Block 3

DEMOGRAPHIC STUDIES

8.0 DEMOGRAPHIC ANTHROPOLOGY*

Contents

Learning Objectives

After reading this Unit, you would be able to:

➢ Define demographic anthropology;

➢ Understand the scope and relationship of demographic anthropology with other allied disciplines; and

➢ Explain the sources of demographic data and the process of demographic changes.

8.0 INTRODUCTION

Demography is the systematic study of the size, distribution and composition of human population, and their changes resulting from fertility, mortality, and migration (*Poston* and *Bouvier*, 2010). The term demography is derived from two Greek words 'demos' means population and 'graphia' means description or writing. The term was first used in 1855 by Belgian statistician Achille Guillard. Anthropological demography uses anthropological theory and methods to offer a better understanding of demographic fact in present as well as past populations (*Bernardi*, 2007). As a discipline, it started gradually from the last two decades of the twentieth century and is still under development. Both demography and anthropology deals with human populations as their

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research object. Demography is mostly concerned with the dynamic forces which define population size, structure and their difference across time and space. Anthropology largely focuses on the dynamics of various population processes affecting different populations living under varied geographic and environmental conditions. So, in nutshell our focus would be on the ethnic groups and breeding isolates.

The other different branches of anthropology such as evolutionary anthropology, archaeology and paleodemography are characterized by the demographic methods to understand the bio-demographic structure of past or contemporary populations (*Bernardi*, 2007). Physical anthropologists on the other hand have their two most important demographic interests. The first interest explains the fundamental demographic factor of the species under conditions which are unaffected by modern life. Much of this work is paleodemographic depending on the evaluation of recovered skeletal materials. The second interest is to describe how 99 percent of human history spent in hunting and gathering has led by selection, to underlying physiology and psychology of human and indeed to the institutional structure and cultural components that are evident in demographic process today.

8.1 SCOPE

The scope of demography is broad from simple description of population changes over time and space to a complex growth and distribution of population with due attention to such determinants as migration, racial difference, psychology, social and economic class and geographical location. The necessity to study distribution, structure and changes in population had never so intensively felt as has been in the past few decades. It studies how small or large population are; how populations are composed as per age, sex, race, marital status, and other characteristics and how populations are distributed in physical space (*Bogue*, 1969). The variations in human population changes over time like variation in terms of size, composition and distribution. These changes are affected by several factors which include fertility, mortality and migration. Again, these factors are considered as the three basic demographic processes. If the population change in size, composition and distribution then these changes depend only on one or more of the three main demographic processes.

The population study deals with the population phenomenon which takes place and also changes in social, biological and economical settings. Population composition includes the measurable characters of population such as age, sex, marital status, educational level, religion, caste, race, etc. in a country during a particular period. The demographic studies try to discover the changes these characters influence on size and distribution of population and the variables responsible for the change. There are many factors affecting population distributions such as geographical location, social position and economy etc. It also studies by categorization of residence including both the rural and urban residence pattern, increasing urbanization, ratio of rural and urban population, locality etc. Fertility, mortality and migration are the primary aspect of demography. Demography studies the influence of biological limits, reproductive span, etc. in addition to the social, psychological and cultural factors which affect the fertility. The studies of mortality include age at death,

sex, cause of death, mortality trends and difference in mortality such as rural and urban. The study of migration involves the trends in migration movements, place of origin and destination, migration intervals, national and international migration.

8.2 RELATIONSHIP WITH OTHER BRANCHES OF SOCIAL SCIENCES

Demography studies several aspects of population which share close relationship with other disciplines. Some of the relationships are given below:

8.2.1 Demography and Anthropology

Both anthropology and demography share common research object i.e. human beings. Demography's main concern is with the dynamic forces defining population size and structure and their variation across time and space. Anthropological demography uses anthropological theory and methods to look into demographic phenomena. The main theoretical concept in anthropological demography includes culture, gender, institution, and political economy. Its empirical research approach includes both quantitative and qualitative methodology applied in case studies. For conducting research, ethnographic fieldwork and participant observation are considered main approach as it is the interpretative understanding of primary data and historical material. In addition, demography is also central to understanding human evolution and variation, because it's most important elements - fertility and mortality are fundamental aspects of evolution and variation.

Scholars in both anthropology and demography have occasionally come together as team in multidisciplinary research. Both the disciplines also created complex research models to construct on mutual strength and reduce disciplinary limitations thereby introducing the field of anthropological demography (*Majumdar*, 2010).

8.2.2 Demography and Sociology

Both the disciplines regard man and woman as social animals. Being a unit of society, human beings have to perform series of activities both as an individual and as well as partner of a larger group. Demography is used by sociologists both as a tool and a provider of social space for understanding social issues, social relations, social interactions, social reactions and the evolution and continuation of social processes. Demography is not just a study of population composition, sex ratio in population, prevailing or changing birth rates, death rates, migration rate or marriage rate. It is also important in the perspective of social, cultural and economic conditions of the human aggregate under scrutiny. Even studies about fertility, mortality and migration have a strong social base. The change in death rates, especially age, sex specific death rates and marriage rates are intimately related to social customs and cultural determinants. The measures suggest the practiced for controlling birth rate differ from one country to another which is primarily because of the social and cultural situation prevailing in those countries. A typical reciprocal relation appears to exist between social status on one side and fertility and mortality on other side. Class positions include superiority over others in explaining fertility, expectation of

life and some of the principal cause of mortality and morbidity in a population (*Majumdar*, 2010).

8.2.3 Demography and Economics

Economists provide major contribution to demography in both theory and application. For the graduate studies in economics, population studies are integral part of course. Even population size, its distribution and quality of skill are important factors in the total production and consumption process. Labour supply and labour productivity are reliant upon the size and skill composition of the population supply. Employment generation, resource management and distortion in income distribution are key issues that confront today's economists more than what they did hundred years back. There can be no uncertainty that raising the stage of living of people is closely related to the population growth. Investment priority, economic and development planning have frequently been derailed by the population explosion. Fertility, mortality, emigration and immigration, population density, urban-ward migration, etc. have direct or indirect effect by economic issues (*Majumdar*, 2010).

8.2.4 Demography and Human Ecology

Human ecology is mainly concerned with birth that gives the population base. Ecology as well concerned with environment and its association with every form of life on this earth. It views human population to an extent in which people share in exploiting and developing the same environmental resources. Human ecologists use demographic data as other disciplines do. According to Otis Duncan, human ecology gives a general perspective, concepts and specific hypothesis of the first rate significance to the demographers. Ecologists often use demographic variables as independent variables in many other causal models. For example, a small isolated population cannot have social organizations of the type of a large population is concentrated in a defined space (*Majumdar*, 2010).

8.2.5 Demography and Geography

Geography and demography are very close to each other due to their distributional perspectives. Population settlements appear to develop in places according to the climatic, temperature and rain fall experience of the place. Population growth and its dispersion have close association with geography. Birth, death and migration are broadly discussed in modern geography.

Check Your Progress

1) What do you understand by Demographic Anthropology?

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2) Explain in brief the relationship between demography and other disciplines.

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8.3   SOURCES OF DEMOGRAPHIC DATA

Demographers are more fortunate than others when it comes to data collection and develop their individual databases. Generally speaking, most of the data used have already been gathered for us, but not always. Indeed, some demographers do gather their own data, especially those who use anthropological perspectives and who are engaged in ethnographic research (*Greenhalgh*, 1994; *Riley*, 1998; *Riley* and *McCarthy*, 2003). However, most of us use data already collected and developed by other organizations. National censuses, registers, and surveys are the three basic sources of demographic data.

8.3.1 National Census

As per the United Nations (1958), a national census is the whole process of collecting, compiling, and publishing demographic, economic and social data pertaining at a particular time to everyone in a country or delimited territory. Everyone in a population and the entire demographic events that take place in the population are supposed to be registered in a national census. A census is like taking picture of a population once after every ten years. Its main objective is to find out data regarding the size, composition and distribution of the population. It also collects information regarding the size of the population and its social and geographic sub population, as well as data on their educational composition. Other typical census includes population data such as area of birth, citizenship, language, current migration experience, religion, and ethnic heritage, that refers to group distinction based on shared cultural origins (*Shryok et al*. 1976). Census has a very long history. The modern periodic census began halfway in the 18th century (Sweden, 1749, Norway and Denmark, 1769). Even though the first census was conduct in Virginia (USA) in 1624, the periodic census becomes an integral part of American Constitutions in 1787. In case of India, national census started in 1881. About 95 percent of the world's population have been counted in a national census conducted sometime during the decade of the 1990s (*Majumdar*, 2010).

There are two ways of counting people by following de jure method or by following de facto method (*Shryock*, 1964). In case of de jure method each person in a population is counted depending on their usual or normal place of residence in the country. In case of de facto method, each person in the population is counted according to his/her geographical location on the day of the census undertaking. De facto type is more common than the de jure method in more than 230 countries conducting national census (*Wilmoth*, 2004).

Census data are very important for the performance of government bodies in the present day context. It gives helpful and essential information of people to government officials in their country. Census statistics are utilized by the authorities in making public coverage on problems such as what number of kids the general public faculties want to serve and where to place brand new roads.

It also provides data on death rates, crime rates, per capita income figures, and other statistics for local and national governments administration. Even the

private business needed census data for their market analyses and advertising activities (*Anderson*, 2003). India uses census head count to determine the size of representatives both in parliament and assembly, all local bodies from a particular state as also to decide on the share of revenue and assistance from the central budget for different states and other purposes (*Majumdar*, 2010).

8.3.2 Registration System

Registration system is a continuous collection of major population events, often births, deaths, marriages, divorces and sometimes migrations. Registration data of demographic events such as birth or death which are registered with government are generally compiled and published annually or monthly. Although it applies mainly to births and deaths, many countries do maintain registrations of marriages, divorces, and abortions. A population register is a list of people that includes the name, date of birth, address, and a personal identification number. Some countries have maintained some kind of population register, and many of the other countries either have them in place or are planning to implement them. The United States does not maintain any type of national population register. The earliest example on record of a population register of families and associated household events was in China during the Han Dynasty (205 BC-AD 220). Irene Taeuber (1959) recorded that the demographic tradition of China and the East Asian region was a population registration. Its main function was only gathering of demographic events but also to control the population at the local level (*Bryan*, 2004).

