Working Paper 244

Health, Labour Supply and Wages: A Critical Review of Literature

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ISBN 978-81-7791-100-8

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HEALTH, LABOUR SUPPLY AND WAGES: A CRITICAL REVIEW OF LITERATURE

Amrita Ghatak[1]

Abstract

This article addresses the research question, how does general physical health status influence the labour supply behaviour and labour productivity? It deals with the issues that are dealt by the economists to explain the mechanism through which health as a form of human capital is related to labour productivity and labour supply decision. This article discusses the definition and measurements of health, theories that try to explain the health-productivity linkage, followed by a description of empirical studies that address the issue, both at the macro and micro levels. The review identifies the knowledge gaps important for further research in this area.

Introduction

How health influences the labour market and economic outcomes has been an inquiry in the development research since the last 50 years. With the advent of efficiency wage hypothesis and its nutrition-based variant (Leibenstein 1957), this question has been addressed in many dimensions as far as development economics is concerned. The implication of this wage theory, namely nutrition-based efficiency wage hypothesis, raises the importance of an improved health status for a less developed country like India not only because of its concern in theory, but also because of the much needed empirical support in order to come out with proper policy implication towards sustainable growth and development. India's present demographic profile, with a bulk of population in the working age group, has further raised the importance of discussing this issue for the sustenance of economic growth, realised in terms of the benefit of "demographic dividend". However, apart from this "instrumentalists' view", health assumes importance as a basic human right.

As a component of human capital, health is a key factor in the creation of wealth (Mwabu 1998). Lucas (1993) emphasises productivity growth as the source of economic miracles in East Asian countries. Though the relationship between health and wealth, realised in terms of productivity, appears to be simple and straightforward at the surface, the underlying process and intricacies behind this relationship are quite complicated and complex in nature, both conceptually and methodologically. Being an intrinsic factor, it is difficult to conceptualise health status and its relationship on individual behaviour. Concepts and methods of analysis become further complicated primarily because of difficulty in measuring health status of an individual. Measurement of health both at the macro and individual level is highly debatable in the literature, making research in this area cumbersome.

The paper is broadly divided into four sections. The next section deals with the nature of the health-productivity linkage and the theoretical literature. At the theoretical level, the relationship

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The author is thankful to Professor S Madheswaran, Professor K S James, Professor Meenakshi Rajeev, Professor Abdul Aziz, Professor R S Deshpande, Dr C M Lakshmana and Dr Lekha Subaiya for their useful comments and discussion. She also render thanks to the unknown referee/s of the working paper series of Institute for Social and Economic Change, Bangalore.

between wages and consumption and its implication to 'efficiency' hours (nutrition- based efficiency wages) and to the health status in an economy, with disguised unemployment is discussed. In addition, the Human Capital theory is also briefly presented. The third section analyses a set of issues related to the alternative measures of health. The fourth major section comprises the empirical literature on the health-productivity linkages. The final section raises the issues for further research in this area.

However, this study is not just a collection of mere evidences supporting or defying the nutrition-based efficiency wage hypothesis; rather, it shows how the broad issue of health-productivity linkage has been dealt with both by the theoreticians and by the empiricists, what is the basic nature of this relationship, what are the different measures of health status and how can they be advantageous or disadvantageous as far as feasibility of the research is concerned. The paper argues that considering health being an input of production and thus influencing the wages, it doesn't ignore the relationship in the other way round completely. It mentions the studies that consider wage or income being a factor that influences health status; hence, the present paper highlights the causality issue between health and productivity. Further, it also attempts to throw light on the relationship between health status and farm production. The very nature of the relationship between health and productivity is causal, which stems from the idea of nutrition-based efficiency wage hypothesis valid in most cases for a subsistence economy.

Causality and Theories

Interestingly, health has two-way relationship with wealth and income. It enhances the productivity, which enables an individual or a nation to accumulate income or wealth, but at the same time individuals with higher income or nations with higher wealth have evidently been found to enjoy better health status. Effect of income on health and nutritional status is also evident in the literature (Higgins and Alderman 1997). In a study, Pritchett and Summers (1996) found causality between these two phenomena and concluded that wealthier nations were healthier nations. The causal nature of the relationship between health and the economic or labour market outcomes is the bottom core in understanding their linkages. The link between productivity and health, especially those dimensions related to nutrition, has long played a key role in theories of economic development, through the idea of nutrition-based efficiency wages, and has also taken a central place in the study of economic history (Rosenzweig 1988, Dasgupta 1993, and Fogel 1994). However, until very recently, development economists have typically concluded that there is little reliable empirical evidence indicating health having an important impact on labour productivity (Rosenzweig 1988). Now, why do some researchers diverge in their opinion and conclude that income has an effect on health status and thus on productivity? This is primarily because they differ in basic ideas and concepts. There are two different alleyways of thought — one which starts with health status and then examines its impact on labour productivity and wages and the other which starts with income and finds whether income level has any role in ensuring better quality of food intake and health facilities that in turn enable the individual to put more work effort. This conceptual divergence among researchers is also reflected in method while selecting the instrumental variable in order to examine the pure income effect on health and *vice versa*, so as to overcome the problem of reverse causation or incidental association between health and

productivity. However, the concept of causality is also theory- driven, which is discussed in the next sub-section (2.1).

