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Indira Gandhi National Open University
School of Social Sciences

BECE-141
Economics of Health and Education

BECE 141

ECONOMICS OF HEALTH AND EDUCATION

School of Social Sciences
Indira Gandhi National Open University

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CONTENTS

		Page No.
BLOCK 1	**Introduction**	**7**
Unit 1	Health and Education for Human Capital	9
Unit 2	Role of Health in Human Development	27
BLOCK 2	**Foundations of Health Economics**	**49**
Unit 3	Demand for Healthcare Services	51
Unit 4	Supply of Healthcare Services	68
Unit 5	Measurement of Health Benefits	88
BLOCK 3	**Health Policy**	**105**
Unit 6	Market Failure and Role of Government	107
Unit 7	Public Health Services	123
BLOCK 4	**Health Sector in India**	**139**
Unit 8	Status of Health and Medical Care in India	141
Unit 9	Health Policy in India	158
BLOCK 5	**Economics of Education**	**173**
Unit 10	Human Capital	175
Unit 11	Demand and Supply of Education	195
BLOCK 6	**Education Sector in India**	**213**
Unit 12	Status of Educational Outcomes	215
Unit 13	Government Policy and Financing of Education in India	231
Glossary		**249**
Suggested Readings		**257**

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COURSE INTRODUCTION

The first block (**Block 1**) is on 'Introduction' to the course. It has two units. **Unit 1** gives an account of the significance of 'health and education' for formation of 'human capital'. Distinguishing between the terms 'physical capital' and 'human capital', it outlines the complementary effect of health and education to 'human capital'. It discusses the significance of 'returns to investment in human capital' to show the role of human capital in enhancing economic growth. **Unit 2** is on the 'Role of Health in Human Development'. Introducing the concept of 'Human Development Index', it explains the relationship between 'health, income and healthcare expenditure' to bring out the causality between 'health and poverty'. The unit also introduces the concepts of 'gender adjusted health equality (GAHE)', 'equally distributed equivalent achievement (EDEA)' and 'concentration index (CI)'.

Block 2 deals with the theme of 'Foundations of Health Economics'. The block covers three major areas viz. Demand for Healthcare Services (**Unit 3**), Supply of Healthcare Services (**Unit 4**) and Measurement of Health Benefits (**Unit 5**). **Unit 3** makes a distinction between health as a 'consumption good' and health as a 'investment good'. It also covers the concepts of utility maximisation, market demand, demand elasticity, etc. in the context of demand for health services. **Unit 4** covers the issues of: (i) factor market for healthcare services, (ii) determination of equilibrium price and (iii) production and supply of healthcare services. **Unit 5** explains the approach to: (i) cost benefit analysis and (ii) impact evaluation, in the context of measuring health benefits.

Block 3 deals with 'Health Policy'. It has two units: Market Failure and Role of Government (**Unit 6**) and Public Health Services (**Unit 7**). **Unit 6** discusses the issues of: (i) characteristics of healthcare market, (ii) government's role in providing healthcare services and (iii) health insurance. **Unit 7** discusses issues relating to: (i) investment in public health services, (ii) economics of health externality and (iii) economics of epidemiology.

Block 4 is specifically on 'Health Sector in India'. It has two units: **Unit 8** on Status of Health and Medical Care in India and **Unit 9** on Health Policy in India. **Unit 8** covers the issues of: (i) trends in disease burden, (ii) healthcare inputs, (iii) delivery and outcomes and (iv) measurement of health inequity. **Unit 9** covers the aspects of: (i) public health policies and programmes in India and (ii) National Health Policies.

Block 5 is on Economics of Education. It has two units. **Unit 10** is on Human Capital. It covers the issues of: (i) linkage between health and education, (ii) theoretical background from endogenous growth models, (iii) linkage between human capital investment, fertility and poverty and (iv) expenditure on educational services. **Unit 11** is on Demand and Supply of

Education. It first makes a distinction between 'individual demand for education' and 'social demand for education'. It also covers the themes of: (i) supply of education and (ii) role of industry in education.

Block 6 is on Education Sector in India. This block also has two units. **Unit 12** is on the 'Status of Educational Outcomes' and **Unit 13** is on 'Government Policy and Financing of Education in India'. The unit on 'educational outcomes' discusses the trends in: (i) literacy rate, (ii) participation and dropouts and (iii) quality and efficiency. The unit on 'policies and financing' covers the themes of: (i) National Policies on Education (1968, 1986 and 2020), (ii) rationale on public financing of education, (iii) PPP models of education and (iv) educational grants and loans.

BLOCK 1
INTRODUCTION

BLOCK 1 INTRODUCTION

Block 1 is introductory to Economics of Health and Economics of Education. It has **two units**. **Unit 1** is on Health and Education for Human Capital. The unit begins by making a distinction between 'physical capital' and 'human capital'. How both health and education mutually complements to enhance human capital is described next. The linkage of health with economic growth is then explained. Features of healthcare market like market failure and information asymmetry are outlined. In light of these, how government intervention for attaining 'health equity' is needed is explained in this unit.

Unit 2 is on Role of Health in Human Development. It introduces you to the important composite development indicator viz. Human Development Index. The unit then explains the relationship between health, income and health expenditure. In particular, it explains the causality between health and poverty. The unit then discusses the importance of health for 'gender development'. The concepts of GAHE (i.e. gender adjusted health equality), EDEA (equally distributed equivalent achievement) and CI (concentration index) are then described to help you appreciate the analytical features of these indicators.

UNIT 1 HEALTH AND EDUCATION FOR HUMAN CAPITAL

Structure

1.0 Objectives

1.1 Introduction

1.2 Health and Education for Human Capital

- 1.2.1 Distinction between Physical and Human Capital
- 1.2.2 Health and Human Capital
- 1.2.3 Education and Human Capital
- 1.2.4 Complementary Effect of Health and Education to Human Capital

1.3 Health and Economic Growth

- 1.3.1 Returns to Investment in Human Capital

1.4 Healthcare Market

- 1.4.1 Features of Healthcare Market
- 1.4.2 Market Failure and Information Asymmetry
- 1.4.3 Government Intervention for Health Equity

1.5 Let Us Sum Up

1.6 Key Words

1.7 Some Useful Books and References

1.8 Answers/Hints to Check Your Progress Exercises

1.0 OBJECTIVES

After reading this unit, you will be able to:

- define the scope of health economics;
- relate the concept of human capital to health and education;
- distinguish between physical and human capital;
- derive the growth equation bringing out the conditions under which higher growth of 'per capita output' can be realised;
- discuss the basic features of healthcare market;
- differentiate between healthcare market and markets for other goods and services;
- illustrate the prevalence of market failure and information asymmetry to result in 'supplier induced demand' in healthcare market; and
- explain why government intervention in healthcare market is desired.

1.1 INTRODUCTION

According to medical science, health is defined as a state of physical, mental and social well-being in the absence of any disease or abnormal conditions. But economists define health as a durable good providing many services. Grossman (1972) has argued that the flow of services generated from the stock of health capital is consumed continuously over an individual's life time. The stock of health depreciates with age but can be maintained at an efficient level by investments in healthcare services. Death occurs when an individual's stock of health falls below a critical minimum level.

Why do people desire to remain healthy? From an economic perspective, there are two principles that drive people for demanding good health. Good health is desired for both consumption and investment. From the consumption perspective, an individual desires to remain healthy in order to get utility by consuming goods and services. A healthy person feels good and capable of enjoying life by consuming various other non-medical goods and services. From an investment perspective, an individual who is in a positive (good) state of health, needs to allocate less time to sickness and is therefore having more healthy days available to work and enhance his/her future income. Thus, a person who puts high value on future is more inclined to pursue a healthy life style and increase the likelihood of enjoying healthy days (as compared to a person who puts low value of future).

Health Economics is an applied field of study which allows the systematic examination of the problems faced in promoting health for all. By applying economic theories of consumer, producer and social choice, health economics aims to explain the behaviour of individuals, healthcare providers, public and private organisations and governments in decision-making.

Healthcare is classified as a 'merit good' because its consumption provides benefits to others besides the individual. For instance, inoculation against a contagious disease provides protection to the individual generating thereby a private benefit. But it also provides a social benefit since it prevents others from contracting the disease from the inoculated person. However, few would want inoculation only to protect others i.e. the demand for healthcare is mainly due to private benefit and is never made keeping the 'social optimum' in view. In other words, the actual demand is less than the social optimum. In order to extend this up to the social optimum, government intervention becomes necessary. In many such contexts, health economics can be useful in evaluating how certain problems (like market failure and inequitable allocation of resources) can impact the health of a community or population so that it can then be used to provide the necessary input to the government on the required course of action. Such inputs for policy critically fall in the areas of market regulation, formulation of national health policies and programmes, etc.

1.2 HEALTH AND EDUCATION FOR HUMAN CAPITAL

The human capital theory suggests that individuals and society derive economic benefits from investments in people. However, traditionally, economic theory has given emphasis on physical capital accumulation as the principal source of economic growth, at least in the short-run. In the long run, exogenous technical progress is considered as the determinant of growth. The exogeneity of technological progress and the diminishing returns to physical capital pose difficulty in explaining long-term economic growth restricting the analytical capacity of the neoclassical models in their empirical verification. This problem is solved by endogenous growth models which gives emphasis on human capital (viz. education and health) accumulation.