In British occupied India, birth registration was started in the year 1670, death in 1720 and marriage much earlier in 1604. Since the promulgation of Birth and Death Registration Act, 1969, registration of birth and death has improved considerably (*Majumdar*, 2010). Generally, the Municipalities, Corporations and Panchayats or local bodies were given responsibility for maintaining registers for births and deaths. The hospitals, health centres, nursing homes, etc. send periodic reports of birth and death to their respective municipalities. When births and deaths occur outside institutional care, certificates from the doctors are submitted to municipality for registration in a given format. The registration offices issue certificate of registration. In 2001, approximately 55 percent of births and 45 percent of deaths were registered at a national level in India.

Today, population registrations are important as they hold information on birth and death records. Simon Szreter (2007) has written that the registration of one's birth and death are fundamental human rights. International Covenant on Civil and Political Rights (ICCPR) of the United Nations states that every child shall be registered immediately after birth and shall have a name (Szreter, 2007). A nation must have complete information regarding the patterns and trends of mortality so that appropriate action can be taken up to protect and improve the life expectancy of their populations. For inheritance of property or putting up claims for insurance and bank deposits, death certificate is made mandatory in India (*Majumdar*, 2010).

8.3.3 Surveys

The third source of demographic data is surveys. Demographers rely often on surveys because censuses and registration systems do not include the extensive

kind of information required to address some of the critical demographic questions. Demographers are better able to find out fundamental patterns of demographic behaviour by conducting surveys to carefully chosen random samples of the larger populations (*Poston* and *Bouvier*, 2010). They often collect data interest to demographers which are not included in censuses and registers. This is mainly true with respect to the study of fertility, while it also applies to mortality and migration.

For collection of demographic data, surveys are very important source second only to census. From user viewpoint, surveys are sometimes more significant and dependable than census. The survey data are much fine tuned since the data are collected under direct supervision of professional persons, specially trained field staff. In India, surveys such as National Sample Survey, Sample Registration Scheme etc. which are getting vital population data have gained momentum in the recent past for various reasons. It is used in addition to the current census on issues which cannot be covered through census. It also provides check on the exactness of the census count along with census. Survey under the aegis of Census Commissioner is conducted on more complex social and economic issues (*Majumdar*, 2010).

Check Your Progress

3) Define Census? Discuss the importance of population census.

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4) What is de jure and de facto method of population counting?

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8.4 DEMOGRAPHIC PROCESSES

Fertility, mortality and migration are three important demographic processes that determine the changes in population size, composition or distribution.

8.4.1 Fertility

Fertility refers to the actual production of children, which in the strictest sense is a biological process. It is different from fecundity. Fecundity refers to the reproductive capability of women during her whole reproductive period. Even though the production of child is a biological process, the different activities and events which lead to given birth are affected by the social, economic, cultural and psychological characteristics of the woman and the man, as well as by the environment in which they live.

There are two ways of studying fertility. Micro fertility analysis refers to the fertility of individual woman and man. Fertility of the person can be studied through: 1) examining the number of births a woman (or man) has produced by a

given point in time, 2) examining the number of births of woman (man) has had by the end of the child bearing years; and 3) focusing on the timing and spacing of birth at different stages of the life cycle (*Poston* and *Bouvier*, 2010). Macro fertility analysis determines the rate at which birth occurs in population or sub-population during a given period of time. Rather than studying the fertility of persons, macro fertility analysis studies the fertility of population (*Poston* and *Frisbie*, 2005). One reason demographer measure fertility at the macro level is to evaluate it with mortality, and to compute rates of reproductive change. They also compare the fertility levels of different types of sub-populations over time. There are several factors affecting fertility change which includes biological, physiological, socio-economic factors, lifestyles etc.

Demographers are paying attention in various social, economic, cultural and environmental factors that influence both the possibility of women having a baby and the number of babies she will have in her lifetime. Demographers have shown, for example, that the more years of education a woman has, the fewer will be her number of children. Women who attained higher education tend to marry later and also start a family later, compare to women who attended school for a shorter period of time. Usually, the higher a person's socio-economic status, the fewer children that person is likely to have. In industrialized societies, women employed in the labour force tend to have fewer children than women who are not so employed. Levels of child bearing also tend to be lower in urban than in rural areas. This is particularly true in more modernized countries, even though in the past three or four decades, the difference between rural and urban child bearing has diminished. As per National Family Health Survey (NFHS-4) of India, women in rural areas have higher fertility on average than women in urban areas. Women with no schooling have more children than women with 12 or more years of schooling. Women from low economic status have more children on overage than women from high economic status. The most important point to remember about fertility is that fertility rates are heavily conditioned by social, economic, psychological, cultural and environment factors (*Poston* and *Bouvier*, 2010). In the year 1956, two well known demographers, Kingsley Davis and Judith Blake, wrote an influential paper about the behavioural and biological variables that are intermediate and thus directly influence fertility. According to them, there are three variables such as intercourse, conception, and gestation which should be considered as intermediate to the various other social, economic, cultural and environment factors influencing fertility.

8.4.2 Mortality

Mortality refers to the relative frequency of deaths in a population. The two different concepts which were used by demographers when referring to mortality, namely, the life span, which is the numerical age limit of human life and life expectancy, which is the average expected number of years of life to be lived by a particular population at a given time (*Kintner*, 2004). Each and every one of us has been born and will die. Death will not take place at the same time for everyone. Some of us will die earlier than others. Whereas death is a certainty, the length of time we live depends on many factors; over some of them we have no control, but over other factors we have lot of control. The impact of mortality varies significantly according to social and demographic characteristics. People who belong to higher social classes live longer as compare

to those belong to lower social classes. Married people live longer than single, separated, or divorced people (*Poston* and *Bouvier*, 2010). Death is considered as complex behaviour. There are literally thousand different ways to die. Some cause of death occurs frequently than others. It can be due to famine, war and diseases such as influenza, pneumonia, smallpox, tuberculosis, HIV/AIDS, cancer, diabetes and other related diseases. Mortality is heavily influenced by a person behaviour and lifestyles choices. Deaths in this stage are caused due to social pathologies, like alcoholism, accidents, suicide and homicide, even some lifestyle factors, such as smoking and diet. There are also some environmental and socio-economic forces that influenced mortality. These forces include climate, weather, standard of living, housing condition, population density, industrial development, sanitation, medical facilities, occupation, the frequency of travel by air and other means of transport and the pursuit of hazardous sports such as motor racing, and political condition, especially war.

8.4.3 Migration

Migration is defined as the movement of people from one place to another within the country or outside. Persons may be added to a population by moving into it or subtracted by moving away from it. Unlike birth and death which occur to each of us once and only once, migration may occur on several occasions, or we may never experience migration. Demographers distinguish between movers and migrants. Any person who changes residence, whether the change involves moving across the street is a mover. A migrant is a person whose residential move involves the crossing of political boundary. Movement usually involves changes in one's school, job, church, doctor, library, pub, shopping centre, automobile mechanic, and other institutional aspects of daily life. In contrast, with local movement, a permanent change in residence does not involve change in the main institutions in the mover's daily life (*Poston* and *Bouvier*, 2010).

Internal migration and international migration are the two main types of migration. The dynamics of the two kinds of migration differ significantly. The change of permanent residence within a country, involving a geographical move which crosses a political boundary is the internal migration. It can be in-migration, which refers to the residential migration of persons to an area of destination, and out migration, which refers to the migration of persons from an area of origin. However, International migration is the migration that occurs between countries. It could be immigration and emigration. Immigration is defined as the migration of people into a new country for the idea of establishing a permanent residence. This concept is analogous in the study of internal migration to in-migration. On the other hand, emigration denotes the permanent departure of people from a country and this concept is analogous to out migration in the study of internal migration.

Migration is a significant event not only for individuals but also for communities as well. Migration from one area to another has the effect of decreasing the size of the population in the area of origin and increasing in the area of destination. Considering the dynamics of the population growth for communities, migration is the single most important of the three demographic processes. Differences in birth rates and death rates between communities of the same country are generally small compare to the differences between the communities in

migration. Migration is the major method for re-distributing the population within the country (*Bogue*, 1969; *Poston* and *Frisbie*, 2005; *Poston et al.* 2006).

Check Your Progress

5) What are the two ways of studying fertility?

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6) Write down the difference between internal and international migration.

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8.5 SUMMARY

Anthropological demography is a specialized field of anthropology that offers a better understanding of demography using theories and methods of anthropological discipline. It has both the aspects of anthropology and demography wherein demography is specifically concerned with the dynamic forces which define population size, structure and their difference across time and space. Anthropology largely focuses on the dynamics of various population processes affecting different populations living under varied geographic and environmental conditions. The present unit studies several aspects of demography and discusses its close relationship with other disciplines of social sciences like Sociology, Economics, Human Ecology and Geography. National censuses, registration systems and surveys are the three basic sources of demographic data. Each one is an important source of data for demographic study. Demographic analysis requires data from all three sources. Lastly, three basic processes, fertility, mortality and migration that determine the changes in population size, composition or distribution have been discussed.

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8.7 ANSWERS TO CHECK YOUR PROGRESS

1) Anthropological demography is a specialty within demography which uses anthropological theory and methods to provide a better understanding of demographic phenomenon in current and past populations. For further details refer section 8.0

2) Demography studies different aspects of populations and shares close relationship with other branches of social sciences, i.e. Sociology, Economics, Human Ecology and Geography etc. For further details refer section 8.2.

3) According to United Nations (1958), a Nation Census is the total process of collecting, compiling, and publishing demographic, economic, and social pertaining at a specified time to all persons in a country or delimited territory. For further details refer section 8.3.1.

4) In De jure method, the census covers the entire territory of the country and counts persons according to their usual or normal place of residence in the country. De facto method also covers the entire territory of the country but

counts each person in the population according to his/her geographical location on the day of the census undertaking. For further details refer section 8.3.1.

