Chapter-IV

Conceptual Framework and Methodology of the Study

4. Conceptual Framework: The conceptual framework of the study is developed on the basis of different studies on different aspects of health, as outlined in Chapter-3, and keeping in mind the requirements and objectives of the present study. It is combined with the methodology of the study to make it context specific. The present section deals with conceptual framework which is followed by methodology of the study.

4.1 What is Health: Health is a common theme in most cultures. In fact all communities have their concept of health, as part of their culture. Among definitions still used, probably the oldest is that health is the “absence of disease”. In some cultures, health and harmony are considered equivalent, harmony being defined as “being at peace with self, the community, god and cosmos”. The ancient Indians and Greeks shared this concept and attributed disease to disturbances in bodily equilibrium of what they called “humours”. (K. Park 2007).

Health is a fundamental human right and a worldwide social goal. Health is necessary for the realization of basic human needs and to attain the status of a better quality of life. In 1977, the 30th World Health Assembly decided that the main social target of governments and World Health Organization (WHO) in the coming decades should be " the attainment by all the citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life" (WHO 1979).

Such a declaration has led most of the governments in western countries to give much more priority to their health care systems through higher allocation and better utilization of resources in order to improve the quality of health care. Less developed countries are in the process of
improving it and some among them are yet to start. India also has been attempting towards this end. The major hindrances on its way could be attributed to inadequate allocation of resources for the health sector, rapid population growth, inefficient use of the resources allocated and above all lack of public consciousness about their own health status. Health being a State subject in the Indian federal system, different states in the country has been trying to meet the WHO health goal through mobilization of both internal and external resources including the funds from foreign agencies. However, the achievement of the goal of "health for all" for the state is perhaps still a distant dream.

4.1.1 Definition of health

Different professional groups define the concept of health in different ways. Medical professionals define health in terms of illness, which, in turn is expressed in terms of mental or physical disorders. This concept of health is predominantly based on pathology and is concerned with the presence or absence of disease and the stage of its invasiveness. Some others define illness through giving emphasis to the amount of pain suffered or the degree to which individuals are restricted in undertaking their normal day to day activities. For some, the maintenance of health is also linked to social aspects such as unemployment and wealth. The broadest definition of health appears to accept anything and everything that can affect health status. The most widely accepted definition of health is given by World Health Organization (WHO 1948), quoted in FRCH (1987), which is as follows:

"Health is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity".

4.1.2 Dimensions of health
Health is multidimensional. The WHO definition envisages three specific dimensions - the physical, the mental and the social. Many more may be cited, viz. spiritual, emotional, vocational and political dimensions. As the knowledge base grows, the list may be expanding. The broad dimensions are:

1. **Physical dimension of health:**
   The physical dimension of health is probably the easiest to understand. The state of physical health implies the notion of “perfect functioning” of the body. It conceptualizes health biologically as a state in which every cell and every organ is functioning at optimum capacity and in perfect harmony with the rest of the body.

2. **Mental dimension:**
   Mental health is not merely absence of mental illness. More recently, mental health has been defined as “a state of balance between the individual and the surrounding world, a state of harmony between oneself and others, coexistence between the realities of the self and that of other people and that of the environment”.

3. **Social dimension:**
   Social well-being implies harmony and integration within the individual, between each individual and other member of society and between individuals and the world in which they live. It has been defined as the “quantity and quality of an individual’s interpersonal ties and the extent of involvement with the community”.

### 4.2 Determinants of Health

According to WHO Health is multi-factorial. The factors which influence health lie both within the individual and externally in the society in which he or she lives. It is a truism to say that what man is and to what diseases he may fall victim depends on a combination of two sets of factors-
his genetic factors and the environmental factors to which he is exposed. These factors interact and these interactions may be health promoting or deleterious. Thus conceptually, the health of individuals and whole communities may be considered to be the result of many interactions among:

1. Individuals
2. Families
3. Societies
4. Communities
5. Biological
6. Behavioural
7. Environmental
8. Socio-economic
9. Health system
10. Socio-cultural
11. Aging of the population
12. Science and technology
13. Information and communication
14. Gender
15. Equity and social justice
16. Human rights

4.2.1 Health indicators

Indicators of health are required not only to measure the health status of a community, but also to compare the health status of one country with that of another; for assessment of health care
needs; for allocation of scarce resources; and for monitoring and evaluation of health services, activities and programmes. Indicators help to measure the extent to which the objectives and targets of a programme are being attained.

Health is multidimensional, and each dimension is influenced by numerous factors, some known and many unknown. This means we must measure health multi-dimensionally. Thus the subject of health measurement is a complicated one even for professionals. Our understanding of health therefore cannot be in terms of single indicator; it must be conceived in terms of a profile, employing many indicators, according to WHO, which may be classified as:

1. Mortality indicators
2. Morbidity indicators
3. Disability rates
4. Nutritional status indicators
5. Health care delivery indicators
6. Utilization rates
7. Indicators of social and mental health
8. Environmental indicators
9. Socio-economic indicators
10. Health policy indicators
11. Indicators of quality of life
12. Other indicators

1. Mortality indicators

(a) **Crude death rate:** This is considered a fair indicator of the comparative health of the people. It is defined as the number of deaths per 1000 population per year in a given
community. It indicates the rate at which people are dying. Though health cannot be measured by the number of deaths that occur in a community. But in many countries, the crude death rate is the only available indicator of health.

(b) Expectation of life: life expectancy at birth is “the average number of years that will be lived by those born alive into a population if the current age-specific mortality rates persist”.

