Chapter I

Introduction and Previous Studies

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Introduction and Previous Studies

1.1. INTRODUCTION

Income and economic growth measured in terms of increase in gross domestic product (GDP) have been the center stage of the Government’s developmental policy. Since long, Indian economy is striving to adjust to the structural transformation arising due to the liberalization. Among other changes, human capital development in order to increase employment and employability of the labour force are the basic features of economic reforms and structural transformation. Human capital development is the means and ends of the economic growth. At the policy level, human capita development was adopted in the eighth five-year plan for 1992-97; since then human capital has been considered as of strategic importance for economic development. Human capital intensive agriculture and service sector contributed 14.1% and 58.2% respectively of the GDP and respectively contribute 58.2% and 25.3% of the total employment in India in 2011-12 (MOF, 2013a, 2013b).

Majority of the states in India have recorded a consistent decline in infant and child mortality as well as decline in fertility and low dependency ratio. In the age structure transition stage, working-age population grows faster than the population as a whole (Blue & Espenshade, 2011; James, 2011; Lee, 2003). Per capita real GDP in India has increased from ₹9,134 to ₹35,970 during 1981 to 2010, simultaneously, life expectancy at birth has increased from 56 to 67 years, and total fertility rate (TFR) has declined from 4.5 to 2.5 during the same period (ORGI, 2012; RBI, 2013). Such increase in life expectancy at birth and reduction in TFR has resulted in an increased share of working age (15-65) population. According to the UN (2012) estimates, the present (2015) size of the labour force is 849 million and which is expected to increase to 1,098 million by 2050. The dependency ratio
in 1950 was 68, which declined to 51 in 2011 and is expected to drop to 48 by 2050. Working age structure transition shown in Figure 1.1 depicts that the share of working age population will continue to increase till 2050, which means a majority of the adults will be in the prime working age 25 to 50 years.

Good health maximizes the labour productivity by increasing efficiency to work hard for a longer period without absenteeism from the work. Indirectly, better health also increases the average education level through high parental investment in child schooling, cognition development, less absenteeism and dropout from the school (Bloom, Canning, & Graham, 2003; Bloom, Canning, Mansfield, & Moore, 2007; Bloom, Canning, & Shenoy, 2011). Over this, low mortality escalates the pay off period and post retirement life expectancy. Hence, better health promotes savings followed by investment in skill development and physical capital. Directly and indirectly diseases reduce the annual income of society, the lifetime income of individuals, and prospects for economic growth (Sachs, 2001). Health is relatively more critical for a developing economy where a large segment of the labour
force is engaged in manual work (George A.O. Alleyne & Daniel Cohen, 2002). In this context, the present study focuses on health component of human capital, as a determinant of economic growth. Thus, given the physical capital endowment in terms of abundant supply of labour, quality of labour measured in terms of human capital will determine the future economic growth in India (Bloom, 2011a). Hence, it is worth to investigate the effect of health on human capital formation, income, and economic growth in India.

1.1.1. *Inter-state variation in health, Income, and economic growth*

On an average, due to premature mortality among the working age (15 to 65 years) population there is loss of four person years in life, grossly India lost 2,938 million person years in 2010. By state, person years lost is highest in Uttar Pradesh (U.P.) (4.5) and the lowest in Kerala (2.4) in 2010 (ORGI, 2012). India is burdened with a number of preventable premature deaths, India will gain 3.1 years of the life expectancy and 4% to 12% higher GDP, due to 50% reduction of preventable infant and child mortality (MOHFW, 2005). On the other side, 50% reduction in CVD deaths can raise average life expectancy at birth by 1.3 years and GDP by 2% to 5% in India. Similarly, eradication of tuberculosis (TB) will increase average life expectancy by 0.12 years and overall GDP by 0.5% (MOHFW, 2005).

Income and productivity loss due to mortality and morbidity among the poor is relatively higher than the rich. According to the IHDS 2005, person of age 15-65 years lost 10 person days due to morbidity in India in 2005, such figure is 11 for rural area and 7 days for urban area. At the gross level, India lost 7,001 million person days due to morbidity in 2005. By state, Bihar lost the highest 21 person days, and Assam lost the lowest three person days in a year due to morbidity in 2005. Person from rural and urban area lost 10 and 5 days respectively (Desai et al., 2007). Figure 1.2 shows that together due to
premature mortality and morbidity, India lost 5.5 person years in 2005, compared to the highest 7 person years in Bihar and the lowest 4 person years in Kerala (Desai et al., 2007). Largely, there is not considerable inter-state differential in person years lost due to morbidity except lowest in Kerala and the highest in Bihar. Assuming all care-givers and sick individuals of age 15 and above are productive (Engelgau, Karan, & Mahal, 2012), an estimated one trillion rupees loss happened in GDP in 2004 due to Cardiovascular Disease (CVD) in India.