5) There are two ways of studying fertility. Micro fertility analysis refers to the fertility of individual women (and man). Rather than studying the fertility of persons, macro fertility analysis studies the fertility of population. For further details refer section 8.4.1.

6) Internal migration is the change of permanent residence within a country, involving a geographical move that crosses a political boundary. International migration is migration that occurs between countries. For further details refer section 8.4.3.

UNIT 9   INDIAN DEMOGRAPHY*

Contents

Learning Objectives

After reading this Unit, you will be able to:

➢ Understand the concept and elements of demography;

➢ List factors affecting population dynamics;

➢ Define and calculate Fertility and Mortality Rates; and

➢ Explain and state types of migration.

9.0   INTRODUCTION

Demography is the systematic and scientific study of human populations. The term "Demography" has a Greek origin and is composed of two words, demos (people) and graphy (describe) which means "the description of people". Being

*Contributed by Dr. Ratika Samtani, Amity Institute of Anthropology, Noida, U.P.

a scientific study of human population, it broadly includes study of changes in population size, composition and its distribution. In other words, demography studies the structure and composition of the population, various trends and processes associated with population including – changes in population size; patterns of birth, death and migration across varying age groups. Demographic studies also focus on the process of counting or enumeration; which includes census or survey and the systematic collection of data on the people residing within a specified region.

Importance of Demographic data: Demographic data is any data that provides an understanding of population size, distribution, and composition (*Murdock* and *Ellis*, 1991). Moreover, it is vital for planning and implementation of policies, for better economic development and general public welfare. In addition, health status of a community also depends on the dynamic relationship between number of people, their composition and distribution. Demographic variables can assist in the planning of health related services and can deliver a basis for predicting future developments and making informed decisions for the formulation, implementation, and evaluation of plans, policies and programs for education, housing, health, employment and other forms of social services.

According to Bloom, the world experienced a dramatic population growth during the twentieth century, with the number of populations doubling from 3 to 6 billion between 1960 and 2000 (*Bloom*, 2011). India witnessed rapid population growth during this period from 448 million to 1.04 billion and to 1.21 billion in 2010 (*Bloom*, 2011). Global population grew at roughly 2% per annum from 1960-2000, a level that is unsustainable in the long term, as it translates into population doubling every 35 years. According to the latest statistics, India's population is currently growing at a rate of 1.4% per year, far surpassing China's rate of 0.7%. This may result in India surpassing China with respect to population size in less than 20 years (*Bloom*, 2011).

9.1 DEMOGRAPHY: DEFINITIONS AND CONCEPTS

Demography and Population studies: The study of human population is mainly known as Demography and Population studies. In many instances, these two terms are used interchangeably, but some scholars also try to distinguish between the two. Broadly speaking, Population studies are concerned with understanding what are the kinds of changes taking place in the size and nature of human populations. Demography refers to the hard core analysis of numbers while population studies look at the behavioral aspects affecting the reproductive behavior of people. Demographic determinants such as fertility, mortality and migration are the three basic aspects which influence the population of a particular place.

Most demographic concepts are expressed as rates or ratios and they involve two numbers.

9.1.1 Mortality Measures

Information about mortality or how deaths take place within a community is very important from the point of view of estimating the health of a community

and understanding how it will grow. If the death rate is more than the birth rate, the number of people (population) will decrease and the reverse trend shall be observed if the death rate is lower than the birth rate. Following is the list of measures commonly used for measuring mortality.

9.1.1.1 Crude Death Rate (CDR)

Crude death rate is the simplest and the most commonly used measure of mortality. It is defined as the ratio of the total deaths of a specified year to the total mid-year population, multiplied by 1000. It can be calculated as follows:

$$\text{Crude Death Rate} = \frac{\text{No. of death during the year in a given Geographic area}}{\text{Mid-Year population in the same year and same area}} \times 1000$$

(Source: MOSPI, 2015)

9.1.1.2 Infant Mortality Rate (IMR)

The deaths under one year of age are called infant deaths. The infant mortality rate is defined as the number of infant deaths occurring in a community within a specified calendar year per 1000 live births in the same community during the same calendar year (MOSPI, 2015).

$$\text{Infant Mortality Rate (IMR)} = \frac{\text{No. of deaths in age group 0-1 year after birth in a year}}{\text{Total number of live births in that year}} \times 1000$$

Check Your Progress

1) What does Infant Mortality mean?

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9.1.1.3 Maternal Mortality Rate (MMR)

The maternal mortality ratio is the number of women who die as a result of complications from pregnancy or childbearing in a given year per 100,000 live births in that year. This represents special case of sex-related mortality. It represents death cases of women who die during pregnancy and childbirth inclusive the first 42 days after the delivery (WHO, 1994).

In other words, the maternal mortality rate is defined as the number of female deaths due to puerperal causes among the residents of a community during a specified year per 100,000 live births.

$$\text{Maternal Mortality Rate (MMR)} = \frac{\text{Number of female deaths due to puerperal causes}}{\text{No. of Live births during same year}} \times 1000$$

9.1.2 Fertility Measures

Fertility refers to the ability of females to produce healthy offspring. The term fertility denotes the ability to reproduce by natural means. In demographic terms, fertility refers to the actual production of offspring. There are various important social, biological and economic factors that determine fertility such as age at marriage, duration of marriage, child survival, spacing of children, economic stability, educational status, cultural beliefs and practices.

The physical capacity of bearing a child is termed "Fecundity". Fecundity is the potential reproductive capacity of a female.

Some of the more common demographic measures used in relation to fertility and/ or fecundity are given below.

9.1.2.1 Crude Birth Rate (CBR)

It is defined as the number of live births that occur in a community per 1000 mid-year population of that community in a year (*Bhende & Kanitkar*, 2011). In other words, crude birth rate is the ratio between the specified number of people in a population over a given period of time and the number of live births that occur in a population over the same period of time (*Bhende & Kanitkar*, 2011). Most annual rates, such as the birth rate, relate demographic events to the population at midyear (July 1), which is considered to be the average population at risk of the event occurring during the year (NIHFW, 2014). The crude birth rate varies with social, economic, political, cultural, geographical and biological factors at a particular time in a country.

$$\text{Crude Birth Rate} = \frac{\text{Total No. of live births in a year}}{\text{Mid-Year Population}} \times 1000$$

9.1.2.2 General Fertility Rate (GFR)

It is the number of live births that occur in a country, in a giver year, per 1000 mid-year population of women in the childbearing age group of that country in that respective year (*Bhende & Kanitkar*, 2011). In other words, general fertility rate refers to the number of births per 1000 women (ages 15-49) in a given year. GFR includes all women of childbearing age, both married and unmarried.

9.1.2.3 Age-specific Fertility Rate

The Age specific fertility rate is defined as the number of births per year 1000 women of a specified age. Age specific fertility rates may be computed either for single years of age or for age intervals (MOSPI, 2015).

In other words, Age-specific fertility Rate refers to the number of live births that occur in a country to women in a particular age (a year or age group) per mid-year population of women of that age in that country in that particular year. e.g. females in the age group 20-24 years.

$$\text{General Fertility Rate (GFR)} = \frac{\text{No. of live births per year}}{\text{Mid-Year female population (ages 15-49)}} \times 1000$$

9.1.2.4 Total Fertility Rate (TFR)

The Total fertility rate estimates the average number of live births that a woman will have during her total reproductive span (*Bhende & Kanitkar*, 2011). In other words, the total number of children the average women in a population is likely to have based on current birth rates throughout her life defines the total fertility rate. The total fertility rate is the sum of age-specific fertility rates of a woman of a country per 1000 mid-year population of women in the reproductive age group of that country in that particular year. This is the best single measure to compare fertility across populations in a country.

$$\text{Age-specific Fertility Rate} = \frac{\text{No. of live births (Age-group)}}{\text{Mid-Year total female population in each age group}} \times 1000$$

9.1.2.5 Net Reproductive Rate (NRR)

The average number of daughters that would be born to a woman (or a group of women) during her lifetime if she passed through all her childbearing years conforming to the age-specific fertility rates and age-specific mortality rates of a given year. This is similar to the GRR except that it includes the effect of mortality that would cause some women to die before completing their childbearing years (NIHFW, 2014).

9.1.2.6 Gross Reproduction Rate (GRR)

The GRR is the average number of daughters that would be born to a woman (or group of women) during her lifetime if she passed through her childbearing years conforming to the age-specific fertility rates of a given year. The gross reproduction rate reflects the potential of women in a country to produce their own kinds, which is female giving birth to female (*Bhende & Kanitkar*, 2011). This rate is like the TFR except that it counts only daughters and literally measures "reproduction"— a woman reproducing herself by having a daughter (NIHFW, 2014). The gross reproduction rate highlights the importance of female in the fertility of a country and shows that the fertility process can be handed over from one cohort of female population to another. In order to obtain gross reproduction rate (GPR), first add the single year age-specific fertility rates (ASFR) on woman of a country that covers the entire 30 years' reproductive age span and then multiply the product by the new born sex ratio of the country. It can also be calculated by simply multiplying the total fertility rate (TFR) of the country by the new born sex ratio of the country (*Bhende & Kanitkar*, 2011).

9.1.3 Migration

This is the third important determinant of the total population of the place after births and deaths and so demographic study is also concerned with how and why people move from one place to another. Migration is either internal or international. The internal migrant is referred to as an in-migrant or an out-migrant and the person who crosses international borders an immigrant or emigrant depending on whether s/he is coming in or going out.

9.1.4 Sex Ratio

Sex ratio is the demographic term that is used to define the proportion of males to females in a given population. It is measured as the number of females per 1000 males in one calendar year. As per 2011 census, total Female Sex Ratio in India is 940 females per 1000 males (Census, 2011, Govt. of India).

Check Your Progress

3)   What do you understand by sex ratio?