This skeptical view stems, in part, from the paucity of studies on the subject, which reflects the fact that health indicators have seldom been collected in surveys that contain measures of wages or productivity. The skepticism also reflects questions over the proper interpretation of correlations between health and labour outcomes presented in many early studies, which paid little or no attention to the direction of causality. Those studies ignored the fact that any component of income, such as wages or labour supply, may affect current behaviour which, in turn, affects health, such as consuming a healthier diet, and *vice versa*. However, recent studies are coming up with the evidence of causal relationships between health and labour productivity in low-income countries (Strauss and Thomas 1995).

These studies have focused on rural populations, mostly male workers, and have seldom examined more than one or two health measures. But, if knowledge is to be advanced in this area and if it is to be potentially relevant for policy, then it is necessary to be more precise and to identify the types of individuals and activities for which the returns to investments in health are the highest. Furthermore, just as education has different dimensions such as its quantity and quality, so does health. Which dimensions of health have labour market impacts? Do investments in health as an adult reap returns, or is it only health investments during childhood that matter? And, does the impact of health vary across the income distribution; in particular, does it especially matter among the poor?

Treatment of minor and major illness, temporary and permanent disabilities can throw labour households into the vortex of poverty. Substantial wage and productivity loss could be incurred during illness. Major illness can cause catastrophic expenditure to households, rendering them vulnerable by liquidating assets, borrowing heavily and pulling further into deep poverty. Moreover, unlike the households with fairly secured/permanent source of income, households depending on income from manual casual labour face double burden of health care expenditure in case of illness of working members, direct payment as well as loss of income. Lack of social security and low levels of income often compel these households to compromise on required duration of treatment. This has long-term consequences not only on worker's health and poverty but also on labour productivity, economic growth, and social welfare. It is imperative, therefore, to understand the magnitude of the issue and to explore the underlying nexus and causes. A study is required in this area to understand the issues like, for example, how to measure health properly, how does health be an element of human capital, what is the relationship between health, labour productivity, wages and farm production evidently existing in different countries, etc.

A. Theoretical studies

There are many reasons why the relationship between health and labour market outcomes in developing economies is of special interest. First and foremost, there is a long tradition of theoretical models of **nutrition-based efficiency wages** in the development literature. Efficiency wage models are based on a convincing and coherent explanation as to why firms may find it unprofitable to cut wages in the prevalence of involuntary unemployment. This theory basically has alternative implications

in explaining the contract farming, internal labour market, higher wage payments, reduction or shirking of work by employees, improvement in average quality of job applicants, real wage rigidity, the dual labour market, the existence of wage distributions for workers of identical characteristics and discrimination among observationally distinct groups. The efficiency wages theory basically talks about the wage differential. Among all other different types of efficiency wages models, the pioneer is the nutrition-based model that was originated in the development economics literature and has been applied to LDCs (Romaguera 1991). This hypothesis is relevant in the primary sector, but in the secondary sector it is (wage-productivity relationship) weak or non-existent, which seeks the idea and thought beyond the purview of new Keynesian one.

However, nutrition-based efficiency wage model is one of the most prominent micro foundations of the efficiency wage theory. The hypothesis was first advanced in the context of less developed countries. 'Why labour productivity should depend on real wage paid by farms in less developed countries' was the basic inquiry that paved the path for bringing the issues of health and illness in the wage-productivity linkage. The study on the theory of labour productivity, health and wages through the efficiency wage hypothesis is pioneered by Leibenstein (1957). It has been formalised and extended later by many others like Mirrlees (1975), Rodgers (1975), Stiglitz (1976, 1982), Bliss and Stern (1978a).