1.2.1 Distinction between Physical and Human Capital

Physical capital implies non-human assets such as: (i) plant and machinery, (ii) tools and equipment, (iii) office supplies, etc. that help in the process of production. Human capital refers to: (i) stock of knowledge measured by literacy rate and years of schooling, (ii) health status of the population measured by life expectancy and quality of life index, (iii) talent, skills and abilities brought-in by the employee to the organisation, etc. Thus, although both the physical and human capital are durable, there are also some differences noticed between the two.

Physical capital is tangible but human capital is intangible. Physical capital can be traded in the market but the services of human capital can only be hired. Physical capital is formed through technological progress and economic development whereas human capital is generated through society i.e. it originated through societal culture, customs, mobility and interactions. Human capital can, therefore, generate positive externality to the society whereas physical capital does not possess any such property. Physical capital can be separated from its owner but human capital cannot be separated. A country can accumulate physical capital within a very short period of time but accumulation of human capital requires a long period of time. Mobility of physical capital from one country to another is restricted by trade barriers whereas it is the nationality and culture that makes it difficult to move human capital from one country to another. Both the physical and human capital depreciates but physical capital depreciates at a constant rate while in case of human capital, natural ageing leads to its depreciation which can be minimised by proper medical intervention.

1.2.2 Health and Human Capital

Becker (2007) and Schultz (2010) argued that good health and nutrition enhance workers' productivity. Healthier people not only live longer but have stronger incentives to invest in developing their skills as they expect to reap the benefits of such investments over longer periods. Better health

increases the productivity of workforce by reducing incapacity, debility and days lost due to sickness. Moreover, good health helps to forge improved levels of education by increasing the levels of schooling and scholastic performance. Health therefore impacts economic growth through the demographic attributes. Shorter life expectancies inhibit investment in education and other forms of human capital, since there is greater risk that each individual may not survive long enough to benefit from investment. Further, a large proportion of dependent population (due to poor health) has a detrimental effect on rate of savings and thereby on capital investment and growth. Healthier workers are more productive for a variety of reasons like increased vigor, strength, attentiveness, stamina, creativity, etc. Ill health and malnutrition reduce the physical capacity of the labour leading to lower productivity and lower wages.

1.2.3 Education and Human Capital

Education is another equally important factor which, after health is in every sense, the other fundamental requirement of economic development and social progress. No country can achieve sustainable economic development without substantial investment in its education sector. Education enriches people's understanding of themselves creating positive externality to the society. It improves the quality of their lives and leads to broader social benefits to individuals and society. Education raises people's productivity and creativity and promotes entrepreneurship and technological progression. Lucas (1988) and Romer (1986) have elaborately explained the role of education to human capital in economic development. But their emphasis is different. Lucas's interpretation of human capital is closer to population wide education i.e. education of the masses (school level education) and not directly related to the frontier knowledge domains like science and technology to which Romer refers. Romer (1986) mentions three factors to distinguish physical capital and human capital (the latter measured in terms of knowledge accumulation or stock of ideas). These are: (a) development of new knowledge has positive external effects on the production possibilities of other firms (mainly because knowledge is non-rival in nature); (b) new knowledge too is subject to diminishing value in its nature; and (c) such new knowledge is more profitable when it leads to more efficient outcomes.

1.2.4 Complementary Effect of Health and Education to Human Capital

Education of the poor helps improve their food intake not only by raising their incomes and thereby in spending on their food but also by inducing them to make better and healthier choices. Educated persons tend to consume a healthier diet even when the total amount spent on food is held constant. In other words, the relationship between education and better health and higher life expectancy involves causation in both directions i.e. greater health and lower mortality induces larger investments in education since rates of return

on such investments is greater when the expected amount of working time is higher. Education has therefore emerged as the primary component of human capital although over time it is observed that health and nutritional expenditure facilitates a major part of investment in education. In short, education, health, nutrition, water and sanitation are complementary to each other, with investments in any one contributing to better outcomes in others.

Check Your Progress 1 [answer within the space given in about 50-100 words]

1) How is health defined from a 'medical science' perspective? In what way it differs from an economics science perspective?

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2) How is health a durable good? How is it more precisely classified? Give reasons.

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3) Define Health Economics. Who are the agents whom it covers in its scope?

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4) In what respect is the neoclassical approach considered restrictive? How is this overcome?

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5) Distinguish between Physical and Human Capital.

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6) How is Health an integral part of Human Capital?

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7) Do you agree that the contribution of education to Human Capital is complementary to health? Why?

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8) What is the difference in the respective perspectives of Romer and Lucas (1988) on human capital?

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9) In terms of which three specific aspects, does Romer distinguish physical capital and human capital?

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10) What is meant by 'complementary effect of investment in human capital'?

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1.3 HEALTH AND ECONOMIC GROWTH

The concept of human capital refers to the abilities and skills of human resources of a country. Thus, human capital formation refers to the process of acquiring and increasing the number of people with good health, education and skills, critical for economic growth. In the mainstream macroeconomic growth models, human capital in the form of schooling or enrolment has been given a central place while the role of health has remained peripheral. This is mainly because quantification of health by life expectancy cannot as completely aggregate for the status of health as the 'years of schooling' does for education. In other words, contribution of life expectancy was not regarded as conclusive to productive health years during the working years as the years of schooling was considered to human capital formation. Notwithstanding this, we now proceed to analytically show how both health and education indispensably remain as the two mutually complementary components to economic growth in terms of average productivity of labour.

1.3.1 Returns to Investment in Human Capital

Following the endogenous growth model, consider a simple production function as:

$$Y_t = Y(K_t, H_t, L_t) \qquad (1.1)$$

where Y is aggregate output, K is physical capital, H is human capital and L is the labour force. Differentiating Equation (L), with respect to time t, and placing the components for labour, physical capital and human capital in a sequence, we get:

$$\dot{Y} = \frac{\partial Y}{\partial L}\dot{L} + \frac{\partial Y}{\partial K}\dot{K} + \frac{\partial Y}{\partial H}\dot{H}$$

Dividing the above equation throughout by Y and subtracting

$$r = \frac{\dot{P}}{P}$$

(i.e. rate of growth of population) from both sides of the equation, we get:

$$\frac{\dot{Y}}{Y}-\frac{\dot{P}}{P}=\left(\frac{\partial Y}{\partial L}\right).\frac{L}{Y}.\frac{\dot{L}}{L}+\left(\frac{\partial Y}{\partial K}\right).\frac{I_K}{Y}+\left(\frac{\partial Y}{\partial H}\right).\frac{I_H}{Y}-\frac{\dot{P}}{P}$$

$$\text{Or},\frac{\dot{y}}{y}=\frac{MP_L}{AP_L}.n+MP_K.\frac{I_K}{Y}+MP_H.\frac{I_H}{Y}-r \qquad (1.2$$

where $AP_L = Y/L$ is the average productivity of labour $L/L = n$, the rate of growth of employment, $K = I_K = I_K$ and $H = I_H = I_H$. The LHS of (1.2) is the rate of growth of output minus the rate of growth of population or the 'growth in per capita output'.

We assume that gross investment is equal to net investment and it is valid for both physical and human capital. Now, decomposing r into the components one each for the children, working population and old-age population, we get:

$$r=\frac{\dot{P}}{P}=\frac{\dot{P}_{0-15}+\dot{P}_{15-59}+\dot{P}_{59+}}{P}=\frac{\dot{P}_{0-15}}{P_{0-15}}.\frac{P_{0-15}}{P}+\frac{\dot{P}_{15-59}}{P_{15-59}}.\frac{P_{15-59}}{P}+\frac{\dot{P}_{59+}}{P_{59+}}.\frac{P_{59+}}{P}$$
$$=.r_1\alpha_1+.r_2\alpha_2+.r_3\alpha_3$$

Where, α stands for share of population, $0<\alpha_i<1$, i=1, 2 and 3; r_1, r_2 and r_3 stand for growth rate of child population, working population and old-age population respectively. Substituting the value of r in Equation (1.2), we get, rate of growth of output per capita as:

$$\frac{\dot{y}}{y}=\frac{MP_L}{AP_L}.n+MP_K.\frac{I_K}{Y}+MP_H.\frac{I_H}{Y}-(.r_1\alpha_1+.r_2\alpha_2+.r_3\alpha_3) \qquad (1.3)$$

Now, if we assume that the economy is at full employment, such that: (i) the rate of growth of employment (viz. n) is equal to the rate of growth of working population (r_2) and (ii) average productivity of labour (AP_L) is equal to marginal productivity (MP_L), then Equation (1.3) can be written as:

$$\frac{\dot{y}}{y}=n(1-\alpha_2)+MP_K.\frac{I_K}{Y}+MP_H.\frac{I_H}{Y}-(\alpha_1.r_1+\alpha_3.r_3) \qquad (1.4)$$

Since investment in human capital basically comprises of expenditure on health and education, we can write: $I_H = I_{HE} + I_{EE}$ and Equation (1.4) can be written as:

$$\frac{\dot{y}}{y}=n(1-\alpha_2)+MP_K.\frac{I_K}{Y}+MP_H.\left\{\frac{I_{HE}}{Y}+\frac{I_{EE}}{Y}\right\}-(\alpha_1.r_1+\alpha_3.r_3) \qquad (1.5)$$

Equation (1.5) tells us that the growth of per capita output will increase if: (a) rate of growth of employment (n) increases, (b) share of investment of physical capital to total output increases and (c) if the health and education expenditure as a proportion of total output increases. Conversely, growth of

output per capita is adversely affected if an economy is either characterised by higher proportion of child or old-age population (as well as their corresponding growth rates). Since health and educational outcome depends upon $\frac{I_{HE}}{Y}$ and $\frac{I_{EE}}{Y}$, quality of labour force will improve if an economy spends higher proportion of its income on human capital formation. The term MP_H (marginal productivity of human capital) can be interpreted either by considering stock of health or stock of knowledge. If we consider stock of health by 'life expectancy at birth' as human capital, then MP_H can be interpreted as the incremental change in total output (Y) due to one year increase in life expectancy at birth. In the same way, if we consider education by 'years of schooling' as human capital, then MP_H is interpreted as marginal increase in output/income (Y) due to one unit increase in years of schooling. The importance of health in developing countries can thus be understood by the growth Equation (1.5).