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9.1.5 Population Pyramid (Age-Sex Structure)

Demographers typically use population pyramids to depict the age and sex structure of a population (*Wolf et al*, 2011). When the population of a particular region is arranged graphically according to age-groups and sex, we get a graph which resembles a pyramid. This population pyramid provides information about the composition of a particular society and its situation. Historically for most nations, particularly in those with persistently high fertility rates, they resemble a pyramid, with a wide base representing large numbers of younger age groups and more narrow bands near the top representing smaller numbers of older people near the end of their natural life span (*Wolf et al*, 2011). In a typical developed nation, where the birth rates have declined considerably long time ago and the life expectancy of the population is quite high, the population pyramid is in the shape of a column.

9.1.6 Life Expectancy

This is a measure of how many years a person is expected to survive in the prevalent situation. This measure can be calculated at any particular age, though the common practice is to refer to life expectancy at birth. In India this was not the case till very recently because despite staying at home women had to face much higher risks primarily related to maternal mortality.

9.1.7 Growth Rate

Crude death rate is subtracted from crude birth rate, the net residual is the current annual growth rate, exclusive of migration. Growth rate refers to the overall growth of the population and can be represented either annually or over a period of ten years. Population growth in India has been slowing in

recent decades from an annual growth rate of 2.5 per cent during 1971-81 to an estimated 1.3 per cent as of 2011-16 (Economic Survey, 2018-2019). All major states have witnessed a marked deceleration in population growth during this period. A key driver of this trend has been the steady decline in India's total fertility rate (TFR) since the mid-1980s (Economic Survey, 2018-2019). These developments suggest that India has entered the next stage of demographic transition with population growth set to slow markedly in the next two decades along with a significant increase in the share of working-age population (the so-called "demographic dividend" phase).

9.1.8 Population Projection

This is an estimation or forecasting of the population of a particular region at some point in the future which is crucial for planning and policy formulation. It involves computations depicting the future course of a population's size, its structure, and its interaction with dynamics such as fertility, mortality, and migration. The projection is constructed based on assumptions about the future course of those population dynamics (NIHFW, 2014). According to Economic Survey 2018-2019, India is set to witness a sharp slowdown in population growth in the next two decades. Although the country as a whole will enjoy the "demographic dividend" phase, some states will start transitioning to an ageing society by the 2030s (Economic Survey, 2018-2019).

9.2 INTRODUCTION TO DEMOGRAPHIC PROFILE OF INDIAN POPULATIONS–AN OVERVIEW

Considering the demographic profile of Indian population, the country has observed a drop in its population growth rate in the last four decades (1971-2011). Fertility rates have fallen by 2.7 per cent per annum (2.8 to 2.5) over the 2006-10 period— a faster decline than the decline of 1.6 per cent per annum (3.1 to 2.9) in the preceding five years (National Institute for Heath and Family Welfare. 2014). According to the Sample Registration System (SRS), 2012, it estimates that twenty one states and union territories (UTs) have achieved the replacement level of fertility, though fertility remains high in several states, highlighting different stages of demographic transition among the states, leading to difference in their timelines to achieve population stabilization (NIHFW, 2014). Seven states that have witnessed a high fertility rates are Bihar (3.6), Uttar Pradesh (UP) (3.4), Madhya Pradesh (MP) (3.1), Rajasthan (3.0), Jharkhand (2.9), Chhattisgarh (2.7), and Assam (2.4), of which six belong to the empowered action group (EAG1) states. All of the EAG states and Assam also collectively account for the highest number of births, as well as infant, under-five, and maternal deaths in the country, bringing a focus on poor maternal and child health (MCH) indicators and their correlations with high fertility rates. The main aim of the National Rural Health Mission (NRHM) is to reduce maternal and child mortality rate in the country, and the government is making strategic investments to improve the MCH indicators in the country having a specific focus on high-fertility states (NIHFW, 2014).

Outputs of Population Projections and Expected Levels of Achievement (ELAs): (From National Institute for Heath and Family Welfare, 2014).

Population trends

- India's population is likely to reach 1.381 billion in 2022. The country is likely to add 170 million persons during the next decade, which is about 10 million fewer people added compared to the last decadal increase (NIHFW, 2014).

- A rising trend in the contribution of EAG states' populations to the total population of the country (43.4% in 1991, 44.6% in 2001, and 46% in 2011) has been observed. The population share of eight EAG states and Assam is likely to increase from 46.05 per cent in 1991 to 49.70 per cent in 2022, and the population of the EAG states is likely to cross the combined population of all 26 non-EAG states/UTs between 2020 and 2022 (NIHFW, 2014).

- The projected per cent population in the 0–14 year age group shows a continuous decline over a period of time across all the states and India. The north Indian states have a window of opportunity to utilise the demographic dividend, as a large number of working people will enter into the job market. This group of people will also require access to Family Planning services and products in order address the unmet need for family planning (NIHFW, 2014).

- The slowest decline in Parity Progression Ratio (PPR) has been experienced in the states of Bihar and UP. The analysis emphasizes the significant impact of child mortality among women in all parity categories.

- More educated women tend to have a lower number of children ever born compared to less educated or uneducated women.

- Women, who experience physical violence, characterizing lower status in the house, depict higher fertility or children ever born.

- Increased use of contraception (51%) has been the major cause for fertility decline in India, followed by a pattern of delayed marriage (45%). As per the analysis, abortions show no impact, and a very low decline (3%) has been caused by postpartum infecund ability (NIHFW Report, 2014).

- Among the EAG states, delayed marriage has contributed to fertility decline the most in UP (42%) and the least in Rajasthan (23%).

- According to the NIHFW report, 2014; Variations in two major factors— marriage and contraception— are the primary proximate causes of fertility differences among EAG states. The analysis conducted to assess the magnitude of change caused due to the proximate determinants shows the use of contraception and delay in age at marriage as major contributing factors in fertility decline.

- Among the EAG states, the use of contraception has led to the decline in fertility levels mostly in the states of MP and Uttarakhand, while Bihar and UP have shown the lowest effect of contraception in explaining fertility decline.

- As per data from NFHS-2, abortion has not impacted fertility control, though there has been evidence that fertility in TN has been impacted by abortion.

- Among the EAG states, Postpartum insusceptibility ranged between 11 months in Rajasthan to about 14 months in Bihar and Jharkhand. The mean duration of breast feeding ranges from 7.4 months in TN and 13.3 months in Bihar and Jharkhand.

- Mean length of "sexual abstinence" is estimated at 5 months. AP, TN, and Odisha show the maximum impact of "postpartum insusceptibility" in comparison to the other states.

9.3 THEORIES ON DEMOGRAPHY

Malthusian Theory of Population Growth: The Malthusian theory of population growth is one of the most famous theories of demography and the Malthus's theory of population growth is outlined in his Essay on Population (1798). It was given by Thomas Robert Malthus who was an English cleric and scholar. According to Malthus, food increases in a slow arithmetical ratio, while man grows in geometrical ratio. In other words, while population tends to grow in geometric progression (i.e., like 2, 4, 8, 16, 32 etc.), the agricultural production can only grow in arithmetic progression (i.e., like 2, 3, 4, 5 etc.). Since population growth may invariably exceed growth in production of subsistence, unless prevented by powerful and obvious checks. Malthus alleged that famines and diseases kept a check to population growth which were inevitable as they were nature's way of dealing with the disparity between food supply and increasing population.

Demographic Transition Theory: It is a model that describes population change over time. It is based on an interpretation begun in 1929 by the American Demographer Warren Thompson, of the observed changes, or transitions, in birth and death rates in industrialized societies over the past two hundred years or so. It explains how the population of a particular region changes over a period of time with advances in the economic and social conditions. According to this theory, early agricultural life was categorized by high rates of birth and death with no consequent increase in the population. This was followed by the early growing phase, where due to advances in the field of health services and economic situation the death rates declined fast but the birth rates were still high. In the third phase which can be termed the late expanding phase- the birth rates declined. In the fourth or low stationary phase, birth rates and death rates are again equal to each other but both the figures are very low. In the fifth and final phase, the birth rates reduce even further while death rates have reached their lowest possible level and are more than the birth rate. Here the overall population starts declining.

9.4 SOURCES OF DEMOGRAPHIC DATA

In India, main sources of demographic data are:

- Population Census

- Civil Registration System

- Sample Registration System

- National Sample Survey

- Health Surveys, such as National Family Health Surveys (NFHS), District level Household Surveys (DLHS).

The Population Census, Civil Registration System and the Sample Registration System are organized and conducted by the office of the Registrar General, India; whereas the National Sample Surveys are being launched by the National Sample Survey Organization (NSSO). The National Family Health Survey and the district level health Survey are being conducted under the aegis of Ministry of Health & Family Welfare for evaluation of reproductive and child health programmes.

Population Census: The enumeration of the entire population of a country or a region at a particular time is known as a census. Usually census is conducted at definite intervals which in India occurs after every ten years. Information on every individual is separately recorded, and every effort is made to cover the entire territory. Census is the primary source of population data at the national or at the state level; the data which is thereby required for various administrative, planning and research purposes. The Registrar General is mainly responsible for census, registration of birth and deaths, and for conducting other relevant surveys. The census is conducted in accordance with the Census Act of India (1948).

Civil Registration System: Civil Registration System (CRS) in India is the unified process of continuous, permanent and compulsory recording of the vital events (births, deaths, still births) and characteristics thereof. The Registration of Births and Deaths Act, 1969 provides for the compulsory registration of births and deaths. For the country, the requirement of an effective Civil Registration System is a must as it has important administrative and statistical uses. The data generated through a complete and up-to-date CRS is essential for socio-economic planning and to evaluate the effectiveness of various social sector programmes. The data also serves as the corner stone of public health system by providing various vital statistics like Sex Ratio, Infant Mortality Rate, Still Birth Rate. Statistics derived henceforth help in targeted policy formation. (Presentation by Anil Sant, Joint Secretary and Addl. Registrar General, Office of the Registrar General, India available at https://getinthepicture.org/)

Sample Registration System (SRS): The SRS is a demographic survey for providing reliable annual estimates of infant mortality rate, birth rate, death rate and other fertility and mortality indicators at the national and sub-national levels. Initiated on a pilot basis by the Registrar General of India in a few states in 1964-65, it became fully operational during 1969-70. The field investigation consists of continuous enumeration of births and deaths in selected sample units by resident part-time enumerators, generally Anganwadi workers and teachers; and an independent retrospective survey every six months by SRS supervisors.