Harvey Leibenstein (1957) in his seminal article 'The Theory of Underemployment in Backward Economies' assumed the case of disguised unemployment or visible underemployment and started his argument following Nurkse's (1953) view of employing surplus labour on the construction of capital. He started with the idea that the marginal productivity of labour in agriculture is zero, but then what could be the explanation of a positive wage for the agricultural labourer? Three different cases have been considered: the case of landlord, who employs the labour but receives the rent; the case of small land owner, whose landholding size is so small that he feels the incentive to work for more hours in some other land, and therefore, this is also the case of tenants or sharecroppers; finally, there is the case of landless labourers for whom the unemployment is visible. Obviously, if the market is perfect and if there is surplus labour, then some members of the workforce will remain unemployed and they will be willing to work even below the existing wage rate. The hypothesis stems from the idea that under certain circumstances it would benefit the landowner to pay a wage above the competitive level, and the wage never goes down to zero. This was the crucial point where Leibenstein brought the often-neglected idea regarding the relationship between wage level and productivity. The whole idea of nutrition-based efficiency wage was based on the relationship between wages and productivity, i.e., in poor economies where wages determine workers' consumption level, the amount of workers' effort would depend positively on their nutrition and health status, and thus on wages. The amount of work that a labourer can be expected to perform depends on his energy level, his health and his vitality, which in turn depend on his consumption level and on the nutritive value of his food intake. What is the important point of his analysis is that the wage-productivity linkage was examined in two parts: (1) the relation between income (wage) and nutrition and (2) the relation between nutrition and productivity. It was also indicated that additional experimental and empirical evidence relating not only calorie intake but also other nutritive elements, either directly or indirectly through their effects on debilitating diseases,

absenteeism, and lethargy, should also be taken as an indicator of health status. However, it is important to remember the difference between supply of labour time (man-hours or man-years) and supply of work (or effort) and between wages per man and wages per work unit. It is argued in his theory that the number of units work supplied by the labourers will increase gradually as wage rate and consumption rise. It clearly implies an increase in productivity with an increase in consumption level. However, it was also admitted that the relationship between health and income dated back to the work by Lord Boyd Orr in 1936, where it was shown that in England, the value of nutritive components of diet (such as total calories and calories from proteins, fats, calcium and iron) are monotonic increasing functions of income. But obviously, this study also did not consider the causal nature of the relationship.

In a different note, Bliss and Stern (1978)[2] formalised this theory. According to them, the productivity-consumption relationship of the model is as follows:

A working day is considered in terms of ordinary clock hours while "clock hours" is different from the "efficiency hours". "Efficiency hours" is assumed to measure the productivity of the workers' effort. For better understanding, a more productive worker will be expected to generate a higher number of efficient hours of labour in a given number of clock hours. These efficiency labour hours depend on the workers' consumption level *c* of calories while the functional relationship between efficient labour hours and consumption is denoted by *h(c).* Now, all workers are given the same wage *w*, and they are assumed to be hired to work for the same number of clock hours. The workers spend all their wages only for food consumption. Therefore, the relation between efficient labour hour and consumption can be expressed as *h(w)*. If the number of clock hours worked is *l*, the number of efficient hours produced is *lh(w)*. The output produced by these efficient hours is:

$$y = f[lh(w)].$$

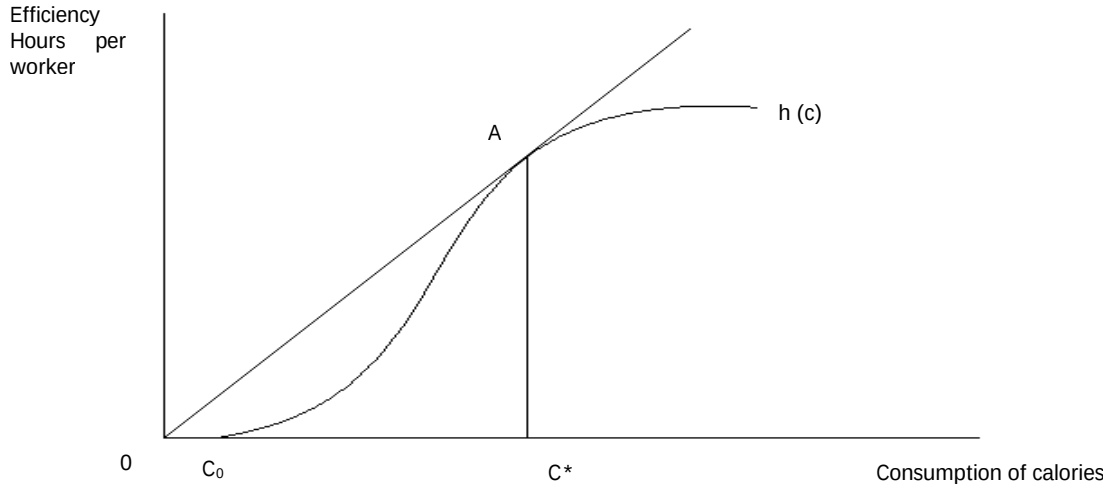

Figure (1)

In the above figure 1, the productivity of labourer is shown as a function of caloric intake or *h(c)*, where *c* is the consumption in calories. The efficient hours supplied by a worker is depicted as a function of the level of caloric intake. Wages are assumed to be spent only for food. A certain level of

[2] ***Source:*** *G.B. Rodgers (1975), Fahima Aziz (1995)*

daily consumption (C_o) is required to cover the basic metabolic requirements for basic life functions. OC_o is the basic minimum requirement of food consumption; therefore, any amount above the OC_o level provides the energy to be spent in activity. Productivity is assumed to increase over a range of calories up to C*, beyond which diminishing returns set in with further increases in caloric intake.