Developing countries generally experience a higher proportion of child population (α_1) and its growth (r_1) because of high fertility rate. If the children, who are the potential human resource, remain unhealthy due to low level of healthcare spending, the process of human capital formation will be seriously affected. Since health and educational attainment are complementary to each other, with one depending on the other, one can not separate out health without considering education and vice-versa. Keeping in mind the present low levels of investment in health sector in developing countries like India, to reap the real benefit of demographic dividend in future, accumulation of effective human capital is necessary. This is possible by effective intervention in improving the health status of female population in reproductive age group and all children in general as they are the potential human capital resource. As of now, although India is passing through its phase of demographic dividend (with its maximum share of person in 'working age group' expected to be attained by 2025), India spends just about one percent of its GDP on health. India should therefore increase its investment in health sector for getting returns from human capital in the coming decades.

Check Your Progress 2 [answer within the space given in about 50-100 words]

1) Define the concept of human capital formation.

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2) State the determinants of per capita growth of output?

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3) Decompose the growth of population in terms of age cohort and state the expression for 'per capita rate of growth in output'.

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4) How is human capital investment interpreted?

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5) Why is it particularly important to invest in healthcare in a developing economy?

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1.4 HEALTHCARE MARKET

The term market refers to a situation where buyers and sellers interact to trade goods and services. It is a place where the forces of demand and supply interact to determine the prices of goods and services being exchanged. Driven by mutual self-interest, while consumers try to pay the lowest prices possible, producers try to sell at the highest possible price. The process results in equilibrium in conditions of perfect competition where the quantity demanded equals the quantity supplied. In order to ensure optimality, an important condition to be met is perfect information about the price to both

the buyers and sellers. In other words, efficiency by optimal allocation of resources is achieved under perfectly competitive market conditions, from perfect information about the market in general and information on prices in particular. This basic microeconomic principle is inapplicable in case of healthcare market because of its specific features.

1.4.1 Features of Healthcare Market

The characteristics of healthcare market differ from those in a perfectly competitive market due to the following factors:

a) Healthcare is a heterogeneous product or service as the patient can experience a range of outcomes;

b) Some patients who have health insurance are paid for their health expenditure by the third-party payer;

c) 'Market price' is lacking in feedback to reflect the actual value of the resources used in healthcare. This is because healthcare is a service provided by institutions that uses different kinds of inputs of which some are quantitative and some are qualitative. The healthcare provider also adds some profit margin along with these costs in setting the price of specific healthcare. This may happen in case of other product markets also but with a lesser degree of variation as compared to the services of healthcare market.

d) Healthcare providers (doctors or suppliers) know more about illness and treatments than their patients i.e. there is information asymmetry;

e) Individuals in poor health have a greater incentive to purchase health insurance than those in good health.

In addition to the above, healthcare services possesses certain other peculiar characteristics as stated below:

(i) Healthcare is intangible i.e. a medical service is incapable of being assessed by the five senses; (ii) production and consumption of healthcare service take place simultaneously i.e. healthcare providers are unable to maintain an inventory of medical services or it is dispensed to the patient directly and is non-transferable; (iii) the composition and quality of healthcare services vary across individuals as well as across medical events; and (iv) healthcare services are difficult to quantify.

The quality of healthcare services is not uniform and is subject to three types of differences viz. structural, process and outcome. Structural quality is reflected in the physical and human resources of healthcare provider e.g. the level of amenities in hospital/nursing home, medical equipment and tools, medical personnel and administration. Process quality refers to waiting time, collection of background information of patients, diagnosis of the disease and

treatment. Outcome quality refers to the impact of healthcare on the patient's health, patient's satisfaction, post-care complications, etc.

1.4.2 Market Failure and Information Asymmetry

A market that meets all the conditions for efficient resource allocation is an 'ideal' in economic theory. In particular, the healthcare market is characterised by the above outlined specificities. Efficiency in consumption of healthcare means that consumers (i.e. patients) avail of the healthcare services where they get the highest satisfaction. For producers (like hospitals or doctors) of goods and services, being efficient means they produce medical services at the lowest possible average cost. But, in reality, healthcare market fails to achieve efficiency because of the difference in total cost for different agents involved i.e. patients (consumers), healthcare providers (suppliers), insurance companies (third-party payers), and society. The economic impacts of pain and suffering are of concern to the patient and society but may not be similarly relevant for healthcare providers or third-party payers. In view of these factors, healthcare market remains inefficient in allocating resources optimally. In other words, the power of the market forces (demand and supply) to determine the equilibrium price and quantity, and consequently determine optimum resource allocation, is greatly reduced.

Information Asymmetry: Doctors (suppliers) being more aware about illness and treatments than the patients, patients are dependent on the doctor to act in their best interest. But there is a conflict of interest as the doctor is selling a service to the patient. The doctor is not only in a position to determine the demand for the service (acting on behalf of the patient, presumably for the patient's welfare) but the doctor is also the supplier of the services. In other words, both the demand and supply are jointly determined by the same individual. The doctor driven by profit motive, might order more services than necessary (e.g. if he/she owns a laboratory or imaging equipment). Termed as 'supplier induced demand', the situation leads to market failure. Besides this, situation of information asymmetry between individuals purchasing health insurance and the insurance company results in two other specific types of market failures termed as adverse selection and moral hazard.

Individuals in poor health have a greater incentive to purchase health insurance than those in good health. They also make greater utilisation of healthcare, leading to higher payouts by the insurance company. Such a situation in the healthcare market is termed as 'adverse selection'. Further, individuals covered by insurance tend to use more healthcare services by not taking necessary precautions to stay healthy with the knowledge that they have insurance coverage. This leads to inefficient use of resources and is termed as 'moral hazard'. Insurance companies try to correct this by monitoring and restricting healthcare access and by charging 'co-payments and deductibles'.

1.4.3 Government Intervention for Health Equity

A **public good** is one that is non-excludable and non-rivalrous, and hence, a good for which no demand schedule exists. A **merit good** is a good that someone deems to be good for someone else in a way that is not expressed by the immediate utility that the good provides, and hence, market demand exists for a merit good. Certain type of healthcare like 'immunisation against a contagious disease' is a merit good because, although it is not possible to know exactly when the benefit will arise, such immunisation provides protection to the individual and others. It yields a private benefit to the immunised but also an external benefit to other individuals who are protected from catching the disease from the immunised. Such **healthcare** generates a positive externality to the society and hence is a semi-public good as it does not satisfy the non-excludability or non-rivalrous property of public good. Thus, not all healthcare services are public good but many of them are near-public good and merit good. Some parts of it like hospital services, physician services, medicines, etc. cannot be treated as public good as they are characterised by neither non-rivalry nor non-excludability. In general, consumption of a good, if it generates positive externality, is defined as a merit good and in such cases social benefits exceed private benefit. Such goods can either be produced by the private or the public sector. With merit goods, individuals may not fully understand the private benefits of their consumption and hence may not act in their own interest. Government intervention is warranted in such cases.

Check Your Progress 3 [answer within the space given in about 50-100 words]

1) Under what circumstances a market is efficient?

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2) Is the market for healthcare service imperfect? Why?

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3) What are the three types of differences that exist in the healthcare market making its services inconsistent?

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4) How is the term 'supplier induced demand' defined?

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5) How does 'adverse selection' occur in healthcare market? How is this different from 'moral hazard'?

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6) How is a 'merit good' different from a 'public good'? Give example in healthcare market.

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7) In what circumstances, government intervention is necessary in healthcare market?

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1.5 LET US SUM UP

Analysis of the role of health and educational services in endogenous growth models reveal that both are complementary to each other. Together, they account for the formation of human capital in an economy. Developing countries like India, which are expected to enjoy the benefit of demographic dividend, should give higher priority for investment in healthcare and education, as it helps towards formation of effective human capital. However, the healthcare market is characterised by certain specific features rendering it exposed to a unique situation in which doctors can induce what is called as 'supplier induced demand'. In addition, there could be collusion with health insurance market, due to which patients critically ill could consume more healthcare services by especially buying a healthcare insurance, a situation termed as 'adverse selection'. Such complexities of healthcare market, coupled with lack of symmetry in price information and over-use of healthcare due to insurance coverage (called moral hazard), results in sub-optimal allocation of resources. Together, they lead to situation of 'market failure'. Since healthcare services are characterised by the properties of being both a public good (e.g. inoculation against contagious disease) and a merit good (by some of its services where their social benefits are higher than the private benefit), societal considerations demand a key role to be played by the government. Since the supply of healthcare services are rendered by both the private and public sector, and the availability and access to *essential* healthcare services needs to be ensured by the government, the government's intervention becomes necessary in the healthcare market.