National Sample Survey: The National Sample Survey (NSS) which came into existence in the year 1950, is a multi-subject integrated continuing sample survey programme launched for collection of data on the various aspects of the national economy required by different agencies of the Government, both Central and States (NSSO, 2001). The wide variety of subjects brought under the coverage of surveys conducted so far by the NSS can broadly be classified

under four categories: (1) Household surveys on socio-economic subjects, (2) Surveys on land holding, livestock and agriculture, (3) Establishment surveys, and enterprise surveys (4) Village surveys (NSSO, 2001).

Under the first category come the surveys on population, birth, death, migration, fertility, family planning, morbidity, disability, employment & unemployment, agriculture and rural labor, household consumer expenditure, debt, and investment, savings, construction, capital formation, housing condition and utilization of public services in health, education etc. Under the second are covered the surveys on land holding, land utilization, livestock number, product and livestock enterprises. Surveys on medium and small industrial establishments and own-account enterprises not covered by the Annual Survey of Industries (ASI), surveys on other non-agricultural enterprises in the unorganized sector and collection of rural retail prices from markets and shops in rural areas belong to the third category. Finally, the collection from sample villages of various types of information on the availability of infrastructure facility in Indian villages constitute the fourth (NSSO, 2001).

Health Surveys: The first National Family Health Survey (NFHS) was conducted in 1992-93. The primary objective of the survey was to provide data on fertility, mortality, morbidity, nuptiality, family size preferences, knowledge and practice of family planning, the potential demand for family planning services, the level of unwanted fertility, utilization of antenatal care services, breastfeeding/and food supplementation practices, child nutrition and health immunization and infant and child mortality. Ministry of Health and Family Welfare, Govt. of India, had selected the International Institute for Population Sciences, Mumbai, as the nodal agency for the conduct of surveys. The survey covers a number of questions pertaining to topics such as reproductive health, women's autonomy, domestic violence, women's nutrition, anemia and salt iodization, Obesity among men and women, knowledge, attitude and behavior with regard to HIV/AIDS and its prevalence, questions on several emerging issues such as perinatal mortality, involvement of men in maternal health care, adolescent reproductive health, sexual behavior, family education etc.

9.5   NATIONAL POPULATION POLICY OF INDIA

The overriding objective of economic and social development is to improve the quality of lives that people lead, to enhance their well-being, and to provide them with opportunities and choices to become productive assets in a society.

The National Population Policy, 2000 (NPP 2000) affirms the commitment of government towards voluntary and informed choice and consent of citizens while availing of reproductive health care services, and continuation of the target free approach in administering family planning services. The NPP 2000 provides a policy framework for advancing goals and prioritizing strategies during the next decade, to meet the reproductive and child health needs of the people of India, and to achieve net replacement levels (TFR) by 2010. It is based upon the need to simultaneously address issues of child survival, maternal health, and contraception, while increasing outreach and coverage of a comprehensive package of reproductive and child health services by government, industry and the voluntary non-government sector, working in partnership.

The objective of the NPP 2000 is to address the unmet needs for contraception, health care infrastructure, and health personnel, and to provide integrated service delivery for basic reproductive and child health care. The long-term objective is to achieve a stable population by 2045, at a level consistent with the requirements of sustainable economic growth, social development, and environmental protection.

9.6   SUMMARY

Demography is the systematic, scientific and methodical study of human populations. Because demography is interested in changes in human populations, demographers focus on specific indicators of change. Two of the most important indicators are birth and death rates, which are also referred to as fertility and mortality. Additionally, demographers are interested in migration trends or the movement of people from one location to another. While India's population growth has slowed remarkably over the last few years, it's still growing faster than China and is expected to surpass China in population by 2028. Population growth in India has been slowing in recent decades from an annual growth rate of 2.5 per cent during 1971-81 to an estimated 1.3 per cent as of 2011-16 (Economic Survey, 2018-2019). India has also entered the next stage of demographic transition with population growth set to slow markedly in the next two decades along with a significant increase in the share of working-age population (the so-called "demographic dividend" phase).

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9.8 ANSWERS TO CHECK YOUR PROGRESS

1) The number of deaths per 1000 live births of children under 1 year of age in one calendar year.

2) The Maternal Mortality Rate (MMR) is the annual number of female deaths per 100,000 live births from any cause related to or aggravated by pregnancy or it management (excluding accidental or incidental causes). For its calculation, the number of deaths due to infant birth is divided by the total number of infant births.

3) Number of females per 1000 males in one calendar year.

UNIT 10   INBREEDING AND CONSANGUINITY*

Contents

Learning Objectives

After reading this Unit, you will be able to:

➢ Understand consanguineous marriages and inbreeding;

➢ Describe the degree of biological relationship;

➢ Elucidate the biological consequences of inbreeding; and

➢ Identify the prevalence of inbreeding in Indian population.

10.0 INTRODUCTION

In demographic studies, mating has a significant role in shaping the genetic structure of a population. Marriage in the Indian context shows a considerable variation among the different ethnic groups. Marriage between closely related individuals 'consanguineous marriage' is one of the common types of marriages practiced in India since ancient times. Here, closely related individuals mean sharing of common ancestors. India has a diverse culture; such type of marriage is observed very frequent in some communities, whereas it is considered taboo in some other communities. The consanguineous marriage is deeply rooted in the beliefs and socio-cultural norms of the society.

There are different forms of consanguineous marriages which are classified based on the magnitude of relationships. For example, a marriage between father and daughter, mother and son, brother and sister are considered highly

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*Contributed by Dr. Huidrom Suraj Singh, Department of Anthropology, Manipur University, Imphal.

consanguineous and incestuous marriage as it took place within the direct descendants. Moreover, there are other types of consanguineous marriages such as first-cousins marriage, second cousin marriage and uncle-niece marriage practiced in human societies. Among the different types of consanguineous marriage, cousin marriage is the most common type found with appreciable frequencies in India.

The term inbreeding is defined as the mating of individuals who have one or more biological ancestors in common. It means mating between genetically related individuals. The progeny of consanguineous parents is, by definition 'inbreed.' Inbreeding is the outcome of Consanguineous marriages. The term consanguineous is more qualitative and often used in anthropology and social sciences in terms of describing marriage patterns. It describes the relationship of individuals through marriages. However, it is also used in studying human population genetics for its significant contribution in shaping the genetic structure of a population. On the other hand, inbreeding is more quantitative and often use in clinical genetics, describing the degree of biological relationship and consanguinity between the parents and their offspring. Inbreeding is departures from random mating and genetic consequences of consanguineous marriages.

Marriage

George Peter Murdock (1949) defined marriage is a universal institution that involves residential co-habitation, economic co-operation, and the formation of the nuclear family. It is a union between a man and a woman such that the children born to the woman are recognised as legitimate offspring of both partners (Notes and Queries on Anthropology 1951: 111)

Consanguinity increases the degree of inbreeding. In other words, inbreeding is considered to be the genetic consequence of consanguineous marriage. It has shown adverse outcomes on reproductive history, morbidity, and mortality in infancy. Moreover, it also has shown significant impacts on physical and mental disadvantages among the childhood and adulthood periods.

In the present unit, we shall try to understand the basic concept of consanguinity and inbreeding. We shall also discuss the biological consequences of inbreeding and prevalence of inbreeding in different Indian populations.

10.1 CONSANGUINITY

10.1.1 Definition of Consanguineous Marriages

The term consanguineous is originated from the Latin word 'consanguineous' meaning 'of the same blood'. It is defined as the biological relationship of individuals characterized by the sharing of common ancestors. Therefore, we can say that two individuals are consanguineous if they have at least one common ancestor. In simple words, consanguineous marriage is those marriages that take place between closely related individuals. We are all human beings to some extent, consanguineous as we are descended from a common ancestor. The consanguineous marriage is practiced in different societies at different degrees. The custom of consanguineous marriages in India could be traced back to several centuries (*Rao et al.*, 1975). In some societies, consanguineous

marriages have been encouraged, for example, in Egyptians and Incas favoured unions of brothers and sisters of the reigning dynasty to maintain 'royal blood' in the family. In India, consanguineous marriages are practiced by different communities. However, reasons for practicing such marriages are varied from one community to the other. It is generally associated with the strengthening of family ties and socio-economic purposes. Moreover, it is also practiced to maintain the purity of blood in the royal family members.
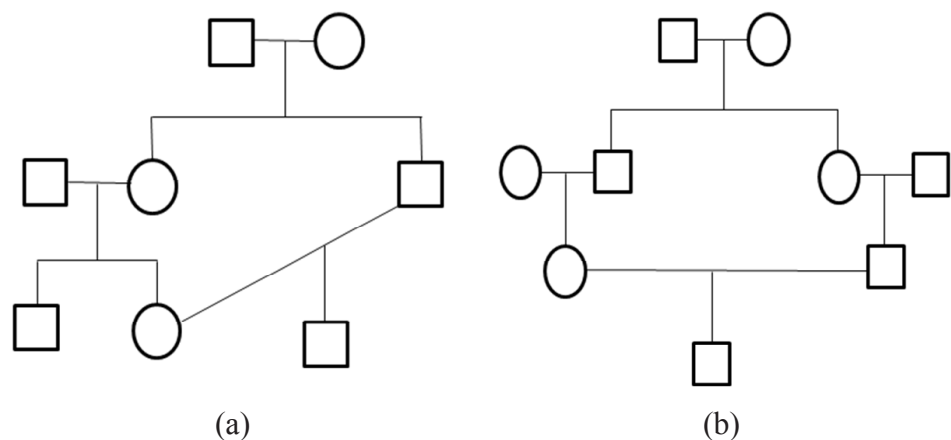
10.1.2 Types of Consanguineous Marriages

Consanguineous marriages are of different types, which can be categorised based on biological relationships. Such relationships can be expressed in terms of degrees. Marriage between an individual with parents (mother or father) or with full sibs (brother or sister) is called first-degree relationship. Such type of biological relationship such as father with daughter, mother with son, and sister with brother is generally considered as incest taboo by most of the societies.