Harvey Leibenstein (1957) hypothesised that relative to poorly nourished workers, those who consume more calories are more productive, and that at very low levels of intake, better nutrition is associated with increasingly higher productivity. This type of non-concave nature of the nutrition-productivity relationship, which, not only is the underlying essence of the efficiency-wage models, but also has very powerful implication in the literature for the level and composition of employment (Rodgers 1975). This theory has been used to explain several issues in economics, e.g., the constant real wage in the agricultural sector of a developing economy as a part of equilibrium with involuntary unemployment, shadow wage rates, etc., but it is the relationship between nutrient intake and labour productivity that remains the primary motivation for the efficiency wage hypothesis as it is applied to developing countries (Strauss 1986).

However, this hypothesis is often criticised for its limitations in providing a generalised picture. Since it is focused on the rural sector and on the relationship between wages and consumption, it is applicable only to rural poor countries, which are very homogeneous in its socio-economic, cultural and other characteristics. There are a number of studies that attempted to test this model in less developed economies; but the results vary from being inconclusive (Inmink and Viteri 1981) to weakly supportive (Bliss and Stern 1978) to strongly supportive (Rodgers 1975; Audibert 1986). In case of India, the nutrition-based efficiency wage model is evidently consistent in some villages of Kosi area of Bihar, which is one of the most underdeveloped poor states in India (Rodgers 1975). Hence, the hypothesis may not hold true throughout the country, due to wide variation in level and pace of development, socio-cultural, historical and geographical heterogeneities, etc. Even though the labour market in villages studied in the Kosi area were more or less compatible with a nutritionally-based wages, some inconsistency with the theory was found in one area out of five studied. However, Leibenstein (1957) himself noted that the specific types of institutional arrangements might enable the landlords to employ the entire labour force at a wage in excess of its marginal product. The appropriate institutional arrangements will usually arise out of the historical situation of the backward economy. Therefore, it would be interesting to see the effect of different formal and informal institutional arrangements on the determination of health-wage or health-productivity nexus. Explaining the health-productivity relationship with a consideration of seasonality in agricultural sector was a strong criticism by Harry T Oshima (1958). Disguised unemployment has a very definitional aspect and it often depends on the nature and interpretations of institutional arrangements, which in turn has a role in explaining the health-productivity linkage. Discussion in this line is also missing in Leibenstein's article (1957).

Even if one does not explicitly work in the framework of the wage-efficiency literature, the concept is useful in understanding the philosophy of health-labour linkage in a rural subsistence set-up. Instead of making hypothesis on wages to have impact on consumption and productivity, it will be interesting to hypothesise the health status of an individual having impact on his or her own productivity, which in turn will be reflected in wages he/she earns under certain assumptions of

neoclassical economics. However, literature indicates that positive effects of health and nutrition on productivity may reasonably be thought to be a necessary condition for wage-efficiency mechanism. Thus, elasticities of labour productivity, with respect to health or nutrition, will be useful for decision-makers for the welfare enhancing policies adopted to increase the production or lower the unemployment.

Interestingly, on one hand, there are some evidences in support of the health-labour productivity relationship contributing to the overall growth of the economy having the economic impact at the macro level; on the other, there are some studies (Behrman and Deolalikar 1988; Strauss and Thomas 1995a) pursued at the household level which confirmed that income and health are correlated at the individual level. There are many studies, which have used household production function model approach to analyse this linkage at the micro level. In general, any analysis of the consumption decision or labour supply decision at the household level has to account for the interdependence of household production and consumption (Becker 1965).

There are other theories like **human capital theory**, which goes beyond the nutrition-based efficiency wage model by conceptualising health as an element of human capital in the process of economic and human development. This theory argues that health has pervasive effect on wages, earnings, participation, hours worked, retirement, job turnover and benefits packages**.** The economic value of health lies in the effects they have on individual's productivity.