1.6 KEY WORDS

Human Capital : Human capital refers to (i) stock of knowledge measured by literacy rate and years of schooling, (ii) health status of the population measured by life expectancy and quality of life index, and (iii) talent, skills and abilities brought-in by the employee to the organisation.

Health as Human Capital : Good health and nutrition enhance workers' productivity. Healthier people who live longer have stronger incentives to invest in developing their skills since they expect to reap the benefits of such investments over longer periods. Better health increases workforce productivity by reducing incapacity, debility and number of days lost due to sickness.

Market Failure : Inefficient allocation of resources due to asymmetric information.

Marginal Productivity of : If we consider, health stock (say, life expectancy at birth) as capital, then MP_H is interpreted as the

Health (MP_H) incremental change in total output due to one year increase in life expectancy at birth.

Supplier Induced Demand : Driven by profit motive, and taking advantage of a situation of information asymmetry, a doctor might order more services than necessary. This leads to a situation of market failure termed as 'supplier induced demand'.

Moral Hazard : In health insurance market, individuals covered by insurance tend to use more healthcare and they might not take necessary precautions to stay healthy because of the knowledge of their insurance coverage. This leads to inefficient use of resources. The situation is termed as Moral Hazard.

Adverse Selection : Individuals in poor health have a greater incentive to purchase health insurance than those in good health. Individuals in poor health make greater utilisation of healthcare than the healthy, leading to higher payouts by the insurance company. This is termed as Adverse Selection in healthcare market.

Merit Good : When the consumption of a good by some, generates positive externality to others, resulting in a situation where the social benefit is larger than the private benefit, it is defined as a merit good. Such a good does not unconditionally obey the dual characteristics of a public good i.e. being non-excludable and non-rivalrous in consumption. But they are important for accumulation of human capital and economic development.

Co-Payment : A '**co-payment'** is a term associated with health insurance where the insured has to pay a fixed amount (as out-of-pocket expenditure) of total hospital bills or fees claimed by the healthcare institution. Co-payment discourages the insured to visit frequently the doctors. If people (who have health insurance) have to pay a small amount at each visit to a doctor, they will only go to the doctor when they actually need.

Deductible : A **deductible** is the amount that a policyholder must pay each year toward his/her medical expenses before the insurance company begin to pay its share. The purpose of the deductible is to help keep premiums low through cost-sharing and by reducing the number of small claims and unnecessary doctor visits.

1.7 SOME USEFUL BOOKS AND REFERENCES

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1.8 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Encompassing physical, social and mental wellbeing without any burden of disease. From an economic perspective, it is a durable good whose value depreciates with time due to age.

2) Though classified as a durable good due to its life long service to the individual, it is more precisely classified as a 'merit good' in view of its positive externality benefits.

3) Health economics is an applied area in which using microeconomic tools important policy inputs. It covers individuals, healthcare providers, public and private organisations and governments in decision-making.

4) It is restrictive in explaining long term economic growth due to the exogeneity of technological progress and depreciation in the value of physical capital. This limitation is overcome by the inclusion of human capital as a determinant of long term economic growth.

5) Value of Physical capital depreciates with time while that of human capital can be minimised by investment in healthcare (Sub-section 1.2.1).

6) Good health helps to forge improved levels of education while shorter life expectancies inhibit investment in education. So health is primary and a prerequisite to education.

7) Educated persons can ensure that they take proper diet even with constant expense on food.

8) While Lucas's emphasis is on mass education, Romer emphasises on frontier knowledge domains like science and technology.

9) Positive externalities of new knowledge due to its non-rival nature, such new knowledge too is affected by diminishing values, etc. (Sub-section 1.2.3).

10) The relationship between education and better health and higher life expectancy involves causation in both directions (Sub-section 1.2.4). Moreover, education, health, nutrition, water and sanitation complement each other.

Check Your Progress 2

1) Human capital formation refers to the process of acquiring and increasing the number of people with good health, education and skills, critical for economic growth.

2) Rate of growth of employment, share of investment in physical capital to output, expenditure on health and education as a proportion of total output (Equation 1.5, Sub-section 1.3.1).

3) Sub-section 1.3.1. Equation (1.5).

4) If we take it stock of health, then it is interpreted as: incremental change in total output (Y) due to one year increase in life expectancy at birth. Likewise, for education.

5) To raise productivity and reap the benefit of demographic dividend.

Check Your Progress 3

1) When information about prices is known to both producers and consumers (Section 1.4).

2) No. Doctor knows more about the disease of the patient, he could have profit motive, healthcare services are heterogeneous with a range of outcomes, etc. (Sub-section 1.4.1).

3) Structural quality, process quality and outcome quality.

4) It is a situation where doctors may prescribe tests due to profit motive alone and not due to the actual requirement of the patient.

5) Adverse selection means patients knowing their serious health condition, purchasing health insurance policies to meet out the costs of healthcare. Moral hazard refers to healthy persons taking healthcare insurance policies and then neglecting to take care of their health.

6) Consumption of a good, when results in positive externality i.e. social benefits are more than private benefit, is termed as a merit good (Sub-section 1.4.3).

7) In the case of merit goods when due to lack of knowledge people may under consume such goods government interference becomes necessary.

UNIT 2 ROLE OF HEALTH IN HUMAN DEVELOPMENT

Structure

2.0 Objectives

2.1 Introduction

2.2 Health and Human Development

- 2.2.1 Human Development Index
- 2.2.2 Health, Income and Healthcare Expenditure: Relationship
- 2.2.3 Causality between Health and Poverty

2.3 Health and Gender Development

- 2.3.1 Gender Adjusted Health Equality (GAHE)
- 2.3.2 Empirical Exercise

2.4 Health Inequality and Socio-Economic Status

- 2.4.1 Concentration Curve and Concentration Index (CI)
- 2.4.2 Empirical Illustration of CI

2.5 Let Us Sum Up

2.6 Key Words

2.7 Some Useful Books and References

2.8 Answers/Hints to Check Your Progress Exercises

2.0 OBJECTIVES

After reading this unit, you will be able to:

- outline the measurement issues of health at the individual level and at the macro level;
- state the components and rationale behind the HDI, 2010;
- show the interdependence between income, healthcare expenditure and health;
- explore the causality between health and poverty;
- discuss the concept of 'equally distributed equivalent achievement' (EDEA) in the context of 'gender adjusted health equality' (GAHE) goals;
- define the concepts of Concentration Curve and Concentration Index (CI); and
- estimate health inequality empirically (at the individual and group level)
- using Concentration Index.

2.1 INTRODUCTION

For long, the principal indicator of the measurement of economic development used to be taken as the growth rate of GDP or per capita GDP. Cross country growth comparisons however suggested that a country having higher level of income need not necessarily have a higher health status or educational level. This meant that income or its growth does not always ensure the well-being of the people. This realisation led to the development of the concept of human development resulting in a distinct shift in the focus of development economics from national income accounting to people-centric indicators like the HDI in the 1990s. Human development came to be defined as a process of enlarging people's choices, particularly in three essential choices viz. (i) by leading a long and healthy life, (ii) with skills acquired by education and (iii) by having access to resources needed for maintaining a decent standard of living. It was recognised that if these choices are not available, many other opportunities would remain inaccessible. For measurement purposes, for each dimension of human development (viz. longevity, educational attainment and access to resources), a relative 'distance' from a 'norm' was calculated, and a value between 0 and 1 assigned to help in its aggregation and serve as a composite indicator. In this unit, we shall specifically focus on the analytical aspects linking health with human development.

2.2 HEALTH AND HUMAN DEVELOPMENT

Health has been a multi-dimensional concept, difficult to define and measure, especially at the individual level. At the individual level, it includes risk of mortality or morbidity, physical limitations caused by injuries, level of pain, chronic health disorder, psychological well-being, etc. In other words, an individual's perception about the ill-being or well-being of health varies widely as it is highly subjective depending up on the above factors. It varies over time and across different age cohorts. In view of this, to assess the health status of an individual, it requires a combination of subjective and objective measures. To deal with this, the issue of measurement has followed the approach of first assessing it at a macro level, using which the individual's health status can then be assessed. For instance, BMI (i.e. body mass index) is tabulated for different regions, gender-wise, on the basis of which an individual can assess for himself, whether he/she is obese or overweight or fit. Similar indicator are available for malnutrition. You have studied about these in Unit 7 of Course 11 (Indian Economy I). Another such indicator about which we shall now study is SAHS i.e. self reported health status. This is computed and used as follows.

At macro level, health status of a community or cohort can be assessed based on the data collected on the performance of a group of individuals (belonging to a specific age cohort). Using Likert scale (i.e. a 5 to 7 point scale used to

allow the individuals to express how much they agree or disagree with a particular statement), a group of individuals belonging to a specific age cohort are asked to report their position 'ordinally' (i.e. in relative terms) on some basic functions (e.g. walking, breathing, digestion, hearing, chronic health disorder, etc.). Once observations on these parameters are recorded for a group of individuals belonging to a specific age cohort, a cardinal number (i.e. a numerical value) can then be assigned (for each ordinal ranking) for each one of the specific functions. An individual can then obtain a score based on his/her self-assessment of his health status. Such a score or index obtained by the individual is known as 'self assessed health status' (SAHS). SAHS is easy to estimate and is shown to be a strong predictor of more subjective measures of health. However, SAHS has some limitations. Besides being subjective, it suffers from cultural bias. It is also influenced by personality, general outlook, social and economic environment.