Incest Taboo

The term "incest taboo" is derived from a combination of two words 'incest' meaning the sexual relationship between biologically close relations (parents and children or between siblings) and 'taboo' meaning prohibition. In anthropology, taboo implies the avoidance of a specific behaviour or social action for fear or beliefs of harm by supernatural power. Hence, according to the anthropological point of view, the term 'incest taboo' refers to a cultural prohibition of sexual relations. Such sexual relationships between close blood relations are universal of cultural taboo. Claude Levi Strauss, one of the great French anthropologists, argued that incest taboo in human societies should be prohibited.

The biological relationship between an individual and his or her sib's offspring is called second-degree relationship. It is represented by uncle-niece marriage (Figure 10.1 a). Such a relationship could be in between brother with brother's daughter, brother with sister's daughter, sister with sister's son, and sister with brother's son. The other form of consanguineous marriage is between the first cousins, and it forms the third degree of biological relationship (Figure10.1b). It is followed by different levels of relationships such as fourth degree (second cousin, Figure10.1c), fifth-degree, and so on.
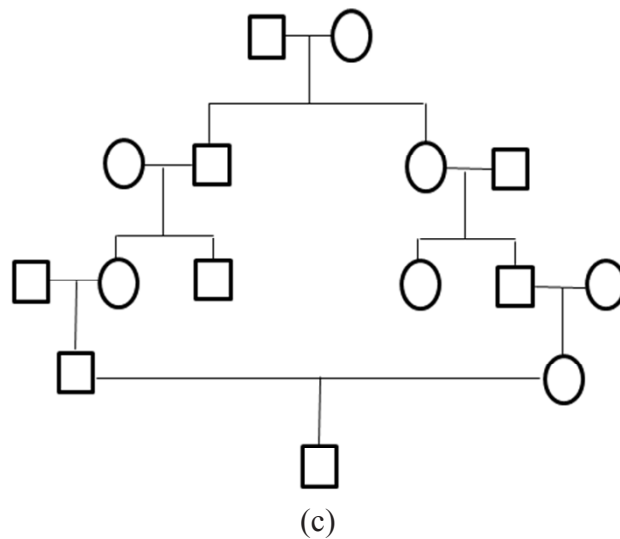

(a)   (b)

(c)

Fig. 10.1: Different forms of consanguineous marriage (a) Uncle-niece marriage; (b) First cousin marriage; (c) Second cousin marriage

In case of third-degree relationship i.e. first-cousin marriage, there are four possible types of marriages of a person such as to father's brother's daughter (FBD), to father's sister's daughter (FSD), to mother's brother's daughter (MBD) and to mother's sister daughter (MSD). The FSD and MBD are called cross-cousin marriages whereas the FBD and MSD are known as parallel cousin marriages (Bittles, 2002).

Check Your Progress

1) What do you mean by consanguineous marriage? Discuss its effects on the genetic structure of a population.

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2) How degrees of biological relationships are measured?

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10.2 INBREEDING

10.2.1 Definition

The term inbreeding is defined as the production of offspring as a result of a mating between closely related individuals. Closely related individuals are those individuals who are having common biological ancestors. Therefore, the progeny of consanguineous parents is, by definition, inbred. Inbreeding is the genetical outcome of consanguineous marriage. In most societies, marriage regulates mating pattern, and consanguineous marriage leads to inbreeding. Inbreeding increases the degree of homozygosity to the offspring and also the expression of recessive traits.

10.2.2 Inbreeding Coefficient

The genetic relationship of individuals can be measured or quantified by using standardized mathematical formulae. In general, the genetic relationships can be measured by two basic measures, such as the coefficient of relationship (r) and coefficient of inbreeding (F). The term 'coefficient of relationship' was introduced by Sewall Wright in 1922. It measures the degree of consanguinity between two individuals. In other words, it is the proportion of genes identical by descent, which is shared by two individuals. It is calculated by using the following formula:

$$r = \{(1/2)^n\}$$

Where n is the number of steps apart between two individuals through their common ancestor. For example, the coefficient of relationship (r) of two individuals (A and B) who are related as first cousins can be calculated as follows:

$$r = \{(1/2)^4 + (1/2)^4\}$$

$$= 1/8$$

Since the total number of steps (n) from A to the other person B through their common ancestors is 4 as both A and B share two common grandparents.

Example of Finding the number of Steps 'n'
Path I =   A ------- Father ------ Grandfather ------ Aunt (Fathers' sister) ------ B
(through grandfather) Step 1   Step 2   Step 3   Step 4
Path II =   A ------- Father ------ Grandmother ----- Aunt (Fathers' sister) ------ B
(through grandmother) Step 1   Step 2   Step 3   Step 4

The coefficient of inbreeding (F) is defined as the proportion of gene at which an individual of consanguineous mating is homozygous by descent. Generally, it is calculated by using the following formula:

$$F = \sum (1/2)^n (1+F_A)$$

Where $\sum$ is the sum of all paths in the relationships through common ancestor; n is the number of individuals in the relationship path connecting the parents of the individual; F_A is the inbreeding coefficient of ancestors.

Generally, the coefficient of inbreeding (F) is half of the coefficient of relationship (r). For example, the coefficient of relationship of incestuous relationship (such as in between father-daughter, mother-son, or brother-sister) shares half of their genetic materials (r=0.5). Therefore, any siblings of such incestuous parents would be homozygous at 1/4 of gene loci (F=0.25). In the case of uncle-niece marriage, both the parents share 1/4 of their genetic components, and hence, the coefficient of relationship (r) is 0.25. On the other hand, the coefficient of inbreeding in their progeny will be half of the coefficient of relationship (r) i.e., F=0.125. Measure of relationship of individuals in terms of consanguinity that is coefficient of relationship and coefficient of inbreeding of different levels of degrees are shown in table 10.1.

Table 10.1: Relationship of individuals in terms of Consanguinity

Biological Relationship	Genetic Relationship	Coefficient of relationship (r)	Coefficient of inbreeding (F)
Incest	1st Degree	0.5	0.25
Uncle-niece	2nd Degree	0.25	0.125
First cousin	3rd Degree	0.125	0.0625
First cousin once removed	4th Degree	0.0625	0.0313
Second cousin	5th Degree	0.0313	0.0156
Second cousin once removed	6th Degree	0.0156	0.0078
Third cousin	7th Degree	0.0078	0.0039

(Source: Adapted from Vogel and Motulsky's Human Genetics, 2010)

10.3 BIOLOGICAL CONSEQUENCES OF INBREEDING

Inbreeding is associated with both favourable and unfavourable biological consequences. Studies have reported that consanguineous mating have reduced the rate of intrauterine mortality and also lowered the rates of incompatibility between the mother and foetus. Studies have also shown positive correlation between fertility and consanguineous mating. On the other hand, consanguineous mating also has many adverse health outcomes. Inbreeding has increased the rate of homogeneity among the population, which results in the expression of various deleterious recessive traits. There are numerous examples of recessive traits expressed among the offspring of consanguineously married parents. Some of the common examples of recessive traits expressed among the newborn babies of consanguineous parents are hydrocephalus, albinism, six-fingered dwarfism, tay-sachs, alkaptonuria, cleft lip, and cystic fibrosis. The burden of genetic disorders increase particularly among those societies where consanguineous marriages are culturally accepted. In general, it is a consensus that the progeny of consanguineous parents has a higher rate of postnatal mortality and morbidity. Different studies have also demonstrated a significant positive association between consanguinity and early mortality (*Fareed et al.*, 2017).

Inbred offspring have a higher chance of carrying double dose of a gene inherited from the consanguineously married couple. Carrying of such double dose increases the frequency of recessive trait, which required two copies of allele to express, in the population. Closely related individuals have a higher chance of carrying the same allele than less closely related individuals. Consanguineous children are more frequently homozygous for various alleles than the children of non-consanguineous parents. Children of consanguineously married parents experience several genetic disorders. Consanguinity has social significance in some of the population. However, it has some side effects on the individual as particular and the population as a whole from genetic points of view.

10.3.1   Theoretical Consequences

Short-term and Long-Term effects: Effects of inbreeding in a population as a result of continuous practice of consanguineous marriages can be of short-term effect, or it can be long-term effect. In the short-term effect, inbreeding increases frequency of homozygosity in the population, and simultaneously, decreases in heterozygosity. Presence of homozygous genotypes enables the expression of recessive traits that were dominated by the dominant allele. Expression of such recessive traits, if deleterious in character, then inbreeding will result in decreasing fitness level. Moreover, inbreeding will also increase in both genetic and phenotypic variability within a population. However, the frequency of recessive homozygous trait will be decreased when the above population continued to practice consanguineous marriage over a period of generations at a constant rate. For example, if the homozygous genotype is deleterious then it will cause premature death before attaining reproductive age. Therefore, the expression of deleterious traits might be lost from the population due to the process of selection. Hence, continuous inbreeding in a population over a long period of generations reduces the frequency of deleterious alleles as a result of long-term effects.

Genetic load: Genetic load is defined as the measure of the extent to which the average fitness of a population is decreased. In other words, genetic load measures the rate of damage caused by the presence of certain deleterious genes in the population. According to Crow (1958), genetic load is the relative decrease in the average fitness of a population if all individuals in that population had the genotype that has the maximum fitness. It also measures the total number of disadvantageous genes present in a particular population. The genetic load may be caused by different factors that are based on the types of load that decrease the average fitness of the population. Some of the important types of load includes mutational load (caused by the presence of deleterious mutation in the population); segregation load (caused by the segregation of homozygotes over the heterozygote); recombination load (caused by breakup of favourable gene through recombination); drift load (it is caused by increasing unfavourable allele frequency in small population); and migration load (caused by adaptation to new environment by immigrants).

The deleterious or disadvantage gene reduces the fitness level of the population by causing morbidity, mortality, and sterility. It could happen in two ways, such as may be in heterozygote condition (when the deleterious gene is dominant in character) and in homozygous condition (when the deleterious gene is recessive in character).

