / electro*

ejaculation) and ovum obtained by laproscopy are injected into the mid part of the oviduct by a separate catheter in a cycling female (in proliferative stage).

11 SEXUALLY TRANSMITTED DISEASES

- The general term **sexually transmitted disease (STD)** is applied to any of the large group of diseases that can be spread by sexual contact.
- The group includes conditions traditionally specified as **venereal diseases (VD),** such as chlamydia, gonorrhea, syphilis, and genital herpes.
- AIDS and hepatitis, which are sexually transmitted diseases and are that also can be contracted in other ways also.

SOME COMMON SEXUALLY TRANSMITTED DISEASES (STDS)

Name of sexually transmitted disease	Causative organism	Symptoms
Gonorrhea	Bacterium (*Neisseria gonorrhoae*)	-Infects mucous membrane of the urinogenital tract. -Genital discharge, painful urination. -Children born to infected mothers often suffer eye infections.
Syphilis	Bacterium (Treponema pallidum)	-Causes sores and lesions in the genital tract. -Burning sensation at the time of urination. -Later causes sores in mouth. -Can be deadly if not treated.
Trichomoniasis	Trichomonas Protozoa	-Vaginal irritation, itching and discharge.
AIDS (Acquired Immuno Deficiency Syndrome)	HIV (Human Immuno Deficiency Virus)	-Destroys the immune system of body. -Persistent cough and fever. -Body gets infected by other diseases like pneumonia, TB and certain cancers. -AIDS is a life-threatening disease. At present there is no cure. However AIDS is preventable from agrevation.

12 INFERTILITY

Infertility (L. *in-not, fertilis*-fruitful) is failure to conceive even after 1-2 years of regular unprotected sex.

The term is not synonym of **sterility** which means complete inability to produce offspring.

Infertility can best be defined as relative sterility.

It is of two types, primary and secondary.

Primary infertility is the infertility found in patients who have never conceived.

Secondary infertility is found in patients who have previously connceived.

Infertility is caused by defects found in males, females as well as both

Infertility in Males

Semen of a fertile male is 2.5 to 5 ml per ejaculation with a sperm count of over 200-300 million, mostly motile, having proper fructose content and fluidity which is deposited high in the vagina.

Any defect in sperm count, sperm structure, sperm motility of seminal fluid leads of infertility.

Low sperm count is called **oligospermia** while near absence of sperms is known as **azoospermia.**

Low sperm motility is called **asthenozoospermia** while defective sperm morphology is termed as **teratozoospermia**

Infertility in Females

A fertile woman is the one who regularly ovulates once every cycle, passes the egg down the reproductive tract which develops conditions for smooth passage of sperms and implantation of fertilised egg.

The various causes of infertility in females are as follows :

1. **Anovulation** (nonovulation) and **oligoovulation** (deficient ovulation).
2. Inadequate growth and functioning of corpus luteum.
3. The ovum is not liberated but remains trapped inside the follicle due to hyperprolactinaemia.
4. Fallopian tube may fail to pick up ovum.
5. Noncanalisation of uterus.
6. Defective uterine endometrium.
7. Fibroid uterus.
8. Defects in cervix.
9. Defective vaginal gro

13 ASSISTED REPRODUCTIVE TECHNOLOGIES (ART)

More than two decades ago, in an experimental procedure called invitro fertilization (IVF), doctors joined a woman's egg and a man's sperm in a glass dish on the laboratory table.

For the first time, fertilization happened outside a woman's body. Nine months later, the first test-tube baby was born.

Today, assisted reproductive technology (ART) refers not only to IVF but also to several variations tailored to patient's unique conditions.

These procedures are usually paired with more conventional therapies, such as fertility drugs, to increase success rates.

Almost one out of every three cycles of ART results in the birth of a baby.

But ART procedures are invasive and expensive.

Though no long-term health effects have been linked to children born using ART procedures, most doctors recommend reserving ART as a last resort for having a baby.

Following is the list of important techniques which could benefit such infertile couples.