1.2. CONCEPT, DEFINITION, AND MEASUREMENT

According to World Health Organisation, (WHO, 1946) health is ‘a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’. Thus, the multidimensional concept of health and associated health measurement error determines the association with income and labour productivity. Health dimensions and its determinants vary over the life course, and have a different effect on one’s productivity and labour supply. On the other hand, health measurement error may be related with the
health outcome thereby demand for health, labour supply, and productivity. Considering the multidimensional nature of health and its measurement error mortality, morbidity, and physical function are the crude measures of population health (Thacker et al., 2006).

1.2.1. **Macro measurement of health**

Infant and child mortality measures the comparison of population health at a point of time, and also progress over time (C. J. Murray, Salomon, & Mathers, 2000). Economic development has a strong association with infant mortality because of the high correlation of infant mortality with sensitive measures (disability adjusted life expectancy, DALE) of population health (Reidpath & Allotey, 2003). Whereas adult survival rate (ASR), measures the survival during working years (15-65) is also a good indicator of the working population health (Well, 2007). Studies have shown that higher survival probability increases the parental investment in children’s education and health (Bils & Klenow, 2000). Being highly correlated with under-five mortality, adult survival rate gives the average health status of the population and measures the health status of the working age population.

1.2.2. **Micro measurement of health**

At the micro level, self-reported general health status, morbidity, and functional limitation are the widely used measures of health outcome. General health status is best single health index foretell the subsequent morbidity and mortality (Miilunpalo, Vuori, Oja, Pasanen, & Urponen, 1997; Singh-Manoux et al., 2007). Irrespective of the nature and interaction among diseases, self-reported morbidity measures the consequences of ill health and person days lost due to morbidity (Ferraro & Su, 2000; T. Paul Schultz & Tansel, 1997). However, poor health and sickness perception differs not only by culture but also by age, sex, race, and socio-economic characteristics. Self-reported health and morbidity could not
differentiate true health from measurement error. Thus, the association between health outcome and labour force participation, productivity, and wages will be biased upward (Kim M Iburg, Salomon, Tandon, Murray, & Policy, 2001; C. J. L. Murray & Chen, 1992). Another self-reported health measure physical functioning measures the difficulties in activities of daily living (ADLs) like walking, sitting, bending, climbing etc. Self-reported ADLs index is truly comparable across different population and subgroups within population; hence ADLs index is less prone to measurement error as self-reported health and morbidity (Kuhn, Rahman, & Menken, 2006; John Strauss, Gertler, Rahman, & Fox, 1993). However, ADLs only capture the physical health problems such as shortness of breath, joint problems, or back problems.

1.2.3. Nutrition or calorie intake as a measure of micro measurement of health

Taking nutrition intake as a health input, micro level studies have established the efficiency-wage hypothesis (Alok Bhargava, 2001; Anil B. Deolalikar, 1988; John Strauss & Thomas, 1998; Weinberger, 2004). Nutrition intake and subsequent health outcome, anthropometries portend the perceived health, morbidity, and physical functioning. High calorie intake among the nutritional deficient population increases the height during infancy and income among adults (Juan Alberto Fuentes, Julio Fernandez, & Maria Pascual, 2001; Martorell, Horta, et al., 2010; Martorell, Melgar, Maluccio, Stein, & Rivera, 2010; J. Strauss, 1986). Increased calorie availability for work has made a significant contribution in due course of 200 years of the industrial revolution followed by per capita income growth in the Western Europe (Fogel, 1994).

Based on consumer expenditure survey 50th round of the NSSO Weinberger (2004) found that wage will increase by 5-17% if household achieve the recommended level of iron intake. Readily available conversion table can be used to calculate nutrient intake from
food consumption. Though net energy intake is associated with labour productivity, but it is extremely difficult to measure. Again, calorie intake is measured at the household level, whereas wage is recorded for the individuals. Calorie-wage relation will be biased if calories intake are not shared equally among the household members (John Strauss & Thomas, 1998). This measurement error could be minimized by calculating 24-hours food recalls measured at the individual level. Based on 24-hours food recall Alok Bhargava (1997) found a significant association between calorie intake and probability of rural man engaged in high wage earning strenuous activities.