According to the Grossman model (1972), the implication of good health is two-fold. It is valued not just for its own sake but also because being sick takes time away from market and non-market activities. Non-market time is an input in both health production and the production of other valued non-market goods (eg, leisure). The model is useful to yield a conditional labour supply which depends upon (among other things) an *endogenous* health variable, because individuals start off with large health endowment which must be continually replenished as it depreciates, therefore, many investments in health occur late in life.

Grossman model treats wages as parameters, but it is possible that health influences wages (and other prices eg, life insurance), therefore, more complete model would recognise that investments in health may affect wages and *vice versa*, so health is determined endogenously with wages and labour supply. Further, it is empirically found that in middle and at older ages, there is pronounced effects of new health events on household income and wealth, but it is an open question how much earlier in the life cycle such a sweeping statement is true. While economic resources also appear to impact health outcomes, this may be most acute during childhood and early adulthood when health levels and trajectories have been established (Smith 1999). Though there are some studies (Pritchett and Summers 1996), Higgins and Alderman 1997), and Rosenzweig 1988) showing the effect of income on health status, the essence of the efficiency wage theory strongly suggests that the examination should be started with the health status having an impact on wages or productivity or income. This is relevant particularly to the manual labourers who primarily depend on heavy physical works. However, one cannot ignore the causal nature of the relationship between these two factors, which necessitates sophisticated methodology for any study in this area.

Interestingly, any empirical work testing for these theories or dealing with the causality shows that among many other issues in analysing the relationship, it is the issue of measurement of health status that seeks primary attention, as measurement of adult health status is highly debatable in the literature.

Concept of Health and Its Measurements

There is a plethora of literature on empirical studies available on the issue of health measurements; however, there is no unique consensus with regard to the perfect measure or proper method for quantifying health status. Though this is an age-old issue, perfect measure of health is still not yet suggested by any empirical study.

Health is multi-dimensional. The WHO definition (1948)[3] envisages three specific dimensions – the physical, the mental and the social. In addition to these, spiritual, emotional, vocational and political dimensions could also be added in understanding health status (Park 2002). However, the literature primarily focuses on the physical health status and its impact on the labour market behaviours and outcomes.

To go beyond the broad historical record of the concurrent increase of life span and economic prosperity involves research depending on how health is measured for comparative purposes. Being a dimension of human capital, health is nothing but the 'unobservable general ability of the people' (Lucas 1988), and because of its unobservable nature, measurement of health is very much complicated. According to Mwabu (1998), practically, there is no direct way of assessing magnitude of health. There are two components of the health status: Mortality, which is the quantitative component, and Morbidity, which shows the quality of health.

Crude Death Rate, Life Expectancy at Birth, Infant Mortality Rate, Child Mortality Rate, Under-5 Proportionate Mortality Rate, Maternal (puerperal) Mortality Rate, Disease-Specific Mortality, Proportional Mortality Rate, etc. indicate the quantitative component of health status, whereas, Disability Rates[4], Sullivan's Index[5], Health-Adjusted Life Expectancy (HALE)[6], Disability-Adjusted Life

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[3] *WHO definition on health: Health is a state of complete physical, mental and social wellbeing and not merely an absence of disease or infirmity".*

[4] *he commonly used disability rates fall into two groups: (a) Event- type indicators and (b) person-type indicators.*
- *(a) Event-type indicators:*
  - *(i) Number of days on restricted activity*
  - *(ii) B ed disability days*
  - *(iii) Work-loss days (or school loss days) within a specified period*
- *(b) Person-type indicators:*
  - *(i) Limitation of mobility: for example, confined to bed, confined to house, special aid in getting around either inside or outside the house.*
  - *(ii) Limitation of activity: for example, limitation to perform the basic activities of daily living (ADL), e.g., eating, washing, dressing, going to toilet, moving about, etc; limitation in major activity, e.g., ability to work at a job, ability to household work, etc.*

Source: *Park (2002)*

[5] *Sullivan Index: This index (Expectation of life free of disability) is computed by subtracting from the life expectancy the probable duration of bed disability and inability to perform major activities.*

Source: *Park (2002)*

[6] *HALE: It is based on life expectancy at birth but includes an adjustment for time spent in poor health. It is most easily understood as the equivalent number of years in full health that a newborn can expect to live depending on current rates of ill health and mortality.*

Source: *Park (2002)*

Years (DALY)[7], Nutritional Status Indicators[8] and Health Care Delivery Indicators[9] show the quality of health status.

In modern medicine, usually the assessment of physical health status includes self- assessment of overall health status, inquiry into symptoms of ill health and risk factors, inquiry into medications, inquiry into levels of activity (e.g., number of days of restricted activity within a specified time, degree of fitness), inquiry into use of medical services (e.g., the number of visits to a physician, number of hospitalisations) in the recent past, standardised questionnaires for cardiovascular diseases, clinical examination, nutrition and dietary assessment, biochemical and laboratory investigations.