Life expectancy is a good indicator of socioeconomic development in general. As an indicator of long-term survival, it can be considered as a positive health indicator. It has been adopted as a global health indicator.

(c) Infant mortality rate: Infant mortality rate is the ratio of deaths under 1 year of age in a given year to the total number of live births in the same year; usually expressed as rate per 1000 live births. It is one of the most universally accepted indicators of health status not only of infants, but also of whole population and of the socio-economic condition under which they live.

(d) Child mortality rate: Another indicator related to the overall health status is the early childhood (1-4 years) mortality rate. It is defined as the number of deaths at ages 1-4 years in a given year, per 1000 children in that age group at the mid-point of the year concerned. It is thus excluded infant mortality.

(e) Maternal mortality rate: maternal mortality accounts for the greatest proportion of deaths among women of reproductive age in most of the developing world, there are enormous variations in maternal mortality rate according to country’s level of socio-economic status.
(f) **Disease specific mortality:** mortality rate can be computed for specific diseases. As countries begin to extricate themselves from the burden of communicable diseases, a number of other indicators such as deaths from cancer, cardiovascular diseases, accidents, diabetes, etc. have emerged as measures of specific disease problems. 

Mortality indicators represent the traditional measures of health status. Even today they are probably the most often used indirect indicators of health.

2. **Morbidity indicators:** To describe health in terms of mortality rates only is misleading. This is because; mortality indicators do not reveal the burden of ill-health in a community. Therefore morbidity indicators are used to supplement mortality data to describe the health status of a population.

The following morbidity rates are used for assessing ill health in the community

(a) Incidence and prevalence

(b) Notification rates

(c) Attendance rates at out-patient departments, health centres etc.

(d) Admission, readmission and discharge rates

(e) Duration of stay in hospital and

(f) Spells of sickness or absence from work or school

A number of factors are associated with morbidity and disability, including physical/medical conditions, health behaviours and lifestyle, demographic and economic factors such as education and income, and psychosocial and cultural determinants.

3. **Disability rates:** Disability rates related to illness and injury have come into use to supplement mortality and morbidity indicators. The commonly used disability rates fall into two groups (a) event type indicators and (b) person type indicators
(a) Event type indicators:

(I) Number of days of restricted activity
(II) Bed disability days
(III) Work loss or school loss days within a specified period

4. Nutritional status indicators: Nutritional status is a positive health indicator. Following nutritional status indicators is considered as important indicators of health status which are anthropometric measurements e.g., weight and height, mid-arm circumference

5. Health care delivery indicators

The frequently used indicators of health care delivery are:

a. Doctor-population ratio
b. Doctor-nurse ratio
c. Population-bed ratio
d. Population per health/sub-centre
e. Population per traditional birth attendant

These indicators reflect the equity of distribution of health resources in different parts of the country, and of the provision of health care.

6. Utilization rates: In order to obtain additional information on health status, the extent of use of health services is often investigated. Utilization of services-or actual coverage- is expressed as the proportion of people in need of a service who actually receive it in a given period, usually a year. It is argued that utilization rates give some indication of the care needed by a population, and therefore, the health status of the population.

7. Indicators of social and mental health: As long as valid positive indicators of social and mental health are scarce, it is necessary to use indirect measures, viz. indicators of social and
mental pathology. These include suicide, homicide, other acts of violence and other crime; road traffic accidents, juvenile delinquency; alcohol and drug abuse; smoking; consumption of tranquilizers; obesity etc. These social indicators provide a guide to social action for improving the health of the people.

8. **Environmental indicators:** Environmental indicators reflect the quality of physical and biological environment in which diseases occur and in which the people live. They include indicators relating to pollution of air and water, radiation, solid wastes, noise, exposure to toxic substances in food or drink. Among these, the most useful indicators are those measuring the proportion of population having access to safe water and sanitation facilities.

9. **Socio-economic indicators:** These indicators do not directly measure health. Nevertheless, they are of great importance in the interpretation of the indicators of health care. These include:
   a. Rate of population increase
   b. Per capita GNP
   c. Level of unemployment
   d. Dependency ratio
   e. Literacy rates, especially female literacy rates
   f. Family size
   g. Housing: the number of persons per room
   h. Per capita “calorie” availability

10. The single most important indicator of political commitment is “allocation of adequate resources”. The relevant indicators are: (i) proportion of GNP spent on health services (ii)
proportion of GNP spent on health related activities (iii) proportion of total health resources devoted to primary health care.

11. Indicators of quality of life: Life expectancy as an indicator of health is no longer considered adequate, especially in developed countries, and attention has shifted more toward concern about the quality of life enjoyed by individuals and communities. The physical quality of life index is one composite index which consolidates three indicators viz. Infant mortality, life expectancy at age one, and literacy.