Health status at the macro level (viz. a country) can be estimated by considering factors like life expectancy at birth (LE), infant mortality rate (IMR), maternal mortality rate, morbidity prevalence rate, etc. Life expectancy at birth (LE) is considered as the best measure of health for cross-country comparison as it is assumed that countries showing higher LE manifest higher health status. However, it may not be always true unless the quality adjusted life years is taken into account.

2.2.1 Human Development Index

The computation of human development index (HDI) has evolved over time since the 1990s. The Human Development Report (2010) used a revised formula to measure the HDI by taking into account a combination of three dimensions as follows:

- a long and healthy life captured by Life expectancy at birth (LE);
- knowledge dimension captured by 'mean years of schooling' and 'expected years of schooling'; and
- access to resources for a decent standard of living captured by gross national income (GNI) per capita (measured in $PPP i.e. purchasing power parity dollars)

a) **Life Expectancy Index (*LEI*)**

$$LEI = \frac{LE - 20}{85 - 20} \qquad (2.1)$$

LEI is 1 when Life expectancy at birth is 85 and 0 when Life expectancy at birth is 20.

b) **Education Index (*EI*)**

$$EI = \frac{MYSI + EYSI}{2} \qquad (2.2)$$

Mean Years of Schooling Index (MYSI) $= \frac{\text{MYS}}{15}$, where 15 years of schooling is taken to yield the value of 1 (the projected maximum to be attained by 2025). Expected Years of Schooling Index (EYSI) $= \frac{\text{EYS}}{18}$, where 18 years of schooling, equivalent to achieving a master's degree in most countries, is kept as the target yielding the full score of 1 on its attainment.

c) **Income Index (II)** $= \frac{\ln \text{ PCGNI} - \ln 100}{\ln 75{,}000 - \ln 100}$ (2.3)

where PCGNI = Per Capita Gross National Income measured in \$PPP. The Income Index (II) is 1 when GNI per capita is \$75,000 and 0 when GNI per capita is \$100.

Finally, the HDI is the geometric mean of the previous three normalised indices:

Human Development Index (*HDI*) = $\left[LEI.EI.II\right]^{\frac{1}{3}}$ (2.4)

Illustration: The values of HDI of a country for the year 2011 and 2016 are 0.82 and 0.89 respectively. The country's educational (EI) and income indices (II) are assumed to be fixed over 2011-2016. The initial life expectancy (for the year 2011) was 60 years. Estimate the value of LE for the year 2016. What is the percentage increase in LE over 2011-16?

Using Equation (2.4), we can write:

HDI for 2011: $0.82 = HI^{1/3}.EI^{1/3}.II^{1/3}$ (2.4_a)

where $HI = \frac{60-20}{65} = 0.6153$

HDI for 2016: $0.89 = (HI*)^{1/3}.EI^{1/3}.II^{1/3}$ (2.4_b)

where $HI* = \frac{LE*-20}{85-20} = \frac{LE*-20}{65}$ assuming $LE*$ to be the life expectancy for the year 2016. Divide Equation (2.4_b) by (2.4_a), we have: $\frac{0.89}{0.82} = \frac{(HI*)^{1/3}.EI^{1/3}.II^{1/3}}{HI^{1/3}.EI^{1/3}.II^{1/3}} = 1.0854.$

Since EI and II are assumed to be the same for the two time points, raising the above to the power 3, we get:

$$\Rightarrow \frac{HI*}{HI} = 1.2785 \Rightarrow HI* = 1.2785 * HI = 1.2785 * 0.6153 = 0.7866$$

$$\Rightarrow \frac{LE*-20}{65} = 0.7866 \Rightarrow LE* = 51.13 + 20 = 71.13$$

Hence, the percentage increase in life expectancy (*LE*) over 2011-2016 is:

$$\frac{LE*(2016) - LE(2011)}{LE(2011)} \times 100 = \frac{11.13}{60} \times 100 = 18.55$$

2.2.2 Health, Income and Healthcare Expenditure: Relationship

Following certain basic assumptions [that: (i) health stock depends on healthcare spending; (ii) healthcare spending depends on income; and (iii) change in income depends on current health status], a simple model to describe the relationship between health, income and healthcare expenditure can be specified as follows:

$$\frac{dY}{dt} = Y_t^{'} = h + \alpha H_t \qquad (2.5)$$

$$\frac{dH}{dt} = H_t^{'} = a + \delta S_t \qquad (2.6)$$

$$S_t = c + \tau Y_t \qquad (2.7)$$

where $0<\tau<1$, change in income i.e. $\frac{dY}{dt}$ is expressed as a function of the current health status H_t, change in health i.e. $\frac{dH}{dt}$ is expressed as a function of the current healthcare spending S_t spending on healthcare S_t is expressed as a function of the current income level Y_t with h, a, c, α, δ and τ all assumed to be non-zero. Substituting the value of S_t in Equation 2.6, we get:

$$\frac{dH}{dt} = H_t^{'} = a + \delta\left(c + \tau Y_t\right) = (a + \delta c) + \delta\tau Y_t = d + \gamma Y_t \qquad (2.8)$$

where, $d = a+\delta c$ and $\gamma = \delta\tau$. Differentiating Equation (2.8) w.r.t time 't' and substituting the value of $Y_t^{'}$ (obtained from Equation 2.5), we get:

$$\frac{d^2H}{dt^2} = H_t^{''} = \gamma\frac{dY_t}{dt} = \gamma\left(h + \alpha H_t\right) = \gamma h + \alpha\gamma H_t \qquad (2.9)$$

Differentiating Equation (2.5) w.r.t time 't' and substituting the value of $H_t^{'}$ obtained in Equation (2.8), we get:

$$\frac{d^2Y}{dt^2} = Y_t^{''} = \alpha H_t^{'} = \alpha\left(d + \gamma Y_t\right) = \alpha d + \alpha\gamma Y_t \qquad (2.10)$$

Equations (2.9) and (2.10) are 2nd order non-homogenous differential equations. Therefore, solution of each equation consists of two parts: a 'particular integral' (PI) and a 'complementary function' (CF).

Let the trial solution of PI of Equation (2.9) be $H_t = k$, so that, $H_t^{'} = H_t^{''} = 0$ and the PI from Equation (2.9) becomes: $PI = k = -\frac{h}{\alpha}$. In order to find the CF, we consider the trial solution as: $H_t = Ae^{rt}$ (i.e. we assume constant compounded growth with respect to time 't') so that $H_t^{'} = Are^{rt}$ and $H_t^{''} = Ar^2e^{rt}$. The homogenous part of Equation (2.9) thus becomes:

$\frac{d^2H}{dt^2} - \alpha\gamma H_t = 0$. Inserting the trial solution of CF, we get:

$Ar^2e^{rt} - \alpha\gamma.Ae^{rt} = 0 \Rightarrow Ae^{rt}\left(r^2 - \alpha\gamma\right) = 0$

$\Rightarrow Ae^{rt} \neq 0, \left(r^2 - \alpha\gamma\right) = 0 \Rightarrow r = \pm\sqrt{\alpha\gamma}$

The general solution of Equation (2.9) becomes: $H_t = Ae^{t\sqrt{\alpha\gamma}} - \frac{h}{\alpha}$ where we ignore the negative root. A is the arbitrary constant determined by the initial condition. Putting, t=0, we have: $H_0 = A - \frac{h}{\alpha} \Rightarrow A = H_0 + \frac{h}{\alpha}$. Therefore, the complete solution of Equation (2.9) becomes:

$$H_t = \left(H_0 + \frac{h}{\alpha}\right)e^{t\sqrt{\alpha\gamma}} - \frac{h}{\alpha} \qquad (2.11)$$

Equation (2.11) is the time path of health H_t. Since it can be assumed that initial health stock (H_0) is determined by initial level of income (Y_0), Equation (2.11) becomes:

$$H_t = \left(Y_0 + \frac{h}{\alpha}\right)e^{t\sqrt{\alpha\gamma}} - \frac{h}{\alpha} \qquad (2.11_a)$$

Similarly, the time path of income can be derived as:

$$Y_t = \left(Y_0 + \frac{d}{\gamma}\right)e^{t\sqrt{\alpha\gamma}} - \frac{d}{\gamma} \qquad (2.12)$$

The time path of income and health is closely related. If we insert the value of $e^{t\sqrt{\alpha\gamma}}$ obtained from Equation (2.11) into the Equation (2.12), we can see that income is determined by health. In the same way, one can easily check that health path is also influenced by level of income. This analytically establishes the interdependence of health with healthcare spending and income.

2.2.3 Causality between Health and Poverty

Health and poverty is jointly determined i.e. the two cannot be separated as poverty cannot be eradicated without considering health issues of the population. In other words, there is a two-way relationship i.e. health affects poverty and poverty affects health. A vicious cycle of poverty is generated in poor countries where low health status plays a major role in causing a low level equilibrium trap. Among the reasons put forward to indicate how poverty affects health are:

a) the poor have low level of material resources and hence they cannot purchase healthcare from the market. As a result, they incur huge medical expenses when they become sick;

b) due to distance of public health centers/hospitals and the transportation/ transaction costs involved, the poor cannot access the public healthcare facilities;

c) in poor countries, public healthcare is poorly organised and managed. Hence, public hospitals cannot manage to provide adequate healthcare to the patients. This leads to deterioration of health of the patients who then need immediate and proper medical intervention. Moreover, poor people reside in remote and rural areas, where public healthcare facility is either inadequate or unavailable;

d) one can avoid some of the diseases by taking preventive measures, but due to lack of income, the poor are unable to take such preventive measures;

e) poor families prefer more number of children since they provide economic incentives to the parents by working instead of going to school. This adversely affects the reproductive health of the mothers and newborn babies; and

f) poverty makes the people more vulnerable to infectious and communicable diseases increasing the probability of their death. Due to lack of income poor people cannot consume nutritious food.