Indicators such as death rate, infant mortality rate and life expectancy are useful to assess health at the community level. However, health profile of each individual provides a complete health profile of individual as well as communities (Park 2002).

Given the life expectancy to understand the quality of health status of an adult individual, four major well accepted indicators in the social sciences literature are: Adult height, Body Mass Index (BMI), Activities of Daily Living (ADL), and Self-rated health status.

Adult height is a proxy for adult health, because height is found to be strongly correlated with longevity and with labour force productivity (Fogel 1997; Thomas and Strauss 1997). It may reflect both rewards to human capital investments early in life and strength or robustness as an adult (Strauss and Thomas 1998). Weight for height (wasting) and height for age (stunting)[10] are two widely accepted indicators to understand the nutritional status of an individual, especially children. In case of adults, the most widely accepted measures are Body Mass Index[11], and Mid-Arm or Mid-Muscle Circumference[12]. In contrast with height, body mass index (BMI) varies over the life course and thus may capture both longer- and shorter-run dimension of nutritional status and health. If this weight is too small – typically less than 18 kilograms – a person is too light for his/her height and consequently his/her health is at risk. Similarly, if the BMI is too large – typically greater than 30, a person is obese and his health is at risk.

Clearly, BMI is related to energy intake, net of output; it has also been shown to be related to maximum oxygen uptake during physical work, which is, in turn, related to aerobic capacity and

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[7] *DALY: It is a measure of the burden of disease in a defined population and the effectiveness of the interventions. DALYs express years of life lost to premature death and years lived with disability adjusted for the severity of the disability. "one DALY is one lost year of healthy life".*
Source: *Park (2002)*

[8] *Nutritional Status Indicators: different anthropometric measures like, weight and height, weight for height, height for age, mid-arm circumference, prevalence of low birth weight, etc.*
Source: *Park (2002)*

[9] *Health Care Delivery Indicators: Doctor-Population Ratio, Doctor-Nurse Ratio, Population-Bed Ratio, Population per Health/Subcentre, Population per traditional birth attendant, etc. They reflect the equity of distribution of health sources in different parts of the country, and of the provision of health care.*
Source: *Park (2002)*

[10] *Stunting:* *SD score -2 to -3 (stunting)* *SD score <-3 (severe stunting)*

[11] *BMI:* *Body weight (in Kgs)/Height (in Meters)*

BMI <18	*18<BMI<30*	*BMI>30*
(undernourished)	*(properly nourished)*	*(obese)*

[12] *Mid Arm Circumference = Mid-upper arm circumference (in cms) – (? * triceps' skin fold thickness (in cms))*

endurance, independent of energy intake (Spurr 1983; Martorell and Arroyave 1988). Hence, for the jobs that require sustained physical effort, this is an important pathway through which health may influence worker's productivity. Moreover, energy can be stored in the body and expended when needed, which implies that BMI may be affected by contemporaneous movements in incomes or prices, so that the dynamics linking BMI and productivity may be very complicated. Persistence of positive correlation between wages and BMI for those with a very low or zero level of education indicates that among men with no education, BMI plausibly is associated with greater physical strength, which is of value for manual labour (Strauss and Thomas 1998). It is found that BMI, which is a good proxy for current health and nutritional status of adults, is highly correlated with adult mortality rates (Waaler 1984; Fogel 1994). BMI, which tends to be subject to diminishing returns (Thomas and Strauss 1997), is also approximately orthogonal to height; therefore, both may be included as determinants of productivity without introducing severe multi-collinearity among regressors (Schultz 2005). However, BMI varies with ethnicity, topology, and climate; so it is not very useful in comparing the nutritional status of different group of individuals. On the contrary, mid- arm circumference reflecting the nutritional status as well the nature of physical labour performed by the individuals, and not showing variation with different topology, ethnicity and climatic conditions, could be considered to be a better indicator of health.

A very new and different type of technique to assess the adult health status is the self-rated health status. In this measure, the individual is asked to rate his or her own health status as "very good/good/moderate/bad/very bad", etc. Self-reported general health status is very much dependent on the respondent's own perception, and hence this is pretty likely to suffer from subjectivity bias. It is difficult to understand whether the respondents are consulting the same benchmark of health, or they are referring to the health status of other persons in their neighbourhood or socio-economic class, or age. Besides, self-reported health status could reflect the perception that is related to the individual's socio-economic behaviour and outcomes. Hence, it may not provide an objective index of health status (Schultz 2005).