Anthropometric health outcomes such as height, weight, and BMI have an association with the health input, nutrition intake, in the health production function. Child height is the long-run indicators of nutritional status, which depends on the human capital investment during childhood (Behrman, 2009; John Hoddinott, John A. Maluccio, Jere R. Behrman, Rafael Flores, & Reynaldo Martorell, 2008; Cesar G. Victora et al., 2008). Height is positively correlated with schooling, and provides benchmark to evaluate the magnitude of association between health and wage (John Strauss & Thomas, 1998). Hence, collectively height and weight (BMI) are the most common measure of nutritional status and suffer less from measurement error.

1.2.4. Measurement of human capital

Empirically, human capital is the aggregation of acquired physical health, education, on-the-job training, experience, searching about the job opportunity, and mobility that enhances individual’s productivity in the labour market (Kiker, 1966; Mincer, 1958, 1996). Combining market and non-market activities of the labour force, human capital may be defined as “the aggregation of the innate capabilities and the knowledge and skills that are acquired and developed throughout the lifetime of an individual”. Hence, the potential of
innate physical, cognition, and psychological abilities is realized by the acquired knowledge, experience, and skill (Jongsma, 1982; Laroche, Mérette, & Ruggeri, 1999; T. Paul Schultz, 1994). Human capital development involves innovation of new knowledge along with the transmission and embodiment of available knowledge. This is the basics of technological development, high total factor productivity, and economic growth regardless of its initial level (Mincer, 1984, 1996).

1.2.5. Measurement of income and economic growth

Income is the possession of economic resources or purchasing power of an individual, which gives the command to attain material, social, and health wellbeing. The economic growth is the improvement in material that is achieved by sustained improvement in the mode and input of production (Quah, 2001). Economic growth is measured as economic magnitude, unit of observation, sustainability, and transitory (Kuznets, 1947). Sustained growth in average income leads to the material and social wellbeing through increased employment opportunity (Khan, 2007).

1.3. PREVIOUS STUDIES

1.3.1. Health and human capital formation

Health is a form of human capital as well as an input to produce other forms of human capital i.e., through which the quality of labour further augments the human capital development. Childhood undernutrition increases the likelihood of developing chronic diseases, hence high child morbidity and mortality, hence negative cumulative effect on physical development, school enrolment, cognitive and skill development (Alessandro Tarozzi & Aprajit Mahajan, 2007; Atine et al., 2005; S. Grantham-McGregor et al., 2007; Haas et al., 1995; John Hoddinott et al., 2008; Lozoff, Jimenez, & Smith, 2008).
2006; Susan P. Walker et al., 2007). Poor health in the childhood not only directly affects the adult health, but also through the low immunity based high susceptibility to the incidences of morbidity (Ahmed et al., 1999; S. M. Grantham-McGregor, Walker, Himes, & Powell, 1993; Lutter et al., 1989). Thus, child nutrition or health in the developing countries has enormous impact on human capital formation, labor productivity and economic growth (Belli, Bustreo, & Preker, 2005; John Hoddinott et al., 2008; Sahn & Alderman, 1988; Stenberg et al., 2014).

Studies have shown that child has potential to grow and recover from stunting and underweight during childhood (Adair, 1999; Belli et al., 2005; Fink & Rockers, 2014; Johnston & Macvean, 1995). And, Nutritional supplementation among the severely stunted children has significant positive effect on recovery from stunting and underweight than the relatively healthy ones (Anil B. Deolalikar, 1988; J. Strauss, 1986; John Strauss & Thomas, 1998). Moreover, between mid-childhood and adolescent an individual attains the maximum physical growth and the concomitant cognition development (Berk, 2010; Liem et al., 2013; WHO, 2015).