Likewise, following reasons are put forward to indicate how health affects poverty.

a) Malnourished children are less attentive in the class and their performance is poor compared to healthy children. The absenteeism in school is also found to be high among the unhealthy children. Unhealthy children in the long-run are forced to join informal or unorganised sector where wage rate is low and irregular. This aggravates poverty.

a) Mortality is found to be high among the poor. If the principal earner of a family dies at an early age, the whole family falls into poverty. The dependents (viz. children) are forced to join informal jobs to avoid destitution aggravating poverty in the long-run.

b) Catastrophic health expenditure faced by poor people leads to poverty. If a member of a poor family suffers from an incurable disease, the family is forced to borrow to spend on medical care leading to poverty.

b) If the majority of the population of a country suffer from communicable and contagious disease, the foreign direct investment as well as tourism will be adversely affected. As a result, the health status of the poor counties will remain poor.

Check Your Progress 1 [answer within the space given in about 50-100 words]

1) How is the health status of a country measured?

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2) Define Self-Assessed Health Status (SAHS). What are its advantages and disadvantages?

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3) How is Human Development defined? How is it different from economic development?

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4) How does health enter into the human development index (HDI)?

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5) The values of HDI of a country for the year 2011 and 2016 were 0.72 and 0.81 respectively. The country's educational (EI) and income indices (II) are assumed to be fixed over 2011-2016. The initial life expectancy (for the year 2011) was 65 years. How do we estimate the value of LE for the year 2016? What is the percentage increase in LE over 2011-2016?

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6) How does health affect poverty?

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7) How does poverty affect health?

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2.3 HEALTH AND GENDER DEVELOPMENT

Human development index (HDI) is gender insensitive whereas 'gender development index' (GDI) is gender inequality adjusted human development. Gender development plays an important role in the context of inclusive growth and social justice. Gender discrimination directly affects the well-being of women, thus, gender equality is a legitimate policy goal. Discrimination against female is not generally observed in the developed counties but is more acute in the counties in Asia, especially South Asia including China and Korea.

According to Global Gender Gap Report-2016 compiled by World Economic Forum (WEF, 2016), out of four pillars of development (viz. health and survival, work force participation, educational attainment and political empowerment), India's position is almost at the bottom (India is placed at 142nd rank out of 144 countries). India has been progressing in terms of economic growth but such economic growth fails to correct gender imbalance in respect of health and survival.

2.3.1 Gender Adjusted Health Equality (GAHE)

Following the methodology developed by UNDP (1995), we consider X to be the indicator of development, say, the literacy rate with X_f and X_m standing for female and male literacy rate respectively. We further assume that $X_f < X_m$ and N_f and N_m are the female and male population size. The overall or mean literacy ($\overline{X}$) is therefore given by:

$$\overline{X} = \frac{N_f X_f + N_m X_m}{N_f + N_m} \qquad (2.13)$$

(2.13) can be written as: $\overline{X} = P_f X_f + P_m X_m$ where, P_f and P_m are the proportion of female and male population respectively. We want to increase $\overline{X}$ on the one hand and reduce ($X_m - X_f$) on the other. In order to solve this problem, we consider a social valuation function for achievement that is

'additively separable, symmetric and of constant elasticity marginal valuation' as:

$$V(X) = \frac{X^{1-\varepsilon}}{1-\varepsilon} \text{ , for } \varepsilon \geq 0 \text{ but } \varepsilon \neq 1 \quad (2.14a)$$

$$V(X) = \ln X \text{ , for } \varepsilon = 1 \quad (2.14b)$$

where ε stands for inequality aversion parameter with ε ≥ 0 being considered to reflect a preference for equality. For any pair (X_f, X_m) of female and male achievements, we can construct an 'equally distributed equivalent achievement' variable, X_{EDEA} , defined as the level of achievement that, if attained equally by women and men as (X_{EDEA}, X_{EDEA}), would be judged to be exactly as valuable socially as the actually observed achievements (X_f, X_m). We, therefore, have:

$$X_{EDEA} = \left\{P_f X_f^{1-\varepsilon} + P_m X_m^{1-\varepsilon}\right\}^{\frac{1}{1-\varepsilon}} \quad (2.15)$$

where, X_{EDEA}, is formed from (X_f, X_m) by taking what is called as '(1 – ε) average' of X_f and X_m rather than a simple arithmetic average of the female and male achievements. The optimum trade-off between higher achievement and gender equality is achieved through X_{EDEA} for ε > 0. When ε = 0, X_{EDEA} reduces to $\overline{X}$, the simple arithmetic average i.e. there is no concern for equality. But when ε > 0, there is a social preference for equality (or an aversion to inequality) measured by the magnitude of the parameter ε. Thus, ε is interpreted as preference to equality. Equation (2.15) is valid for literacy rate (or work force participation rate) but is not directly applicable to life expectancy. This is because potential life expectancy of female is higher than that of male. Women's higher potential life expectancy is anticipated in demographic projections as well; for the year 2050, for example, life expectancy in industrial countries is projected at 87.5 years for women and 82.5 years for men, averaging to 85 years (UNDP 1993). In considering the disaggregation of the HDI by gender, the UNDP has used separate goal posts for maximum life expectancy for females and males as 87.5 and 82.5 years respectively, reflecting a 5 year gender gap. Minimum life expectancy has been taken to be 27.5 years for females and 22.5 years for males, giving the same range of variation (60 years) for both sexes.

In the disaggregation of the HDI by gender in the UNDP's report, female and male achievements in life expectancy, X_f and X_m, have been assessed through:

$$X_f = \frac{L_f - 27.5}{87.5 - 27.5} = \frac{L_f - 27.5}{60} \quad (2.16)$$

$$X_m = \frac{L_m - 22.5}{85.5 - 25.5} = \frac{L_m - 22.5}{60} \quad (2.17)$$

where L_f and L_m are the actual female and male life expectancies.

The simple arithmetic mean (AM) $\overline{X}$ of X_f and X_m, assuming equal population share of female and male:

$$\overline{X} = \frac{X_f + X_m}{2} = \frac{1}{2}.\left[\frac{L_f - 27.5}{60} + \frac{L_m - 22.5}{60}\right] = \frac{1}{2}.\frac{1}{60}\left[\left(L_f + L_m\right) - 50\right]$$
$$= \frac{1}{60}\left[\left(\frac{(L_f + L_m)}{2} - \frac{50}{2}\right)\right] \qquad (2.18)$$
$$= \frac{1}{60}\left[\overline{L} - 25\right] = \frac{\overline{L} - 25}{60}$$

where, $\overline{L} = \frac{L_f + L_m}{2}$

Thus, the approach to adjusting for gender inequality for life expectancy must first involve a rescaling to take note of the potentially greater longevity of women. Such adjustments are a part of the methodology already under use by UNDP in estimating GDI. Therefore, instead of taking simple AM of X_f and X_m, we take (1 – ε) average (for ε > 0). As before, we form the average X_{EDEA}, for ε ≠ 1 as:

$$X_{EDEA}^{1-\varepsilon} = 0.5 * X_f^{1-\varepsilon} + 0.5 * X_m^{1-\varepsilon} \qquad (2.19)$$

Using Equations (2.15) and (2.18) and inserting the adjusted values of X_f and X_m, and replacing L for life expectancy, we get:

$$\left[\frac{L_{EDEA} - 25}{60}\right]^{1-\varepsilon} = 0.5 * \left[\frac{L_f - 27.5}{60}\right]^{1-\varepsilon} + 0.5 * \left[\frac{L_m - 22.5}{60}\right]^{1-\varepsilon} \qquad (2.20)$$

when $\varepsilon = 0, L_{EDEA} = \overline{L}$, if $\varepsilon > 0, L_{EDEA} < \overline{L}$. Thus, L_{EDEA} is the gender adjusted Life Expectancy.

UNDP (1995) has suggested the value of ε = 2, which is assumed to be moderate inequality aversion parameter in preference to equality.

2.3.2 Empirical Exercise

A numerical exercise will help us to understand the problem of 'equally distributed equivalent achievement' in respect of health variable viz. LE. In order to simplify the problem, let us consider two countries, A and B. The life expectancy of the two countries, for male and female, is given below.