Another new measure of adult health is the person's performance in activities of daily living (ADL), such as cleaning, walking, lifting simple loads, and climbing stairs or other elevated places (Strauss and Thomas 1995). It is evident that people performing well in ADL are typically healthier than those unable to do so. Individual's physical capacity to perform Activities of Daily Living (ADLs) is often argued to be a better measure, because it is less biased by socio-economic endowments, conditioning factors and perceptions. Thus, it is less likely to be biased subjectively (Strauss and Thomas 1995; Schultz 2005).

Morbidity-based health indicator is reported by individuals or administrative units during a reference period. Again, morbidity rates obtained from administrative records by individuals or socio-economic groups are often less than reliable evidence of clinically confirmed incidence of illness across all individuals, groups, or regions of a low-income country, even when the morbidity is well-identified (e.g., malaria). This is because of different knowledge of health status and illness possessed by different socio-economic groups as well as their access to different medical care sources.

However, according to Schultz (2007), a child's health status is the key factor in determining his adult height, achievement in school, IQ, labour market productivity, reduced middle- and late-age mortality and delayed onset of many chronic health limitations which can be expected to impact labour force participation and productivity per hour worked or wage rates, as well as welfare.

However, different health indicators should be carefully chosen and interpreted because of the minute differences in their definition and calculation. Disability index is used primarily to understand the degree of severity of disability. Other indices are used to understand the degree of severity of ailments and nutritional status. Results will also differ with the use of different indices; therefore, it is very important to take note of the index used in any study of this kind where health status and its impact on many other factors are evaluated. For example, HALE is a probabilistic measure, which indicates the expected number of years in full health that a newborn can expect to live. Thus, it also depends on current ill-health and morbidity rate. On the contrary "one DALY" signifies one lost year of healthy life. Sullivan index is almost similar to HALE, but the only difference is, it emphasises bed-ridden disability and not the general morbidity rate. However, these indices are by and land large used in medical sciences and human physiology. The use of these kind of sophisticated measures are very scant in the social science literature, except a very few recent literature that have used HALE or DALY. These indices are useful for macro-level studies as they are statistical or probabilistic measures calculated for a group of individuals. For micro-level study, the only useful indices are measures of different anthropometric or nutritional status indicative measures, self-rated health status, history of illness and ADL. These different measures also have different impact on the outcome, because of their definitional difference, measurement error, subjectivity bias, error in recollection, etc. Therefore, any micro study also needs a very careful use of the health measures with an appropriate definition, calculation and interpretation. However, health care delivery indicators are a completely different set of measures which do not measure the health status of a mass or of an individual; rather they show the supply side factors of health status and indicate the performance of different institutions providing health care service and framing policies for a better health care facility.

Empirical Evidences

The empirical studies have used different measures of health and arrived at different conclusions about the health-labour productivity linkages. In the last few years, the relationship between labour productivity and indicators of adult health and nutritional status has been analysed in a growing number of low-income countries.

In literature, an analysis dealt with the intake of calories as an endogenous demand decision by individuals and families made in response to factors including the local prices of nutrients (Strauss 1986). This approach was then extended to other nutritional intakes, such as proteins, and nutritional status proxied by Body Mass Index (BMI), which is expected to increase productivity of a labourer and help him resist the debilitating effects of infections and all parasitic diseases. Although adult height may be largely determined during early child development (Thomas and Strauss 1997), adult height appears heterogeneous and measured with error.

Strauss (1986) argued that the relationship between nutrition and productivity could be biased because productivity also stimulates the demand for increased nutrition and health inputs. He estimated the marginal product of agricultural labourer in Sierra Leone, where he hypothesised that labour might be more productive when family workers were supplied with more calories. Instead of wage function, he estimated household agricultural production function. Overall, Strauss's (1986) work is the most thorough study which tests and quantifies the effect of current nutritional intake on farm productivity using the household level data, thereby, testing the Efficiency Wage Hypothesis. In Sierra Leone, it was found that more food increased labour productivity. Though, the major weakness was that this study did not have individual level data on calorie intake of the household.

Effect of illness on family labour supply was found to be significant though family illness did not have a significant impact on profit (Pitt and Rosenzweig 1986). It was also found that with a decrease in calorie intake of male workers in Minnesota from 3500 calories to 1500 calories over a period of 24 weeks, the activity level of workers dropped immediately (Key *et al* 1950).

Health affects productivity, and in turn, productivity increases demand for nutrition. A worker with higher productivity demands for better nutrients and other health inputs. Therefore, relationship between nutrition and agricultural labour productivity could be biased because of this increased demand for nutritional and health inputs stimulated by productivity (Strauss 1986). Although healthier people may be more productive, more productive people may also allocate more resources to create and maintain their good health. Because of this two-directional relationship, the association between individual health and personal productivity suffers from endogeneity bias.