1.3.2. Nutrition intake, labour productivity, and wage

Better nutritional status increases individual efficiency to work more and reduces the absenteeism from work due to illnesses (Bloom & Canning, 2000). In the form of “Efficiency Wage Hypothesis”, Leibenstein (1957) first formulated the relationship between nutritional intake, labor market productivity, and wage determination. Increase in calorie intake enabled workers to perform more demanding tasks, expressed in a greater marginal productivity as measured by wages (Mrrlees, 1975; Stiglitz, 1976). Nutrition deficiency reduces the hemoglobin level; hence lower the individual’s endurance to work hard for a long period (Duncan Thomas & Frankenberg, 2002). At the micro level,
improved nutrition or calorie intake increase the labour productivity through per time unit worked and labour supply per adult (John Hoddinott et al., 2008; J. Strauss, 1986; John Strauss & Thomas, 1998; Swaminathan, Edward, & Kurpad, 2013; Duncan Thomas & Frankenber, 2002; D Thomas & Strauss, 1997). Studies have established the positive effect of calorie intake on productivity and wage of the agricultural worker in India (Aziz, 1995; Anil B. Deolalikar, 1988; Jha, Gaiha, & Sharma, 2009). Also, at a low level of income and nutrition distribution, increased calorie intake leads to higher labour productivity and wage but at a decreasing rate (Dasgupta, 1997; Anil B. Deolalikar, 1988; John Strauss & Thomas, 1998).

J. Strauss (1986) reports a significant effect of calorie intake on farm productivity in Sierra Leone. He estimates a calorie-farm output elasticity of 0.33, implying that a worker who consumed 1500 calories daily would be only 60% as productive as a worker consuming 2400 calories. Sahn and Alderman (1988) estimate a calorie-wage elasticity of 0.2 only for men but not for women in Sri Lanka. D Thomas and Strauss (1997) quantify the effect of height, BMI, per capita calorie intake, and per capita protein intake on wages in Brazil and find that all the four indicators have positive impact on wages in Brazil. Furthermore, they show a non-linear relationship between calorie intake and wage, further highlighting the fact that severely malnourished workers benefit more from higher calorie intake. Alok Bhargava (1997) also noted the positive effect of calorie on wages in Rwanda. In a more recent study by Jha et al. (2009), the evidence on the effect of micronutrients and calorie on wages is mixed. The effects differ by gender of workers and nature of work. For example, calorie coefficient was significant only in the cases of harvesting and sowing wages of female.
Similarly, using a sample of Indian agricultural workers, Anil B. Deolalikar (1988) shows a strong positive effect of weight-for-height on market wage rate and farm output in rural South India but no such significant effect of calorie was found on wage and farm output. Effect of calorie intake on wage or income depends on demand for labour, for example, high wage-calorie elasticity in peak agriculture season (J. R. Behrman, A. D. Foster, & M. R. Rosenzweig, 1997; Swamy, 1997).

1.3.3. Health, income, and economic growth

Health as an input and output of human capital, affects the labour physiology and their’s productivity through increased physical capacities, endurance, knowledge and skill development (Bloom & Canning, 2005; Paul E. McNamara, Ulimwengu, & Leonard, 2010). Moreover, poor health directly reduces income through person years lost due to morbidity and/or premature death, and also reduces the labour productivity due to low efficiency to work hard for a long period (Alok Bhargava, 1997; Bloom & Canning, 2000; Bloom, Canning, & Fink, 2009; Well, 2007). Low infant and child mortality promotes the parental investment in schooling and skill development due to long payoff period caused by increased life expectancy and low infant and child mortality (Lorentzen, McMillan, & Wacziarg, 2008; J. Strauss, 1986; John Strauss & Thomas, 1998). Healthier children have better attendance, lower dropout likelihood, and high cognition; thereby they receive a better education for a given level of schooling and high per capita effective labour (Anne Case & Christina Paxson, 2008; Alok Bhargava, 2001; Sachs, 2001). Moreover, increased longevity promotes the savings, which in turn raises the per worker physical capital (Bloom et al., 2003; Bloom, Canning, & Sevilla, 2004). At a low level of income and nutrition, health has a significant effect on labour productivity (T. P. Schultz, 2003); as in a study Anil B. Deolalikar (1988) has established a strong positive effect of weight-for-height on market wage rate and firm output in south India. Maternal and child under-
nutrition have not only has short term effect in the middle and low income countries, but also long-term effect on adult human capital, including height, school achievement, economic productivity, and birth weight of the offspring (Cesar G. Victora et al., 2008).