10.3.2 Studies on Inbreeding Effects in India

In India, various studies have been conducted to understand the effects of inbreeding on consanguineous offspring. Studies have reported that there is a significant decrease in anthropometric variables (birth weight, length, head circumference) and gestational period of newborn babies of the consanguineously married couple than non-consanguineous union (*Badruddoza*, 1998). The mean birth weight, length, head circumference, and gestational period of the babies born to consanguineous couples were significantly lower than non-consanguineous offspring. Congenital birth defects have also been diagnosed among the inbred offspring. Inbreeding increases the mortality rate and serious

congenital disabilities, particularly among the incestuous progeny. In most of the consanguineous marriages, the women were reported to be very young and hence become mothers at a very young age group. It results in gynaecological immaturity and affected both mother and children. Inbreeding may also lead to decline in reproductive and survival rates as a result of increase in expression of rare homozygous recessive traits. Such a condition is known as inbreeding depression. It is also evident that there is increase in numbers of miscarriages or stillbirths among inbred mothers (*Bittles*, 2001). Studies have also reported that postnatal mortality and infant mortality (early first year) is common among the offspring of consanguineously married couples than the mortality in non-consanguineous union (*Hussain et al*. 2001). It could be possibly due to the expression of deleterious recessive genetic traits. Moreover, the infant mortality rate is reported to be highest among the consanguineous offspring, particularly in developing countries.

Cognitive impairment is another typical example of child morbidity among the consanguineous offspring (*Fareed* and *Afzal*, 2014). Moreover, such consanguineous children are also found to have low IQ levels, and intellectual and development disability (IDDs) while comparing with non-consanguineous children (*Durkin et al*., 1998). Some of the effects and autosomal recessive disorders commonly observed among the consanguineous offspring are shown in the following table 10.2.

Table 10.2: Studies on biological consequences of Inbreeding in India

Author, Year	Population/ State	Associated Disease/Effect	Brief Description of the Disease/Effect
Basu, 1975; Basu and Roy, 1972	North Indian Muslims	Fertility and Mortality	Fertility rate was higher among the consanguineous marriage than non-consanguineous; with highest mortality rate (below 21 years) among first cousins' consanguineous marriage
Kulkami et al., 1989; Jain et al., 1993	Andhra Pradesh; Pondicherry	Neural tube defects; Congenital development disorders	It is a severe form of congenital disabilities of the brain and spine which happen in the early stage of pregnancy
Verma et al., 1992	Pondicherry	Miscarriage	It is the loss of the foetus before attaining the 20th week of pregnancy. Generally, it happens in the first three months of pregnancy
Jain et al., 1993	Pondicherry	Mental retardation	It is an intellectual disability disorder characterized by a delay in cognitive development

Jain et al., 1993; Badruddoza et al., 1994; Gnanalingham et al., 1999	Pondicherry; Qureshi (Aligarh); Andhra Pradesh	Congenital heart defects	It is a problem in the structure of the heart at the time of birth. Congenital heart defects are the most common type of birth defects
Rahi et al., 1995	9 States (Gujarat, Madhya Pradesh, Haryana, Uttar Pradesh, West Bengal, Maharashtra, Karnataka, Kerala and Tamil Nadu)	Early-onset of retinal dystrophies	It is characterized by severe congenital night blindness
Chen et al., 1997	Madras (Chennai), Tamil Nadu	Autosomal recessive hearing loss / deafness (DFNB)	It is very common and accounts for approximately 80% of all congenital deafness. It is the result of a genetic mutation that is inherited from both the mother and the father
Homby et al., 2001	Andhra Pradesh	Anophthalmos	A rare congenital anomaly characterized by the complete absence of one or both eyes
Panicker et al., 2002	Hyderabad, Andhra Pradesh	Primary congenital glaucoma (PCG)	It is characterized by abnormal development of the eye's aqueous outflow system, which leads to elevation of intraocular pressure. It can lead to childhood blindness if untreated

Sometimes, it is difficult to understand the influence of inbreeding on fertility and mortality since they are also dependent on non-genetic factors, such as maternal age and birth interval. There are several non-genetic variables that influence it. The prevalence rates of genetic disorders among the progeny of consanguineous parents in India are unrepresentative of the actual affected cases because there is paucity of state-level data for all the types of genetic disorders, particularly from rural populations. Moreover, there is paucity of literature on the possible effect of consanguinity on adult-onset of diseases in

India. There are some preliminary literature reporting increased risk of breast cancer and premature coronary heart diseases are more prevalent among the inbred adults. In brief, inbreeding has become one of the strong predictors of the onset of different genetic disorders in both infant and adult populations.

Check Your Progress

3)   Briefly enumerate the biological consequences of inbreeding.

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10.4 PREVALENCE OF INBREEDING IN INDIAN POPULATION

10.4.1 Geographical Variation

Consanguineous marriages are practiced in different forms to a greater or lesser extent among most of the religious and ethnic groups living in India (*Sanghvi*, 1966). Inbreeding, the genetical consequences of consanguineous marriage is prevalent in most of the states at different degrees. The rate of consanguineous marriages varies on various factors such as geographical location, religion, caste, tribe, language, socio-economic status, education, culturally isolated, and population size (*Basu*, 1975; *Rao*, 1984). According to NFHS (2015), fourteen percent of marriages in India are consanguineous marriages, which are more common in all of the southern states except Kerala. The people of Kerala practice strict avoidance of consanguineous marriage. The highest frequencies of inbreeding population as a result of consanguineous marriage are reported from south India. About one-third of women in Tamil Nadu, Lakshadweep, Andhra Pradesh, and Telangana reported being in consanguineous marriages. Pondicherry records the highest level of consanguineous marriage (uncle-niece) in a single generation, with 54.9% (*Puri et al*., 1978). They have a long tradition customary of the first-cousin union that is between a man and his maternal uncle's daughter (*Sastri* 1976). In simple words, it is the mating between a man and his mother's brother's daughter. One of the primary reasons for high rates of consanguineous marriages in south India is a means of ensures the maintenance of their property. It is a common belief that marriage between known and close relatives will helps in strengthening the family ties socially and economically. Moreover, consanguineous marriage is also practiced in order to minimise the dowry in some societies.

There is a wide variation in inbreeding levels within the northern and southern states in India. The consanguineous marriage is preferential among the South Indian population whereas it is prohibited in most of the North Indian population. According to NFHS 4 (2015-16), Tamil Nadu and Lakshadweep record the highest level of inbreeding, reaching up to 33% in India. Arcot district of Tamil Nadu practices the highest frequency of consanguineous marriage in the state.
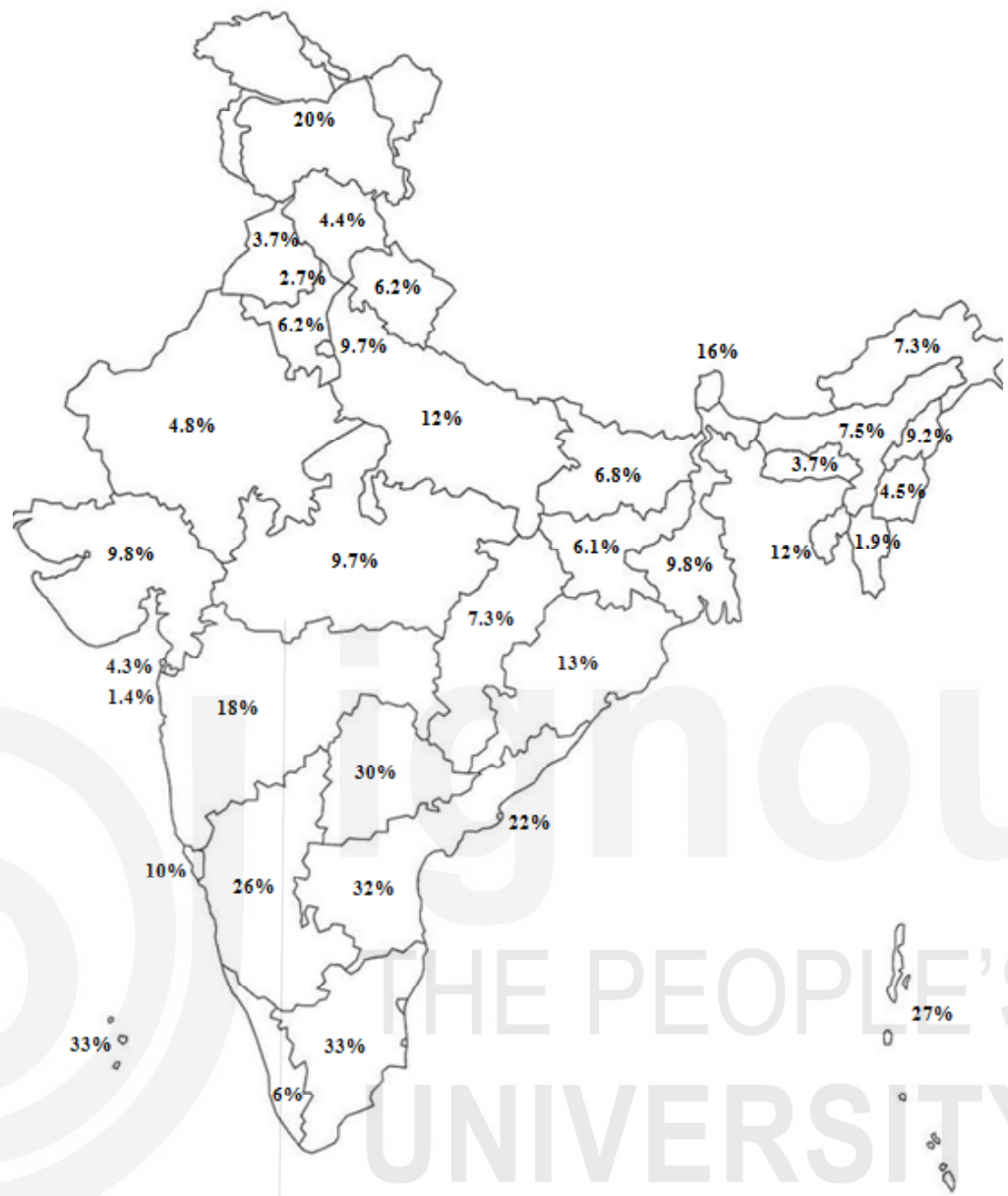
Fig. 10.2: Map of India showing frequency distribution of consanguineous marriage practices in different states of India

(Source: adapted from NFHS-4, 2015-16)

The rate of inbreeding decreases when we move from southern states to northern states. Most of the northern states of India record up to 10-12% of inbreeding except Jammu and Kashmir, which reach up to 20% (before separation into union territory in the year 2019). The least frequency of inbreeding in India is recorded from Dadra & Nagar Haveli in western India whereas, Mizoram in the eastern side with only 1.4% and 1.9%, respectively. The rates of consanguineous marriages practice in different states of India are shown in Figure 10.2. Among the different forms of consanguineous marriages, the uncle-niece marriage is most common in south India. Uncle-niece marriages are practiced in high proportions, particularly in the coastal areas of southern India. When we look into the levels of ethnic group, the Dravidian have the highest frequency of consanguinity when compared with other ethnic groups that is the Indo-Aryan, Indo Scythain, and Mongoloid ethnic groups (*Saheb* and *Bhanu*, 1984).