Country	Female Life Expectancy (LE_f)	Male Life Expectancy (LE_m)
A	72	70
B	72	74

From Equation (2.20), we can write:

$$\left[\frac{L_{EDEA}-25}{60}\right]=\left[0.5*\left(\frac{LE_f-27.5}{60}\right)^{1-\varepsilon}+0.5*\left(\frac{LE_m-22.5}{60}\right)^{1-\varepsilon}\right]^{1/1-\varepsilon}$$

L_{EDEA} stands for equally distributed equivalent achievement representing gender adjusted life expectancy at birth. Now, we insert the values of LE_f and LE_m and setting inequality aversion parameter, ε=2 which are assumed to be moderate as suggested by UNDP (1995) for country A:

$$\left[\frac{L_{EDEA}-25}{60}\right]=\left[0.5*\left(\frac{72-27.5}{60}\right)^{1-2}+0.5*\left(\frac{70-22.5}{60}\right)^{1-2}\right]^{1/1-2}$$

$$\text{Or, } \left[\frac{L_{EDEA}-25}{60}\right]=\left[0.5*(0.7416)^{-1}+0.5*(0.7916)^{-1}\right]^{-1}=0.7657$$

$$\Rightarrow L_{EDEA}=60*0.7657+25=70.94$$

In the same way, we can estimate the EDEA of life expectancy for country B as:

$$\left[\frac{L_{EDEA}-25}{60}\right]=\left[0.5*\left(\frac{72-27.5}{60}\right)^{1-2}+0.5*\left(\frac{74-22.5}{60}\right)^{1-2}\right]^{1/1-2}$$

$$\Rightarrow L_{EDEA}=0.7957*60+25=72.74$$

Gender adjusted life expectancy (L_{EDEA}) is socially desirable. It makes some optimum trade-off between overall life expectancy and gender differential in life expectancy.

In the context of focusing on health for optimum human resource development, 'reproductive and child health' (RCH) is kept as the broader goal. RCH has a multidimensional sphere which includes pregnancy, child birth and post partum care, maternal and infant nutrition, breastfeeding, sexual behaviour, STDs and HIV/AIDS and reproductive rights. Under these circumstances, there is an increasing thinking in the scientific community on the need to stress on maternal health in essence of their reproductive health problems. India, at the aggregate level is expected to enjoy the benefit of demographic dividend roughly after 2025 but only the numbers of working age cohort cannot guarantee to generate sufficient income if the health status of the future working population remains poor. Thus, in order to get the real benefit of demographic dividend in near future, we must know about the present health status of the mothers and children so that appropriate measures can be undertaken to improve RCH.

Check Your Progress 2 [answer within the space given in about 50-100 words]

1) Define gender adjusted heath equality.

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2) Define Equally Distributed Equivalent Achievement (EDEA) in respect of life expectancy.

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3) Why re-scaling of LE of both male and female is needed to estimate EDEA of LE?

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4) Assume that female and male life expectancy is 63 and 62 respectively of a country, A. The maximum life expectancy for females and males are 87.5 and 82.5 years respectively, reflecting a 5 year gender gap. The Minimum life expectancy has been taken to be 27.5 years for females and 22.5 years for males, giving the same range of variation (60 years) for both sexes. Find gender adjusted life expectancy (viz. EDEA of LE) of the country A.

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2.4 HEALTH INEQUALITY AND SOCIO-ECONOMIC STATUS

Health and health seeking behaviour of the individuals depends on socio-economic status. The term socio-economic status includes: income, occupation, consumption pattern, education, caste, culture, life style, religion, living conditions, work place environment, residence in rural or urban, etc.

Age of an individual also affects health as children and old-age people are more vulnerable with their probability of death being higher than the youth. Thus, a large number of predictors affect the health of an individual. Health inequality varies between different socio-ethnic and cultural groups. Health inequality also directly varies with the educational status of individuals. Geo-climatic conditions, occupations and income also affect the inequality of health of different communities.

2.4.1 Concentration Curve and Concentration Index (CI)

Health inequality is much more serious than income inequality. Income inequality can be reduced by imposing tax or by other measures but health inequality is structural in nature i.e. there is no automatic mechanism to eliminate health inequality. It requires longer time to bring down health inequality as compared to income inequality as the latter can be reduced even in short term by transferring income from rich to poor. Health inequality may create negative externality. For instance, a domestic helper with TB has a higher chance of affecting others by TB, especially kids, and the old aged.

There are three classes of inequality measures viz. (i) Lorenz class (e.g. Gini coefficient), (ii) Entropy class (e.g. Mean Log Deviation, Theil Index, Coefficient of Variation) and Welfare Based Measure (e.g. Atkinson Index). All these measures, with their own merits and demerits, are used mainly to estimate income, education and health inequality. But Concentration Curve (CC) and Concentration Index (CI) are explicitly used to identify socio-economic inequality i.e. whether it is more pronounced at one point in time than another or in one country than another. But a concentration curve does not give a measure of the magnitude of inequality whereas the concentration index (CI) does it by quantifying the degree of socio-economic inequality with a particular focus on a health variable. It is used to measure and compare the degree of socio-economic inequality in respect of: child mortality, child immunisation, child malnutrition, adult health, health subsidies, healthcare utilisation, etc. In this section, we will first define the CI and its properties. We then describe its estimation procedure for grouped and micro-data.

Concentration Curve (CC) plots the cumulative percentage of health variable against the cumulative percentage of population ranked by socio-economic status. For instance, in Fig. 2.1, horizontally we have measured cumulative percentage of population ranked by income and vertically we have measured the cumulative percentage of ill health. The figure depicts that ill health (bad health) is disproportionately higher among the poor people since the CC lies above the line of equality. In other words, it plots shares of the health variable against the variable for living standards. The CI is defined as twice the area between the CC and the line of equality (i.e. the 45-degree line). Thus, when there is no socio-economic inequality, the CI is zero. The convention is to assign a negative value to CI when the curve lies above the line of equality to indicate disproportionate concentration of ill-health among the poor, and a positive value when it lies below the line of equality. In

particular, if the health variable is a 'bad' like ill health [e.g. infant mortality rate (IMR), malnutrition, anemia], a negative value of CI means ill-health is higher among the poor.

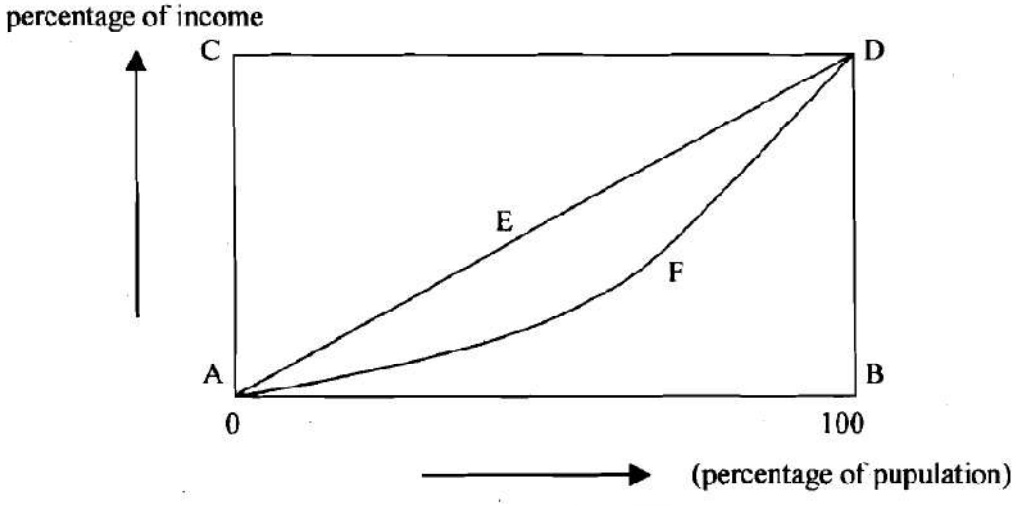

Fig. 2.1: Concentration Curve

Mathematical form of CI: If the health variable is bad and the corresponding cumulative proportion of persons ranked by income) is continuous:

$$CI = 1 - 2\int_0^1 L_h(p)dp \qquad (2.21)$$

where, $\int_0^1 L_h(p)dp$ stands for the area between CC and line of equality.

For a discrete variable of living standards, it is:

$$CI = \frac{2}{N\mu}\sum_{i=1}^{n} h_i r_i - 1 - \frac{1}{N} \qquad (2.22)$$

where h_i is the health sector variable, μ is its mean and $r_i = \frac{i}{N}$ is the fractional rank of individual i in the living standards distribution with i = 1 for the poorest and i = N for the richest. For computational purposes, a more convenient formula for CI, defined in terms of the covariance between the health variable and the fractional rank in the living standards distribution, is given as:

$$CI = \frac{2}{\mu} Cov(h, r) \qquad (2.23)$$

Note that if we expand (2.23), we get (2.22). Hence, there is no difference between Equations (2.22) and (2.23).

In case of grouped data, the CI is estimated by using the formula:

$$CI = (P_1L_2 - P_2L_1) + (P_2L_3 - P_3L_2) + ...(P_{T-1}L_T - P_TL_{T-1}) \qquad (2.24)$$

where P_T is the cumulative proportion of the sample ranked by economic status in group t (t =1,2,3…T), and L_t is the corresponding concentration curve ordinate.

Properties of Concentration Index (CI): The properties of the CI depends on the measurement characteristics of the variable of interest. It is an appropriate measure of socio-economic-related healthcare inequality when healthcare is measured on a ratio scale with non-negative values. The main properties of CI are:

a) CI is invariant to multiplication of the health sector variable of interest by any scalar;

b) CI is not invariant to any linear transformation of the variable of interest. Even adding a constant to the variable will change the value of the concentration index;

c) measurement of health inequality often relies on self-reported indicators of health. A concentration index cannot be computed directly from such categorical data, although the ordinal data can be transformed into some cardinal measure and a concentration index can be computed; and

d) unlike the Gini Coefficient, the CI lies between –1 and +1.