1.3.4. Distribution of health, income, and economic growth

Micro economic evidence suggests that labour productivity rises with health but at a decreasing rate. Improvement in health has strong positive effect on labour productivity at the low level of health and economic equilibrium. Thus, there is a link between the distribution of health and labour productivity. Measuring socio-economic health inequality by child mortality gradient over mothers’ education Grimm (2011) found the negative effect of health inequality on economic growth. In an economy, with a high degree of health inequality, if healthy workers are better paid only, then association between average health and aggregate productivity may be unrelated or negative (Jack & Lewis, 2009).

Testing nutrition-productivity hypothesis J. Strauss (1986) found the highly significant effect of calorie intake on the family farm labour productivity, but the marginal effect of increasing calorie consumption on labour productivity, falls considerably. Additional energy intake is associated with the higher labour productivity among the poorly nourished population. However, due to low adaptation of body after a certain threshold in the short run marginal productivity gain from addition calorie intake diminish or may become zero or negative (Anil B. Deolalikar, 1988; John Strauss & Thomas, 1998).

Contrary to the effect of health inequality on income and economic growth, Bezruchka, Namekata, and Sistrom (2008) has shown that post World War II drastic increase in life expectancy in Japan is the result of economic inequality. Swamy (1997) found that over the relevant range calorie intake has much stronger impact on labour productivity. Similarly, Hübler (2009) established the nonlinear height effect on wage is higher if higher
the lagged GDP growth rate. At the individual level, maximum effect of height on wage
for men is above the mean of male weight, whereas maximum wage value of height for
women is below the average female height. Nonlinear wage and productivity relation
foretell that economic growth in a country will be exceedingly high after a certain
threshold of average nutritional or health status.

1.3.5. Indeterminacy of the effect of health on income and economic growth

The notion of health status is the sole determinant of cross-country income differentials
and economic growth has been challenged on many grounds. Due to lagged effect of
health on income, exogenous improvements in health status lead an increased survival
probability and low birth rate. In the second and third stage of demographic transition, low
fertility is not sufficient to compensate the population growth due to increased life
expectancy. Thus, high life expectancy led increased population, wipes out the per capita
income and economic growth (Acemoglu & Johnson, 2007). Increased population and low
per capita income due to increase in life expectancy may hold true in the short run.
However, in the long-run health improvement leads to consistent fertility decline, which is
more than sufficient to compensate the population growth due to increased life expectancy
(Doepke, 2005; Syamala, 2001; Zhang & Zhang, 2005). Initial increase in population
growth due to improvement in life expectancy starts to decline after the onset of
demographic transition and human capital accumulation foster (Cervellati & Sunde, 2011).

Rejecting the hypothesis ‘health improvement actually reduces per capita income’ Bloom,
Canning, and Fink (2014) and Finlay (2007) established that health has positive effect on
income, as we allow for the lagged and indirect effect of health in the model. He argued
that, at the low level of per capita income population growth raises with mortality decline,
as we consider it as an endogenous variable. Whereas at a high level of per capita income,
population growth fall as per capita income rises (Bloom et al., 2014; Kalemli-Ozcan, 2002). The diluting effect of population growth on income reverses, as parental expectation to child survival is enough to reduce fertility in order to improve the quality of their children (Lawson, Alvergne, & Gibson, 2012). Long time horizon of return due to increased life expectancy promotes the investment in education and skill development, hence higher labour productivity and economic growth. Finlay (2007) has shown that once the indirect effect of health on economic growth is taken into account, health does have a positive and significant effect on economic growth.

Increased longevity induces the quantity-quality tradeoff for the allocation of parent’s limited resources and affects the population in three distinct phases. First phase, at the extremely low level of children’s health additional childcare investments induces the population growth. In the second phase, improved child health is not sufficiently to divert the additional resources from health to education; hence, population grows without the improvement of formal education. Lastly, in the third phase, child health becomes sufficiently better to absorbs the ever-increasing proportion of parental investment in children’s education, hence population growth decelerates (Hazan & Zoabi, 2006).