4.3 Health Income Nexus: The Correlates

There may be different correlates of Health. For example, education can improve health status of people. On the other hand, health may also improve education of people by increasing a person’s ability to continue education. However, the existing literature suggests that income and health are the most important correlates among the others. Income is related to health. When those who are in poverty are compared to those who are wealthy, we find higher rates of disease, ill health and mortality, both across and within nations among the poor (Feinstein 1993; Lynch, Kaplan et al. 1997; Lin, Rogot et al. 2003). The link between income and a range of health outcomes appears intuitively obvious and has been the subject of so many investigations that it hardly merits another. Many studies on the relationship between income and health, with a few notable exceptions (e.g. (McDonough and Berglund 2003; Contoyannis, Jones et al. 2004; Jones and Wildman 2008)) are cross sectional (Martikainen, Adda et al. 2003; Molarius, Berglund et al.)
2007) or, if longitudinal, use only one income measure (Salas 2002; Buckley, Denton et al. 2004)). The problem with cross sectional surveys, or cross sectional analyses of longitudinal data, is that this does not shed light on the causal nature of the relationship between income and health. The first issue to overcome, in determining whether income is truly related to health, is to determine the direction of the relationship. Lower income could lead to poorer health (social causation) or poorer health could lead to lower incomes (health selection). The social causation hypothesis appears to be the dominant pathway for mental health (Chandola, Bartley et al. 2003; Orpana, Lemyre et al. 2009) but for other health outcomes, the direction of effect could go either way.

The existence of a strong positive correlation between health and economic resources is well documented. However, the direction of causation remains an open issue. One possibility is that economic resources affect health (Ettner [1996], Smith [1999]); individuals with more wealth can afford better medical care, live in healthier environments, and so on. Another is that health affects economic resources. Healthier individuals may be able to work more than those who are ill, enabling them to accumulate more wealth (McClellan [1998], Levy [2000], Wu [2003]). Finally, third factors may determine both health and economic resources. For example, individuals with a low rate of time preference may undertake investments in human capital that enhance future earnings as well as engage in behaviors that improve future health (Barsky et al. [1997]). As Attanasio and Hoynes [2000] note, the nature of this relationship is central to economists’ understanding of life cycle wealth accumulation, and to the interpretation of cohort based age-wealth profiles. Further, it is directly relevant to the public policy debate over health care. In particular, it is widely assumed that there is a causal link running from wealth to health, and that, as a consequence, the key to improving health status is to transfer income to the poor.
For example, in a report on a conference on income inequality and health entitled “Dollars Count More Than Doctors,” Lefkowitz [2000] argues that “small differences in socioeconomic status matter to health. In other words, there are significant gains to be made with relatively moderate spending.” However, in light of the possible endogeneity of wealth, such inferences based on the correlation between changes in wealth and changes in health are not compelling. Establishing a causal link requires an appropriate instrumental variables strategy and this has not been done. Lefkowitz proposes to deal with endogeneity by using inheritance as an instrumental variable for changes in wealth. Receipt of an inheritance is clearly correlated with the change in an individual’s wealth, but is plausibly unrelated to changes in his or her health, conditional on initial health status.

A critical issue in examining the relationship between economic resources and health status is how to measure economic resources. A number of studies have used income, and virtually all find that health improves with income, ceteris paribus. (See, for example, Ettner[1996], McDonough, et al. [1997], Meara [2001]). Income data have the advantage of being relatively easy to obtain, but for some purposes, wealth is a superior measure of economic resources. As Smith and Kington [1997] note, “income in a single year may not adequately measure the financial resources available to an individual over the lifetime in which decisions affecting health are made.” McDonough et al [1997], Feinstein [1993], and Smith [1999] similarly argue for the superiority of a wealth measure of economic capacity. Feinstein [1993] suggests that “the problem of reverse causality is less likely to afflict household wealth than household income measures, primarily because wealth accumulates over time and hence is less affected by a single episode of sickness.” Two caveats apply to this comment. First, as noted by Feinstein, very serious negative health shocks could result in a decline in wealth. Indeed, Levy [2000] finds that
the number of nights spent in a hospital is negatively correlated with changes in wealth for those individuals who do not have health insurance. Second, the relationship between wealth and health could still be driven by third factors, such as childhood environment, genetics, or the like. As noted above, researchers in this area are well aware of the possibility that economic resources and health status may be simultaneously determined. However, not much has been done to deal with this problem econometrically. One careful attempt, by Ettner[1996], examines the relationship between health and income in an ordered probit instrumental variables framework. Among the instruments she uses for an individual’s income are the state unemployment rate, work experience, parental education, and spousal characteristics. She finds that the effect of income on health remains significant and even increases after instrumentation. Of course, the instrumental variables results are dependent on the assumption that the instruments can be excluded from the main regression, and as Ettner notes, there may be some problems in this regard. The state unemployment rate is driven by regional variation, and so is a valid instrument only if the well known regional variations in health are due solely to differences in income. Parental education is plausibly related to early human capital investments in health. Spousal characteristics may reflect assortative mating, and so may be directly related to health. And work experience is generally a function of age and education, each of which arguably may directly influence health. Hurd, McFadden, and Merrill [1997] also analyze the causal relationship between health and wealth. They use data from the Asset and Health Dynamics among the Oldest-Old (AHEAD) study, and focus on Granger-causality between measures of socioeconomic status and health. They find that self reported health status (SRHS) in 1993 is correlated with changes in wealth between 1993 and 1995, but that changes in health conditions,
conditional on SRHS, are not correlated with changes in wealth. They also find that measures of
socioeconomic status in 1993 are correlated with mortality rates between 1993 and 1995.

4.4 Nutrition and Health

4.4.1 Definition of Nutrition

Nutrition may be defined as the science of food and its relationship to health. It is concerned
primarily with the part played by nutrients in body growth, development and maintenance. The
word Nutrient or “food factor” is used for specific dietary constituents such as proteins, vitamins
and minerals. Dietetics is the practical application of the principle of nutrition; it includes the
planning of meals for the well and sick. Good nutrition means “maintaining a nutritional status
that enables us to grow well and enjoy good health”.