10.4.2 Social and Religious Variation

The types of consanguineous marriage practiced by the different religious groups were found to vary. In terms of religious affiliations, Christians showed the lowest rates of inbreeding as there is a strict restriction in close-kin marriage in Christianity. And, the highest rate was recorded among the Muslim population. The frequency of inbreeding is reported to be high among the Asna Ashariya, Shiekh Sunni, Dawoodi Bohra, and Muslims of Delhi and West Bengal (*Basu* and *Roy*, 1972; *Basu*, 1975; *Rizvi* and *Buzarbarua*, 1993). The inbreeding coefficient among Hindus in Tamil Nadu is as high as that found in Andhra Pradesh. In Madhya Pradesh, the Muslim community practices the highest rate of consanguineous marriage, and it is comparatively low among the Hindus (*Goswami*, 1970).
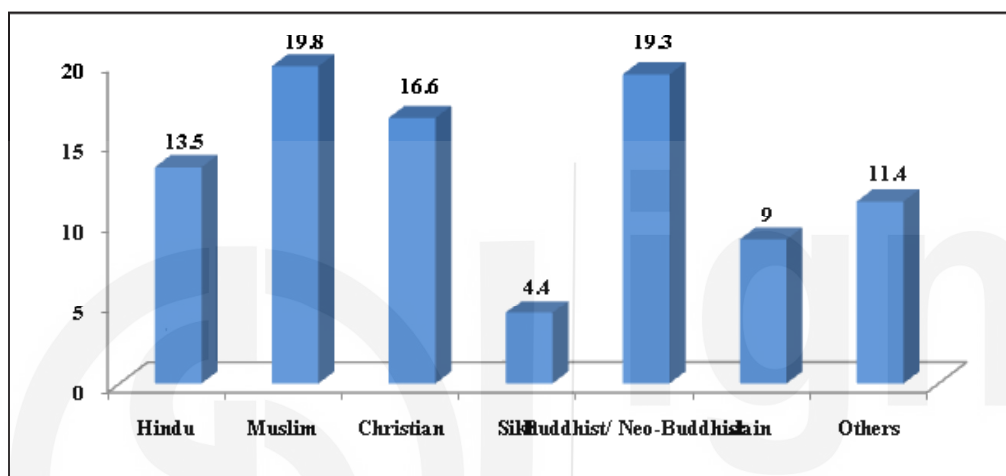

Fig. 10.3: Distribution of consanguineous marriage practices among the different religious groups of India
(Source: adapted from NFHS-4, 2015-16)

According to the NFHS 4 (2015-16), the Muslims (19.8%) and Budhist (19.3%) are found to have the highest rate of consanguineous marriage than the other religious groups. Christians and Hindus also represent high frequencies of consanguineous marriage with 16.6% and 13.5%, respectively. The lowest incidence of consanguineous marriage among the major religious groups is represented by Sikh (4.4%). The remaining small religious groups in India constitute 11.4% altogether (Figure 10.3). Using words 'major' and 'small' religious groups are classified truly based on the size of the population compared to the whole Indian population. And, the scheduled castes, Harijans, and Christians are in intermediate between the Muslims and Hindus (*Goswami*, 1970).

Regarding different categories of the Indian population, the rate of consanguineous marriage is observed to be highest among the other backward class (15.1%). It is followed by scheduled caste (14.6%) and schedule tribe population (13.5%). Scheduled tribes have moderate inbreeding levels in general. But, the tribal population of north-east India shows meagre inbreeding rates compare to other parts of India. The 'others' category of the population which are not included in schedule caste, scheduled tribe, and other backward class comprises of 12.8% who practices consanguineous marriage.
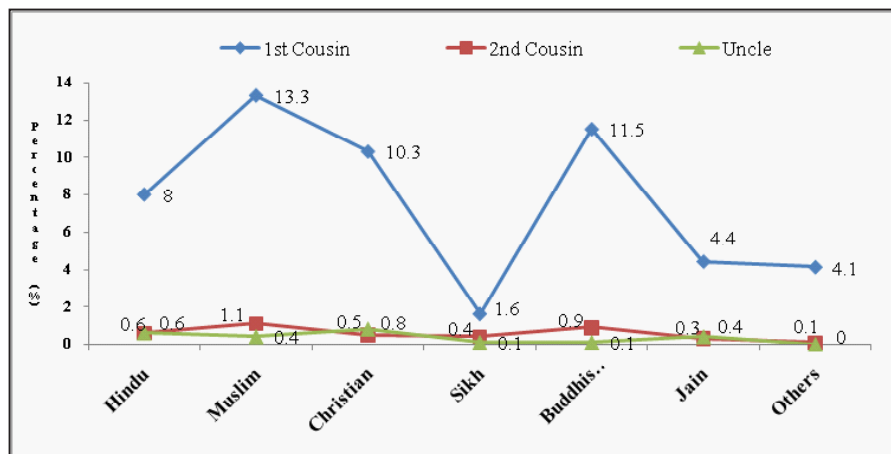
**Fig. 10.4: Distribution of types of consanguineous marriages practice by
different religious groups of India**

(Source: adapted from NFHS-4, 2015-16)

When we talk about the practice of various types of consanguineous marriages in India, in general, three types of consanguineous marriages were reported, such as first-cousin, second-cousin, and uncle-niece. The most common type of consanguineous marriage was marriages to first cousins. The first cousin marriage is practiced by most of the religious groups of India. It is highest among the Muslims (13.3%) followed by Budhist (11.5%), Christian (10.3%) and Hindus (8%). The most preferred form of first cross-cousin marriage is maternal uncle's daughter. The majority of the Hindus practice matrilateral cross-cousin marriage, whereas other types of first-cousin were frequent among the other religious groups. For example, Irula of Tamil Nadu has practiced high frequencies of first cross-cousin marriage (43.98%). The different four types of first-cousin union such as to father's brother's daughter (FBD), to father's sister's daughter (FSD), to mother's brother's daughter (MBD) and to mother's sister daughter (MSD) are observed among the Muslim communities (*Bittles*, 2002). The other types of consanguineous marriages, such as second cousin and, uncle-niece are practiced in fewer frequencies irrespective of religion (Figure 10.4). Concerning to different categories of class, other backward class population shows the highest prevalence (9.6%) when compared with scheduled caste (8.8%) and scheduled tribe categories (7.4%) for first-cousin form of consanguineous marriage in India.

Check Your Progress

4) Name the state(s) that practice the highest frequency of consanguineous marriage in India?

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10.5 SUMMARY

Consanguineous marriage is practiced in India since ancient times. Such marriage is deeply rooted in the beliefs and customs of the society. The prevalence of consanguineous marriage is observed very frequent in some communities,

particularly in South India. Inbreeding is the biological consequences of consanguineous mating. Inbreeding increases the degree of homozygosity and expression of recessive traits. It is evident that consanguineous marriage has genetical disadvantages besides its social and economic benefits. It affects the innocent offspring in particular and the whole community in general.

The control and management of the consequences of inbreeding depends on the identification of the variants in the genome that are causally linked with the disease. However, assessment of biological consequences of inbreeding in terms of morbidity and mortality is still facing lots of problems in our country. It is a challenging mission as the majority of the Indian population are under low socio-economic status, less educated, and appropriate diagnostic facilities are not available in most of the states. Moreover, people could not afford the expenses for diagnosis even if they have the facilities. Therefore, it is an urgent need for counselling for consanguineous parents before family planning, early diagnosis, and proper treatment to decrease the biological consequences. The rate of consanguineous marriage in India could be decreased at some extent by improving educational status as well as improving socio-economic status. It could also be achieved through making awareness at community levels and also developing community education programme.

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10.7 ANSWERS TO CHECK YOUR PROGRESS

1) Consanguineous marriage is defined as those marriages which take place between closely related individuals. Such individuals are those who are biologically related and shared their common ancestors. Practicing of consanguineous marriage over a period of time will increase the rate of homozygosity in the population. This will further result into expression of deleterious recessive traits. Moreover, consanguinity will also increase in both genetic and phenotypic homogeneity within a population.

2) The degree of genetic relationship can be measured or quantified by using standardized mathematical formulae. In general, the degree of genetic relationships can be measured by two basic measures such as the coefficient of relationship (r) and coefficient of inbreeding (F).

3) It is evident from various studies that inbreeding results in unfavourable biological consequences to the newborn babies. Most of the consanguineous offspring have been diagnosed with congenital birth defects. It also increases the mortality rate and many other severe birth defects. The chances of miscarriage increase among inbred mothers. It is also evident that postnatal mortality and infant mortality are quite frequent among the offspring of consanguineously married couples than in non-consanguineous union.

4) The highest rates of inbreeding as a result of practicing consanguineous marriage is particularly concentrated in South India. According to the NFHS-4, Tamil Nadu and Lakshadweep record the highest level of inbreeding, reaching up to 33% in India. Arcot district of Tamil Nadu practices the highest frequency of consanguineous marriage in the state.