1.3.6. Reverse causality between health, income, and economic growth

Though, sufficient evidence shows the positive effect of health on economic growth; many studies have also documented the causation from income and economic growth to population health. Economic growth increases the availability of food, makes health spending affordable, and raises the demand for good health (Banister & Zhang, 2005; Farahani, Subramanian, & Canning, 2010; Nishiyama, 2011; Subramanyam, Kawachi, Berkman, & Subramanian, 2011). Thus, estimation of the effect of population health on economic growth will give over estimate because of endogeneity.
Household economic status determines the health and health care utilization due to low public expenditure on health in developing countries. Micro economic studies have established the direct and indirect effect of household economic status on its members’ health (Brooks, 1975; Hosseinpoor et al., 2006; T. A. J. Houweling & Kunst, 2010; Wagstaff, 2000). In a low economic setting, an insignificant decline in income has a significant impact on population health (Chalasani, 2012; W. Joe, Mishra, & Navaneetham, 2010; Zimmer, 2008). In a rural setting ownership of the farm and productive assets help to produce protein and energy foods that improve the child survival (Nuwaha, Babirye, Okui, & Ayiga, 2011). Over this, poverty-health causation goes through poor nutrition, crowded and unsanitary living conditions, and inadequate medical care (Adler et al., 1994).

Contrary to the income-health causation, many studies have claimed the public expenditure on health expenditure is an exogenous input in the health production function. Preston (1975) has argued that unlike the developed countries mortality decline in the less-developing countries was the result of imported medical technology and foreign aided public health intervention. This phenomenon is evident from the long flattened Preston Curve at the high level of income for 1960’s compared to 1930’s. Analyses of the historical decline in childhood mortality rates in today’s industrialized countries suggest that improved nutrition, public health and medical technological progress were powerful drivers of the mortality decline (Cutler, Deaton, & Lleras-Muney, 2006; Cutler & Miller, 2005; Fogel, 1994). The great takeoffs in the economic history of Britain, South USA, Southern Europe and East Asia was supported by significant breakthroughs in public health, disease control, and improved nutritional intake reduced the vulnerability to infectious disease (Sachs, 2001). Thus, improved health increased the productivity of workers, in addition to improving the energy levels.
Health differential across poor and rich population within and between countries is due to institutional ability and socio-political structure, neither of which is the consequence of income (Bambra, Fox, & Scott-Samuel, 2005; Bezruchka et al., 2008; Feng et al., 2012). Whereas, within country lower earning of the sick people explains much of the correlation between income and health, rather than causation from higher income to better health (Cutler et al., 2006). Low-cost vaccination not only reduces infant and child mortality in the short run, but also has a lasting impact on economic development through adult health, cognitive ability, and education level (Bloom, 2011b). Causality from health to wealth is very much evident in the developing countries, where considerable public health improvement is attributed to low cost public intervention in maternal and child health (Bhalotra, 2007; Deaton, 2006; Anil B Deolalikar, 2005; Stenberg et al., 2014). Thus, although causation moves from income to health, but exogenous low cost public health intervention, improved in nutritional intake, immunization, and diseases control have improved the productivity of labour and economic growth in the developing countries.

1.4. NEED OF THE STUDY

Planned development strategy with welfare measures have resulted in high income and improved health status in India. And, government sponsored public health program and imported medical technology has made substantial improvements in maternal and child health. However, the benefit of the public health policies and advanced medical technology have not been equally accessed and utilized across the population. Studies have proved that socio-economic inequality affects the accessibility, affordability, and utilization of health care services and thereby population health (Singh et al., 2012a; Subramanian et al., 2007; Pathak et al., 2010). Evidences also show that the public health system in India treats its clients according to their socio-economic conditions (Malhotra
and Do, 2013; Singh et al., 2012b). On the supply side, availability of health care services depends on the public health provisions (Ensor, 2004); which is dwindling in last two decades (Berman and Ahuja, 2008); and the benefit of the meager public health service goes to the upper quintile of the population (Mahal, 2001). On the other side, due to excess demand for the expensive high quality health care services by small affluent section, private sector has not developed the low cost health services for the poor.

Given poor health and low capacity to pay along with inadequate public health provisions, sickness of a socio-economically disadvantaged either remains untreated or goes for borrowed health financing. This leads to the double economic burden of low capacity work and depletion in the household productive assets, which may lead to the vicious circle of poor health and low income. The dual burden of the poor health becomes severe as more than 90% of the working age population is employed in the informal sector; about 54% of them are self-employment and 39% as casual labour. Thus, it become imperative to study the effect of health on human capital formation, income, and economic growth.

Given high share of agriculture and service sector in GDP in India, the present study establishes the evidence based human capital investment strategy for sustainable economic growth, to be adopted by the policy planers. Empirical evidence of the effect of health on human capital, income, and economic growth will give the basis for cost benefit analysis of public health investment. Under multidimensional nature of health, this study deals with the following aspects of health, human capital, income, and economic growth in India:-

*First*, childhood nutritional intervention among the severely undernourished has significant positive effect on schooling, cognition development, and adult height and hence labour
productivity and wage. This exposition will give the evidence for targeted public health intervention to the Government.