The terms malnutrition and under-nutrition are often used interchangeably but in reality the two
terms are not equivalent. According to Swaminathan,M. (1977) malnutrition can arise not only
from inadequate intakes of food but from intakes of improper and unbalanced diets as well. In
other words it is a concept that describes situations of insufficient quantity and quality of food
intake. Under- nutrition on the other hand defines a pathological state arising from an intake of
an inadequate amount of food and hence of calories, over a considerable period of time with
reduced body weight as its principal manifestation. Implicit in this definition is the notion that
the chief cause of under-nutrition is the inadequate intake of calories.

4.4.2 Requirement of Nutrition for health

The science of human nutrition is mainly concerned with defining the nutritional requirements
for the promotion, protection and maintenance of health in all groups of the population. Such
knowledge is necessary in order to assess the nutritional adequacy of diets for growth of infants,
children and adolescents, and for maintenance of health in adults of both sexes. The most widely used term to define the amount of nutrient needed by the body is “recommended daily intake” or allowance (RDA).

The term “recommended daily intake” or allowance (RDA) “is defined as the amounts of nutrient sufficient for the maintenance of health in nearly all people”.

4.4.3 Energy (nutritional) requirement of adults:

The energy requirement of an individual might be defined as that level of energy intake in relation to expenditure which is least likely to result in obesity or heart disease or which is most likely to prolong active life.

**Table-4.1: Recommended daily intake of energy (WHO: 1995)**

<table>
<thead>
<tr>
<th>Adults</th>
<th>Category</th>
<th>Body Weight In kg</th>
<th>Energy allowance per day(kcals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref Males</td>
<td>Light work</td>
<td>60</td>
<td>2425</td>
</tr>
<tr>
<td></td>
<td>Moderate work</td>
<td></td>
<td>2875</td>
</tr>
<tr>
<td></td>
<td>Heavy work</td>
<td></td>
<td>3800</td>
</tr>
<tr>
<td>Ref Females</td>
<td>Light work</td>
<td>50</td>
<td>1875</td>
</tr>
<tr>
<td></td>
<td>Moderate work</td>
<td></td>
<td>2225</td>
</tr>
<tr>
<td></td>
<td>Heavy work</td>
<td></td>
<td>2925</td>
</tr>
</tbody>
</table>

The energy requirement decreases with age because of a fall in BMR and a decrease in physical activity in most persons. In general, there is a 2 percent decline of resting metabolism for each decade for adults. The FAO/WHO committee suggested that after the age of 40 years, requirements should be reduced by 5 per cent per each decade until the age of 60, and by 10 percent for each decade thereafter.
In normal individuals at all ages and of both sexes, there is a large variation in energy intake but the reasons for this wide range of nutritional requirements are not known. The concept of nutritional individuality needs to be stressed, and its neglect may result in the overfeeding of some whose needs happen to be less than the “average standard requirement”.

4.4.4 Anthropometry

Anthropometric measurement such as height, weight, skinfold thickness and arm circumference are valuable indicators of nutritional status. If anthropometric measurements are recorded over a period of time, they reflect the patterns of growth and development, and how individuals deviate from the average at various ages in body size, build and nutritional status.

The use of anthropometry as an indicator of nutritional and health status of adults has now been well established (World Health Organization, 1995). The body mass index (BMI) is an indicator of overall adiposity and low BMI and high levels of undernutrition (based on BMI) is a major public health problem especially among rural under privileged adults of developing countries (World Health Organization, 1995). Although adult nutritional status can be evaluated in many ways, the BMI is most widely used because its use is inexpensive, non-invasive and suitable for large-scale surveys (Lohman et al., 1988; Ferro-Luzzi et al., 1992; James et al., 1994). Thus, BMI is the most established anthropometric indicator used for assessment of adult nutrition status (Lee and Nieman, 2003). BMI is generally considered a good indicator of not only the nutritional status but also the socio-economic condition of a population, especially adult populations of developing countries (Ferro-Luzzi et al., 1992; Shetty and James, 1994; Nube et al., 1998; Khongsdier, 2002). A BMI < 18.5 kg/m2 is widely used as a practical measure of chronic energy deficiency (CED), i.e., a ‘steady’ underweight in which an individual is in energy balance irrespective of a loss in body weight or body energy stores (Khongsdier, 2005). Such a
‘steady’ under weight is likely to be associated with morbidity or other physiological and functional impairments (James et al., 1988; Shetty and James, 1994; World Health Organization, 1995).

Another anthropometric measure that can be used to evaluate adult nutritional status is mid upper arm circumference (MUAC). It has been shown that MUAC is particularly effective in the determination of malnutrition among adults in developing countries (James et al., 1994). It has been noted that MUAC is a simpler measure than BMI requiring a minimum of equipment and in practice has now been found to predict morbidity and mortality as accurately as deficits in weight (Breind et al, 1989). James et al. (1994) after an extensive study of 8 countries (Mali, India, Senegal, Zimbabwe, Somalia, Ethiopia, Papua New Guinea and China) suggested that MUAC could be used for simple screening of nutritional state. BMI was computed using the following standard equation: BMI = Weight (kg) / height (m2) Nutritional status was evaluated using internationally accepted World Health Organization BMI guidelines (World Health Organization, 1995). The following cut-off points were used:

<table>
<thead>
<tr>
<th>BMI value</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;18.5</td>
<td>Acute malnutrition</td>
</tr>
<tr>
<td>18.5-19.99</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>20-25</td>
<td>Normal</td>
</tr>
<tr>
<td>25.001-29</td>
<td>Overweight</td>
</tr>
<tr>
<td>30&gt;</td>
<td>Obesity</td>
</tr>
</tbody>
</table>

WHO: 1995

The World Health Organization’s classification (World Health Organization, 1995) of the public health problem of low BMI, based on adult populations worldwide, was followed.
Nutritional status was also evaluated following the internationally accepted standard sex specific cut-off point (James et al., 1994). The following was used:

Undernutrition: MUAC < 22.0 cm

Normal: MUAC ≥ 22.0 cm.