1. IVF & ET

The technique of *in-vitro* fertilization and *in-vitro* development followed by the embryo-transfer in the uterus of the normal female to start the development and finally leading to normal birth, is called **test tube baby.**

(i) **History :** First attempt to produce a test tube baby was made by a Italian scientist, **Dr. Petrucci** (1959 A.D.). Although, this human embryo survived for only 29 days, but his experiment opened a new filed of biological science. The first test tube baby was born to Lesley and Gilbert Brown on July 25, 1978, in Oldham, England. Mrs. Brown had obstructed Fallopian tubes. **Dr.Patiricke Steptoe** and **Dr. Robert Edward** both from England experimented on Mrs. Brown successfully. the world's first test tube baby (a baby girl) was named as **Louise Joy Brown**. Later, test tube babies were also born in Australia, United States and some other countries. India's first test tube baby was born on **3rd October, 1978 in Kolkata.** Her name was **Kanupriya Aggarwal** and was created by **Dr. Subash Mukherjee.**

(ii) **Procedure :** It involves the following steps :

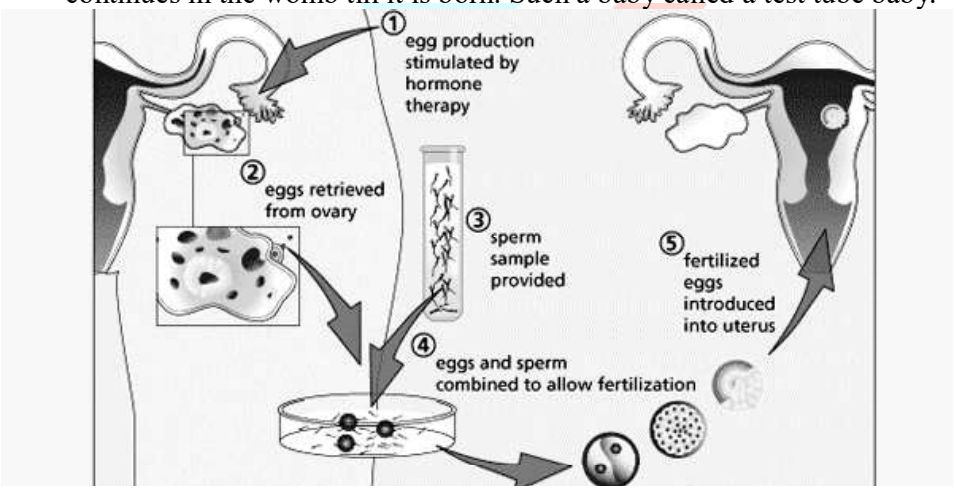
(a) Removal of unfertilized ovum from reproductive tract of a female.

(b) Ovum is kept under aseptic conditions.

(c) Fusion of sperm and ovum in a culture medium, outside the female body, to form the zygote.

(d) Zygote is stimulated to develop *in vitro* upto 32-celled stage.

(e) Developing embryo is implanted on the endometrium of the uterus at 32-celled stage. So the pregnancy in the woman starts and further development of the child continues in the womb till it is born. Such a baby called a test tube baby.



(iii) **Significance**

(a) It is boon to infertile mothers.

(b) It can be used for men with Oligospermia (low sperm count).

(c) Old superior cows can donate oocytes.

Embryos can be frozen and preserved in an embryo tank for 10 years for future use.

In very rare cases, a **surrogate mother** may have to be used to bring up *in vitro* fertilized ovum to maturity. Though biological realization of a test baby is a remarkable achievement, it has raised several ethical and legal problems like the right over the child.

2. ZIFT

In ZIFT (Zygote Intra Fallopian Transfer) the zygote, formed *in vitro*, or early embryo up to 8-blastomere, is transferred into fallopian tube.

3. IUT

In IUT (Intra Uterine Transfer) the embryos with more than 8 blastomeres are transferred into the uterus for further development. The embryos formed by *in-vivo* fertilization can also be used for transfer to assist those females who cannot conceive

4. GIFT

The GIFT (Gamete Intra Fallopian Transfer) is the transfer of an ovum collected from a donor into the fallopian tube of the recipient who can provide suitable environment for fertilization and further development.

5. ICSI

In ICSI (Intra Cytoplasmic Sperm Injection) is another specialized procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum

6. AI

- The AI (Artificial Insemination) is used for the cases of infertility which is either due to inability of the male partner to inseminate the female, or due to very low sperm counts in the ejaculate.
- In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI -intra-uterine insemination) of the female.
- ART requires extremely high precision handling by specialized professionals and expensive instrumentation. The infertility facilities are presently available only in very few centres in the country.
- Obviously their benefits are affordable to only a limited number of people. Emotional, religious and social factors are also involved in the adoption of these methods

Adoption

Our law also permits legal adoption. Adoption can benefit not only the people who are looking for parenthood but also to many orphaned and destitute children in India, who would probably not survive till maturity, unless taken care of.

Surrogacy or use of a gestational carrier: Another woman carries embryo or a donor embryo to term