Second, calorie intake has significant positive effect on farm labour productivity. Given major employment in informal sector, it is needed to establish the effect of calorie intake on wage of the elementary and non-elementary worker in India. The findings will justify the subsidized food distribution to the poor through the public distribution system in India.

Third, assuming exogenous low cost public health intervention and the double burden of poor health it becomes imperative to study the effect of health on income and economic growth in India. This will help in determining the warranted rate of public health investment, required to achieve desired level of income and economic growth.

Fourth, assuming diminishing marginal return to health, unequal distribution of health reduces the average labour productivity and economic growth. Hence, there is need to study the effect of health inequality on income and economic growth. This proposition will give the income distribution effect of public health provisions and health equity.

Empirical evidence of the effect of health on economic growth will give the basis for cost benefit analysis of public health investment. Given high share of agriculture and service sector in GDP in India, the study will provide the evidence based health and human capital investment strategy for the steady economic growth, to be adopted by policy planers. Thus, study will also establish the rationale for several poor oriented public health programs and to increase the annual budgetary health allocation by the Ministry of Finance, Government of India.
1.5. CONCEPTUAL FRAMEWORK

Effect of health on economic growth in this study has been conceptualized on the basis of pathways from health to economic growth as given in Macro Economics and Health: Investing in Health for Economic Development (Sachs, 2001). Population health affects the income and economic growth through quality and quantity of labour. Possible pathways from health to economic growth are discussed below.

The long term direct and indirect effect of the poor health on income can be captured only in the cohort study. Poor health during infancy and childhood retards the cognition and physical development, and low physical capacity affects the school attendance and job absenteeism, hence education level, skill development, experience etc. Reduction in infant and child mortality due to better health leads to high parental investment in child education. Thus, population health has long-term effect on human capital development.

Population health reduces the labour supply as person days’ lost due to morbidity and mortality. Hospitalization of an individual not only affects the labour supply and human capital development of the sick but also of other household members. Hence, poor health reduces the quality and quantity of labour force through low cognition development, low school attendance, high drop out among the children, poor skill development, and increased person days’ loss among the adult. Fatal health outcome increases the premature mortality hence loss of the labour and their accumulated human capital. On the other side, in the long run improved health reduces the infant and child mortality followed by low fertility thus increased size of working age population and labour supply. Improved health not only affects the human capital development but also promotes the physical capital accumulation. As household savings constitutes the 33% of the total savings and 78% of the total health expenditure is privately financed by the household, thus better health
promotes the private investment. Similarly, public spending on health may also diverts away the funds from the productive investment.

Human capital development in terms of education, on-the-job training, and favorable development policy promote the technological advancement, which in turn boosts the economic growth and better health. Now the government’s economic policies, governance, infrastructure, and public provision promote both population health and economic growth. However, despite the multidimensional nature of the production function, health plays the pivotal role in the labour productivity, income, and economic growth.
1.6. **RESEARCH QUESTIONS**

1) Does individual health determine the human capital formation?

2) What is the effect of nutrition/calorie intake on labour productivity or wage?

3) Is there non-linear effect of health on income at the higher level of economic equilibrium?

4) What is the effect of population health on economic growth?

5) Does socio-economic inequality in health reduce income and economic growth?

1.7. **OBJECTIVES**

Assessing the importance of health and its level and distribution across the states of India, the present study establishes the effect of health on human capital formation, income, and economic growth in India. The specific objectives are:-

1) To estimate the effect of health on human capital formation.

2) To estimate the effect of calorie intake on wage in India.

3) To estimate the effects of health on income and economic growth in India.

4) To assess the effect of socio-economic inequality in health on income and economic growth in India.
1.8. ORGANISATION OF THE THESIS

Chapter I: Introduction and literature review (the present chapter).

Chapter II: Effect of linear growth and relative weight gain between mid-childhood and adolescent on human capital formation

Chapter III: Does consuming more calories make you rich? Nutrition-productivity link revisited

Chapter IV: Effect of health on economic growth in India: Evidence from the last three decades: 1983-2011

Chapter V: Effect of socioeconomic inequality in health on income and economic growth in India during the last three decades: 1983-2011

Chapter VI: Summary, conclusion, and policy recommendations