**Table-4.3: Nutritional Status of the Respondents based on MUAC**

<table>
<thead>
<tr>
<th>MUAC</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUAC&lt; 22 cm</td>
<td>Under nutrition</td>
</tr>
<tr>
<td>MUAC≥ 22 cm</td>
<td>Normal</td>
</tr>
</tbody>
</table>

WHO: 1995

In the backdrop of this conceptual framework, the present study is designed to study the health status of a select group of people in North Tripura, Tripura – a tiny state in the eastern corner of India. The methodology followed for the study, with objectives in focus, is discussed below.

**4.5 Methodology:**

The present study seeks to examine the health status of individuals and also to explore relationship between health status and socio-economic and other circumstances of the individuals. As such the units of study in the present study are adult individuals who are the earning members of the households. The health status of individuals is measured with the help of recognized indicators such as BMI, Bicep circumference etc. The list of proximate determinants of health identifies for study is based on extensive review of literature. Chapter-2 on review of literature and the preceding section on conceptual framework corroborate the fact that although education, economic resources, wealth etc are important correlates of health; there are justifications of considering income alone as the possible correlate of health. The present study, therefore, examines the case of health and income as correlates.
4.5.1. Data: The study is based on primary data. Data for the purpose is collected with the help of a pre-tested structured questionnaire from sample individuals through personal interview method. The structured questionnaire is prepared for obtaining information from sample units on his/her physical characteristics such as height, weight, record of illness, income, education, individual habits, household background characteristics, access to health care facilities, sanitation, potable water, factors on which his/her income depends etc.

4.5.2. Sample: The sample comprises of 350 individuals who are the earning members of households belonging to age-group 19-55 years, drawn from rural and urban areas- 200 from rural and 150 from urban areas. The sampling technique followed for the purpose is stratified random sampling where strata represent people belonging to different occupations- formal, informal sector, rural-urban areas etc.- categories. The survey is conducted in the rural-urban areas of the North Tripura District which is one of the most backward developing regions of the state of Tripura. Attempts have been made to make the sample a representative one by including people belonging to different caste, religion, rural-urban areas.

4.5.3 Data Analysis Techniques: Simple statistical methods, graphs, diagrams, tables are used for sample data analysis purpose. Further, to meet the objectives and hypothesis of the study Regression analysis, Two Stage Least Square method, Logistic regression methods are applied.

4.6 The Variables and Models:
The field survey schedule contains information about the health status of the respondents and their income, household assets, education level, personal habits and household background characteristics etc. On the basis of the conceptual frame work of the study and an extensive review of literature, some variables are identified and estimated as indicators of respondent’s
health. These variables are arrayed against a large number of variables which are considered as possible determinants of health. The possible interdependence between health and income of the respondent is also examined by constructing suitable model with the help of selected variables pertaining to which information are available in the survey schedule.

The selected list of variables, both the health indicators, their correlates and determinants, are defined below:

**Variables Defined**

**Dependent Variables:**

1. DCIR = Daily Calorie Intake of the Respondent. Here calorie consumption from different food items of the respondent is recorded on one day recall basis during survey.

2. BMI= Respondent’s BMI= Body Mass Index of the respondent calculated by the formula= Weight in Kg/ height (in Meter$^2$). BMI≤ 18.5, (Underweight), BMI=18.5-24.9 (Normal) and BMI≥ 25(overweight or obese) is categorised according to the standard categorisation by the WHO.

3. MDB= Frequency of Morbidity= Morbidity of the respondent has been recorded by asking the respondents about the diseases suffering from during the last year from the day of survey i.e., whether they were suffering from chronic diseases or seasonal diseases. 1 if frequency of illness is chronic, 0 otherwise.

4. IAHSR= Investigator Assessed Health Status of the Respondent= Here health status of the respondents has been assessed by the investigator at the time of interview and made independent comment like good or bad by observing the present health condition
enjoyed by the respondent, without asking anything to the respondent about their health.
1 if good, 0 otherwise.

5. RAMI = Respondent’s Average Monthly Income = Average monthly income of the
respondent’s from all the sources in Rupees.

**Independent Variables:**

1. RAMI = Respondent’s average monthly income = Average monthly income of the
respondent’s from all the sources in Rupees.

2. HSA = Households size of assets = Size of household asset value is expressed in money
terms (Rs) by taking all the asset values found under the disposal of the respondent
during survey like land value, livestock values, value of building, and other durable
goods.

3. HDR = Household Dependency Ratio = It is calculated by following the formula:

   \[
   \text{HDR} = \frac{\text{number of persons who are under 14 years} + \text{number of persons who are above 65 years}}{\text{number of persons between 14 years and 64 years}}
   \]

   The persons represent members of the surveyed families.

4. AR = Age of the respondents in Years at the time of survey.

5. EDLR = Education level completed of the Respondent in years at the time of survey

6. SEX = Sex of the respondents, Male or Female. 1 if Male, 0 otherwise.

7. RIS = Respondents income source, whether the respondent is salary earner or earning by
other way like farming, labour and driving, etc. 1 if salary, 0 otherwise.