2.4.2 Empirical Illustration of CI

Exercise 1: Hypothetically, the SAHS and income of 10 individuals are recorded as in Table 2.1. Calculate the CI for this individual sample data.

Table 2.1: SAHS Data by Income

Individuals	1	2	3	4	5	6	7	8	9	10
SAHS	19.2	13.6	18.1	13.9	14.5	13.5	39.3	30.3	25.1	38.7
Income('00)	574	609	1470	1885	2320	2529	3431	3654	4413	4529

The income of the individuals are given in ascending order, therefore, we need not arrange these. If income is given in a haphazard order, we have to re-arrange data first in ascending order and proceed. Necessary calculations towards estimation of CI are shown in Table 2.3.

Table 2.2: Computations for Estimation of CI Using Data in Table 2.1

Income ('00)	SAHS (h_i)	Income Rank	Fractional Income (r_i)	$h_i r_i$
574	19.2	1	0.1	1.92
609	13.6	2	0.2	2.72
1470	18.1	3	0.3	5.43

1885	13.9	4	0.4	5.56
2320	14.5	5	0.5	7.25
2529	13.5	6	0.6	8.1
3431	39.3	7	0.7	27.51
3654	30.3	8	0.8	24.24
4413	25.1	9	0.9	22.59
4529	38.7	10	1	38.7
	∑226.2			∑144.02

Inserting the computed values in Equation (2.22) we get:

$$CI = \frac{2}{N\mu}\sum_{i=1}^{n} h_i r_i - 1 - \frac{1}{N} = \frac{2}{10 * 22.62} * 144.02 - 1 - \frac{1}{10} = 0.1733$$

This is positive which means that good health (SAHS) is higher among the richer and the CC will lie below the line of equality.

Exercise 2: Estimate CI for grouped data as given in Table 2.3.

Table 2.3: Estimation of CI for Grouped Data

WG	NB	RPB	CPB (P_T)	U5MR	ND	RPD	CPD (L_T)	CI
Poorest	29939	23	23	154.7	4632	30	30	-0.0007
2nd	28776	22	45	152.9	4400	29	59	-0.0267
Middle	26528	20	66	119.5	3170	21	79	-0.0592
4th	24689	19	85	86.9	2145	14	93	-0.0827
Richest	19739	15	100	54.3	1072	7	100	0.0000
Total/ Mean	129671			118.8	15419			-0.1715

Note: WG=Wealth Group, NB=Number of Births, RPB= Relative % of Births, CPB= Cumulative Percentage of Births, U5MR=Under Five Mortality Rate Per Thousand, ND= No. of Deaths, RPD= Relative Percentage of Deaths, CPD= Cumulative Percentage of Deaths, CI=Concentration Index.

Source: World Bank.

In case of group data, the CI is estimated using formula 2.24. Using Equation (2.24), we get:

CI= (0.23 * 0.59 – 0.45 * 0.30) + (0.45 * 0.79 – 0.66 * 0.59) +

(0.66 * 0.93 – 0.85 * 0.79) + (0.85 * 1 – 1 * 0.93)

= (–0.0007) + (–0.033) + (–0.0578) + (–0.08) = – 0.1715

In Equation 2.29, P_T is the cumulative proportion of the sample ranked by economic status in group t (t =1,2,3…T), and L_t is the corresponding concentration curve ordinate (measured in proportion).

Check Your Progress 3 [answer within the space given in about 50-100 words]

1) What is meant by socio-economic status (SES)? How is health inequality related to SES?

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2) Define Concentration Curve (CC). Under what circumstances CC will lie above and below the Egalitarian line? Can CC coincide with the line of equality?

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3) What is Concentration Index (CI)? What does it capture?

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4) Give the economic meaning of CI if it becomes negative, zero and positive.

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5) State the properties of CI?

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6) Find the CI from the following data

Individuals	1	2	3	4	5	6	7	8	9	10
SAHS	21.3	13.6	18.1	14.9	12.5	13.5	26	30	25	38
Income('00)	500	450	525	1800	1300	1250	900	1400	1150	4500

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7) Find the wealth based health inequality using group CI.

Wealth Group	**Births**	**% of Births**	**Cumulative % of Births**	**U5MR**	**% of Mortality**	**Cumulative (%)of Mortality**
lowest	8331	25.16	25.16	837.27	34.27	34.27
second	7432	22.44	47.60	665.91	27.26	61.53
middle	6518	19.68	67.28	468.65	19.18	80.71
forth	6032	18.22	85.50	308.84	12.64	93.36
highest	4802	14.50	100.00	162.31	6.64	100.00
Total/Mean	33115	100.00		2442.9	100.00	

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2.5 LET US SUM UP

Measuring the health status of an individual is more of a subjective phenomenon. To make it objective, a method like SAHS is used. There is a close linkage between health, healthcare spending and income. The HDI, 2010 is a composite index which takes into account the education and the health attainment for which the 'mean years of schooling' and 'life expectancy at birth' are respectively used. There is a two-way causality between health and poverty. Whereas HDI is gender insensitive, GDI is adjusted for gender inequality. GDI, adjusted for health inequality, is nowadays used by UNDP. These concepts are first explained and then illustrated for empirical computations. Further, to accommodate for varying levels of socio-economic attainment, two measures of health inequality, namely the concentration curve and concentration index are also discussed in the unit.

2.6 KEY WORDS

SAHS : Health status is first ordinally recorded for certain health related functions like walking, breathing, digestion, hearing, chronic health disorder etc. An individual can the self-assess to obtain a pre-specified score as a cardinal number for each of specific health related functions. The score or index so obtained by the individual is known as self assessed or self reported health status (SAHS).

Human Development : Human development is a process of enlarging people's choices – the three essential choices identified as: a long and healthy life, with knowledge or skill acquired by 'years of schooling' and with ability to access resources needed for maintaining a decent standard of living. In Human Development, human beings are both the means and the ends in the development process.

Equally Distributed Equivalent Achievement (EDEA) : An optimum trade-off between higher achievement and gender equality is achieved by an Equally Distributed Equivalent Achievement variable, X_{EDEA} for a positive inequality aversion parameter ε, $\varepsilon > 0$.

Concentration Curve : Concentration Curve (CC) plots the cumulative percentage of health variable against the cumulative percentage of population ranked by socio-economic status.

Concentration Index : The concentration index (CI) is directly related to the concentration curve, and quantifies the degree of socio-economic related inequality in a health variable.

2.7 SOME USEFUL BOOKS AND REFERENCES

1) Grossman, M (1972). 'On the Concept of Health Capital and the Demand for Health', *Journal of Political Economy*, 80 : 223-255.

2) Haldar, S.K., (2008). 'Effect of Health-Human Capital Expenditure on Economic Growth in India: A State-Level Analysis', *Asia-Pacific Social Science Review*, 8 (2), 79-97.

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6) Wagstaff, A., E. van Doorslaer, and N. Watanabe. (2003). 'On Decomposing the Causes of Health Sector Inequalities, with an Application to Malnutrition Inequalities in Vietnam', *Journal of Econometrics* 112(1): 219–27.

7) World Economic Forum. (2016). '*The Global Gender Gap Report',* World Economic Forum, Geneva.

2.8 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) For a country, HDI has come to replace the earlier used PC NI.

2) SAHS is a measure of one's own assessment of health related to pre-recorded 'conditions of health' arrived at for a group of individuals with similar backgrounds. Though it makes the task of assessment of health easier, it suffers from the influence of cultural, social, economic, personality and general outlook factors.

3) Human development is taken to encompass three types of choices, each in the areas of health, education and overall ability to access other resources and opportunities (Sub-section 2.2.1).

4) Health is factored-into HDI through the proxy 'life expectancy'.

5) Follow the same steps indicated in the 'illustration' in the Sub-section 2.2.1.

6) Through malnourishment, mortality and catastrophic health expenditure.

7) Low income, high healthcare cost, transaction/transport cost, inability to take preventive measures, etc.

Check Your Progress 2

1) GAHE is defined as '(1 – ε) average' where ε represents inequality aversion parameter with $\varepsilon \geq 0$ being considered to reflect a preference for equality (Sub-section 2.3.1).

2) EDEA is defined as the level of achievement that, if attained equally by women and men, would be judged to be exactly as valuable socially as the actually observed achievements (Sub-section 2.3.1). The optimum trade-off between higher achievement and gender equality is achieved through X_{EDEA} for $\varepsilon > 0$.

3) This is because potential life expectancy of female is higher than that of male (Sub-section 2.3.1).

4) Follow the steps shown in the illustration in Sub-section 2.3.2.

Check Your Progress 3

1) The term socio-economic status includes: income, occupation, consumption pattern, education, caste, culture, life style, religion, living conditions, work place environment, residence in rural or urban, etc.

2) Concentration Curve (CC) plots the cumulative percentage of health variable against the cumulative percentage of population ranked by socio-economic status (Sub-section 2.4.1).

3) The CI is defined as twice the area between the CC and the line of equality (i.e. the 45-degree line). Concentration index (CI) quantifies the degree of socio-economic inequality with a particular focus on a health variable.

4) When there is no socioeconomic inequality, the CI is zero. A negative value of CI means ill-health (Sub-section 2.4.1).

5) Invariant to multiplication by scalar, non invariant to any linear transformation including addition of a constant, etc. (Sub-section 2.4.1).

6) Follow the steps in exercise 1 of Sub-section 2.4.2.

7) Follow the steps in exercise 2 of Sub-section 2.4.2.