8. ROCCU = Main occupation of the household. During selection of the main occupation of
the household it was kept in mind that the main occupation should be that one from
which the maximum earning comes. 1 if in Service, 0 otherwise.
9. RESI = Respondents place of residence. This means whether the respondent is from rural or urban areas of the district of the study. 1 if in Urban areas, 0 otherwise.

10. ST = Respondent’s Caste is ST. 1 if ST, 0 otherwise.

11. RELH = Respondent’s Religion is Hindu. 1 if Hindu, 0 otherwise.

12. MS = Respondent’s Marital Status. 1 if married, 0 otherwise.

13. AFI = Average monthly family income in Rs.

14. RMME = Respondents monthly medical expenditure

15. PCSFAUR = Per capita square feet area under roof in house of the respondent

16. Working hours = It is recorded as number of hours the respondents works per day.

17. Leisure hours = It is recorded as number of hours in a day the respondent enjoys as leisure hours. = (24 hours – working hours).

18. Respondents working condition = It is defined as whether the job of the respondent is permanent or temporary? If permanent 1; 0 otherwise.

19. Nature of respondents job = whether the job of the respondent is hazardous or not is defined on the basis of working hours, leisure hours, surroundings of the place of work and status of the job in the society etc. 1 if found hazardous; 0 otherwise.

20. HAIMOD = Respondents Households amenities index (constructed)

21. DHI = Respondents Destructive Habits index (constructed)

With these variables, the following Models are constructed for data analysis purpose.

**Model-1: Calorie based Analysis of Health- Multiple Regression Equation**

\[ DCIR = \alpha + \beta_1 \text{RAMI} + \beta_2 \text{HSA} + \beta_3 \text{HDR} + \beta_4 \text{AR} + \beta_5 \text{EDLR} + \beta_6 \text{SEX} + \beta_7 \text{RIS} + \beta_8 \text{ST} + \beta_9 \text{RESI} + \beta_{10} \text{AFI} + \beta_{11} \text{RMME} + \beta_{12} \text{PCSFAUR} + \beta_{13} \text{DHI} + \beta_{14} \text{RELH} + u_i \]
Model -2: Simultaneous Equation Model of Health and Income

(a) Income Regression Equation:

\[ \text{RAMI} = \alpha + \beta_1 \text{HSA} + \beta_2 \text{AR} + \beta_3 \text{EDLR} + \beta_4 \text{SEX} + \beta_5 \text{RIS} + \beta_6 \text{HAIMOD} + \beta_7 \text{MS} + \beta_8 \text{DCIR} + u_i \]

(b) Health Regression Equation:

\[ \text{DCIR} = \alpha + \beta_1 \text{RAMI} + \beta_2 \text{HSA} + \beta_3 \text{HDR} + \beta_4 \text{AR} + \beta_5 \text{EDLR} + \beta_6 \text{SEX} + \beta_7 \text{RIS} + \beta_8 \text{ST} + \beta_9 \text{RESI} + \beta_{10} \text{AFI} + \beta_{11} \text{RMME} + \beta_{12} \text{PCSFAUR} + \beta_{13} \text{DHI} + \beta_{14} \text{RELH} + u_i \]

**Logistic Regression**

**Logistic regression** is an alternative approach to regression that allows us to use a criterion variable that is categorical.

Logistic regression (logit regression) is used when the response or dependent variable is dichotomous (i.e., binary, or 0-1). The predictor variables may be quantitative, categorical or a mixture of the two. Suppose, the probability of the occurrence of event Y, \( P (Y=1) \) depends on a set of explanatory variables \( X_1, X_2, X_3, \ldots X_k \).

The basic form of the logistic function is

\[ \frac{P}{1-P} = e^Z \]

Where \( Z \) is a linear function of a set of predictor variables, \( X_1, X_2, X_3, \ldots X_k \), given by

\[ Z = b_0 + b_1 X_1 + b_2 X_2 + \ldots + b_k X_k, \]

And \( b_0, b_1, b_2, \ldots \) are regression coefficients.

Logit of \( P \) is derived by taking natural logarithm, that is, \( \log \left( \frac{P}{1-P} \right) = Z \)

The quantity \( \left( \frac{P}{1-P} \right) \) is called the odds and hence \( \log \left( \frac{P}{1-P} \right) \), the coefficients \( b_0, b_1, b_2, \ldots \) are similar to regression coefficients and are called logit regression coefficients. These coefficients are used to compute odds ratios (reported in results), which give the ratio of two odds of an event occurring (\( Y=1 \)). In the case of a dichotomous independent variable, the odds
ratio can be interpreted as the increased odds of a positive outcome on the dependent variable for the affirmative category \((X=1)\) over the negative one \((X=0)\). An odds ratio more than one indicates a positive association between the independent and dependent variables and an odds ratio less than one indicate a negative association.

**Model 3: logistic regression equation on morbidity**

In order to identify the health determinants within this limited scope of study, a qualitative response model (Logit Model) is constructed where the dependent variable is a categorical variable taking value \(Y_i=1\) if a respondent in the age group 18-55 years have been suffering from chronic diseases and \(Y_i=0\), otherwise. The model specification is as under:

\[
E(Y_i) = \frac{e^{\alpha+\beta x_i}}{1 + e^{\alpha+\beta x_i}}
\]

Where \(E(Y_i) = P(Y_i=1)\), as above. Denoting \(E(Y_i) = \pi\) for simplicity and solving for \((\alpha + \beta x_i)\), we obtain

\[
\log(\frac{\pi_i}{1-\pi_i}) = \alpha + \beta x_i
\]

where all logarithms are natural logarithm. Here \((\pi_i/1 - \pi_i)\) is the ratio of the odds of \(Y_i=1\) against \(Y_i=0\). The set of explanatory variables \((x_i)\) used is as follows: Respondent Average Monthly Income (RAMI), Household Size of Asset (HSA), Age of the Respondents (AR), Educational Level of the Respondents (EDLR), gender of the respondents (dummy, if male=1, female=0 denoted by SEX), Respondents Income Source (RIS), Caste of the respondents (dummy, if ST=1, 0= otherwise denoted by ST), Place of Residence (dummy, if urban=1, 0= otherwise denoted by RESI), Average Family Income (AFI), Respondents Monthly Medical Expenditure (RMME), Per-
Capita Square Feet Area Under Roof (PCSFAUR), Destructive Habits Index of the respondents (DHI), Religion of the respondents (dummy, if Hindu = 1, 0 otherwise denoted by RELH) and Daily Calorie Intake of the Respondents (DCIR).

**Model-4: Logistic Regression Equation on Investigator Assessed Health Status of Respondent**

In order to identify the health determinants within this limited scope of study, a qualitative response model (Logit Model) is constructed where the dependent variable is a categorical variable taking value \( Y_i = 1 \) if a respondent in the age group 18-55 years have good health and \( Y_i = 0 \), otherwise (implying bad health) The model specification is as under:

\[
e^{\alpha + \beta x_i}
\]

\[E(Y_i) = \frac{1}{1 + e^{\alpha - \beta x_i}} = \frac{\pi_i}{1 - \pi_i}
\]

Where \( E(Y_i) = P(Y_i = 1) \), as above. Denoting \( E(Y_i) = \pi \) for simplicity and solving for \( (\alpha + \beta x_i) \), we obtain

\[
\log(\pi_i / (1 - \pi_i)) = \alpha + \beta x_i
\]

Where all logarithms are natural logarithm. Here \( (\pi_i / (1 - \pi_i)) \) is the ratio of the odds of \( Y_i = 1 \) against \( Y_i = 0 \).

The set of explanatory variables \( (x_i) \) used is as follows: Respondent Average Monthly Income (RAMI), Household Size of Asset (HSA), Age of the Respondents (AR), Educational Level of the Respondents (EDLR), gender of the respondents (dummy, if male = 1, female = 0 denoted by SEX), Respondents Income Source (RIS), Caste of the respondents (dummy, if ST = 1, 0 = otherwise denoted by ST), Place of Residence (dummy, if urban = 1, 0 = otherwise denoted by ST).
RESI), Average Family Income (AFI), Respondents Monthly Medical Expenditure (RMME), Per-Capita Square Feet Area Under Roof (PCSFAUR), Destructive Habits Index of the respondents (DHI), Religion of the respondents (dummy, if Hindu = 1, 0 otherwise denoted by RELH) and Daily Calorie Intake of the Respondents (DCIR).

**Model 5: Logistic Regression Equation on BMI (malnutrition vs normal)**

In order to identify the health determinants within this limited scope of study, a qualitative response model (Logit Model) is constructed where the dependent variable is a categorical variable taking value \( Y_i = 1 \) if a respondent in the age group 18-55 years have malnutrition and \( Y_i = 0 \), otherwise (implying normal nutritional status) The model specification is as under:

\[
e^\alpha + \beta x_i
\]

\[
E(Y_i) = \frac{1}{1 + e^{-\alpha - \beta x_i}} = \frac{e^{\alpha + \beta x_i}}{1 + e^{\alpha + \beta x_i}}
\]

Where \( E(Y_i) = P(Y_i=1) \), as above. Denoting \( E(Y_i) = \pi \) for simplicity and solving for \( \alpha + \beta x_i \), we obtain

\[
\log(\pi_i / (1 - \pi_i)) = \alpha + \beta x_i
\]

where all logarithms are natural logarithm. Here \( \pi_i / (1 - \pi_i) \) is the ratio of the odds of \( Y_i=1 \) against \( Y_i=0 \).

The set of explanatory variables used is as follows: Respondent Average Monthly Income (RAMI), Household Size of Asset (HSA), Age of the Respondent (AR) is considered in two categories, AR2 (Respondent in the Age Group of Above 30-45 Years, Dummy, if yes, 1; 0 otherwise) and AR3 (Respondent in the Age Group of Above 45-55 years, Dummy, if yes, 1; 0 otherwise). The reference age group is AR1 (Respondent in the Age Group of 19-30 years,
Dummy, if yes, 1; 0 otherwise). The Education Level of the Respondent is also divided into following categories: EDLR2 = Education Level of the Respondent in between 1-7 completed years (Dummy, 1 if yes; 0 otherwise) EDLR3 = Education level of the Respondent in between 8-12 completed years (Dummy, 1 if yes; 0 otherwise) EDLR4 = Education level of the Respondent above 12 completed years (Dummy, 1 if yes; 0 otherwise)

Educational Level of the Respondents (EDLR), gender of the respondents (dummy, if male=1, female=0 denoted by SEX), Respondents Income Source (RIS), Caste of the respondents (dummy, if ST=1, 0= otherwise denoted by ST), Place of Residence (dummy, if urban=1, 0= otherwise denoted by RESI), Average Family Income (AFI), Respondents Monthly Medical Expenditure (RMME), Per-Capita Square Feet Area Under Roof (PCSFAUR), Destructive Habits Index of the respondents (DHI), Religion of the respondents (dummy, if Hindu=1, 0 otherwise denoted by RELH) and Daily Calorie Intake of the Respondents (DCIR).

**Model 6: Logistic Regression Equation on BMI (obesity vs normal)**

Another qualitative response model (Logit Model) is constructed where the dependent variable is a categorical variable taking value \( Y_i = 1 \) if a respondent in the age group 18-55 years is obese/overweight and \( Y_i = 0 \), otherwise (implying normal nutritional status) The model specification is as under:

\[
e^{\alpha + \beta x_i} \]

\[
E(Y_i) = \frac{1}{1 + e^{-\alpha - \beta x_i}}
\]

Where \( E(Y_i) = P(Y_i=1) \), as above. Denoting \( E(Y_i) = \pi \) for simplicity and solving for \( (\alpha + \beta x_i) \), we obtain
Log(\(\pi_i / \pi_i \)) = \alpha + \beta x_i

where all logarithms are natural logarithm. Here \((\pi_i / \pi_i)\) is the ratio of the odds of \(Y_i=1\) against \(Y_i=0\).

The set of explanatory variables used is as follows: Respondent Average Monthly Income (RAMI), Household Size of Asset (HSA), Age of the Respondent (AR) is considered in two categories, AR2 (Respondent in the Age Group of Above 30-45 Years, Dummy, if yes, 1; 0 otherwise) and AR3 (Respondent in the Age Group of Above 45-55 years, Dummy, if yes, 1; 0 otherwise). The reference age group is AR1 (Respondent in the Age Group of 19-30 years, Dummy, if yes,1; 0 otherwise). The Education Level of the Respondent is also divided into following categories: EDLR2 = Education Level of the Respondent in between 1-7 completed years (Dummy, 1 if yes; 0 otherwise) EDLR3 = Education Level of the Respondent in between 8-12 completed years (Dummy, 1 if yes; 0 otherwise), EDLR4 = Education Level of the Respondent above 12 completed years (Dummy, 1 if yes; 0 otherwise)

Educational Level of the Respondents(EDLR), Gender of the respondents(dummy, if male=1, female=0 denoted by SEX), Respondents Income Source (RIS), Caste of the respondents (dummy, if ST=1, 0= otherwise denoted by ST), Place of Residence (dummy, if urban=1, 0= otherwise denoted by RESI), Average Family Income (AFI), Respondents Monthly Medical Expenditure (RMME), Per-Capita Square Feet Area Under Roof (PCSFAUR), Destructive Habits Index of the Respondents (DHI), Religion of the respondents(dummy, if Hindu=1, 0 otherwise denoted by RELH) and Daily Calorie Intake of the Respondents (DCIR).

**Model -7: Calorie based Analysis of Health- Multiple Regression Equation (Rural category)**
DCIR = $\alpha + \beta_1 \text{RAMI} + \beta_2 \text{HSA} + \beta_3 \text{HDR} + \beta_4 \text{AR} + \beta_5 \text{EDLR} + \beta_6 \text{SEX} + \beta_7 \text{RIS} + \beta_8 \text{ST} + \beta_{10} \text{AFI} + \beta_{11} \text{RMME} + \beta_{12} \text{PCSFAUR} + \beta_{13} \text{DHI} + \beta_{14} \text{RELH} + u_i$

**Model -8: Calorie based Analysis of Health- Multiple Regression Equation (urban category)**

DCIR = $\alpha + \beta_1 \text{RAMI} + \beta_2 \text{HSA} + \beta_3 \text{HDR} + \beta_4 \text{AR} + \beta_5 \text{EDLR} + \beta_6 \text{SEX} + \beta_7 \text{RIS} + \beta_8 \text{ST} + \beta_{10} \text{AFI} + \beta_{11} \text{RMME} + \beta_{12} \text{PCSFAUR} + \beta_{13} \text{DHI} + \beta_{14} \text{RELH} + u_i$

**Model -9: Calorie based Analysis of Health- Multiple Regression Equation (salaried category)**

DCIR = $\alpha + \beta_1 \text{RAMI} + \beta_2 \text{HSA} + \beta_3 \text{HDR} + \beta_4 \text{AR} + \beta_5 \text{EDLR} + \beta_6 \text{SEX} + \beta_7 \text{RIS} + \beta_8 \text{ST} + \beta_9 \text{RESI} + \beta_{10} \text{AFI} + \beta_{11} \text{RMME} + \beta_{12} \text{PCSFAUR} + \beta_{13} \text{DHI} + \beta_{14} \text{RELH} + u_i$

**Model -10: Calorie based Analysis of Health- Multiple Regression Equation (non salaried category)**

DCIR = $\alpha + \beta_1 \text{RAMI} + \beta_2 \text{HSA} + \beta_3 \text{HDR} + \beta_4 \text{AR} + \beta_5 \text{EDLR} + \beta_6 \text{SEX} + \beta_7 \text{RIS} + \beta_8 \text{ST} + \beta_9 \text{RESI} + \beta_{10} \text{AFI} + \beta_{11} \text{RMME} + \beta_{12} \text{PCSFAUR} + \beta_{13} \text{DHI} + \beta_{14} \text{RELH} + u_i$

All these models are estimated on the basis of data collected from field survey. The results are presented in the succeeding chapters. The construction process of HAIN and DHI and also the steps involved in the test of simultaneity between Health and Income are discussed in the results sections of the work.