A similar approach is used by Sahn and Alderman (1988), using data from Sri Lanka. Both Strauss (1986) and Sahn and Alderman (1988) analyses are limited to the use of household energy values as the only measure of individual nutritional condition. It is also argued that the impact of illness and health impairments on labour market and social welfare are more complex than just shifts in productivity, changes in labour force participation, or absenteeism rate would indicate (DeLeire and Manning 2003). In that study, it is evident that there is not a simple one-to-one relationship between measured productivity losses per worker and the social losses to firms and to workers that we would expect to observe in the market place. Labour contracts also have an important influence on the number of workdays people miss due to illness. This plays a crucial role for casual workers in a low-income country like India where many of the wage- workers are casual labourers. On one hand, they lose their wages for being absent on any given day, on the other, if they are less productive while working in ill health, the employer may consider it as shirking, as a consequence of which the labourer may lose the job. But, if the number of days unable to work is an indicator of productive health status for wage earners, the result may suffer from sample selection bias (Schultz and Tansel 1997).

Improvement in BMI (used as a proxy for nutritional status) was proved to be the reason to increase the productivity of a labourer and was found to help him resist the debilitating effects of infections and all parasitic diseases. It is also asserted that chronic malnutrition caused by chronic diseases is not the only factor that reduces the productivity of labour, especially in poor countries where the intake of calories is extremely low. This depresses both labour productivity and labour force participation (Fogel 1994).

In the late '80s, a study considering rural South India supported the importance of nutritional status – as measured by weight for height – in determining labour productivity in agriculture (Deolalikar 1988). It is found that the elasticity of farm output with respect to the weight-for-height of family workers is as large as 2. Additionally, market wage rates for individuals, who are likely to reflect the marginal productivity of labour, are also found to be highly elastic with respect to weight-for-height. In another study that looked at the relationship between health, wages and labour supply in rural Tamil Nadu, Duraisamy and Sathiyavan (1998) demonstrated that a 10 per cent rise in BMI increased the respective wage rate of males and females by 7 and 2 per cent, while the labour supply went up to 20 per cent and 11 per cent. However, none of these studies captured the burden of disease on labour households and link up with labour productivity with health care expenditure of the labour households. More importantly, none of these studies used national-level data.

Though these studies identify health as an important determinant, these do not highlight the role of workers' health in economic growth. Some studies conducted during the late 1990's, however, tried to capture this macro-level dimension by linking workers' health with labour productivity. The linkages between economic prosperity and health are well documented (Ettner 1996; Thomas and Frankenberg 2002; Duraisamy and Mahal 2005; Bloom *et al* 2006). Bloom Canning and Sevilla (2004) show positive effect of health on labour productivity and argue that output growth brought through health improvements can also generate capital accumulation. Health-specific variables (life expectancy at birth) and quality of life determine total factor productivity growth (Mitra, Varodakis and Veganzones 2002), which in turn evidently influences the overall growth. According to Mitra (1999), "availability of better social infrastructure indicated by percentage of population having access to improved water source attracts high quality labour, and this in turn contributes to productivity growth with better utilisation of available technology".

Based on cross-country data, it was also mentioned that better health status from an individual point of view means better utilisation of labour power, which implies enhanced productivity (Kumar and Mitra 2009). However, use of only variable, i.e., percentage of population having access to improved water source to indicate the social infrastructure carries immense limitation of these studies from the policy perspective. Health is found to have a causal effect on economic prosperity of males during middle and older ages. Using body mass index (BMI) as an endogeneous variable, evidence in favour of a positive and significant ill health and productivity nexus has been strengthened. It is argued that "if a worker is healthier, less susceptible to disease, and more alert and more energetic, then he or she will be more productive and command higher earnings" (Thomas and Frankenberg 2002).

In Brazil, taking data from the Institute de Pesquisa Econômica (IPEA, from the Brazilian Ministry and Planning) based on Census files (from 1970-2000), it is evident that reduction in mortality has a welfare value corresponding to 39 per cent of the observed growth in income (Soares 2007). Life expectancy gains were found to be more or less homogeneous having significant impact on the level of welfare in Brazil.

In a very recent study (Kumar and Mitra 2009), growth and health have been empirically found to be mutually influencing each other. Higher growth evidently improves health outcomes while better health outcomes in turn, raises economic growth. However, the study shows that the effect of growth

on poverty is statistically insignificant, but interestingly, effect of health on poverty is significant implying the effectiveness and importance of health strategies in reducing poverty. The adverse effect of capital-intensive technology that slows down the employment growth, particularly for the semi-skilled and unskilled workers, and tends to aggravate poverty is also reflected in their empirical findings.

Further, a higher labour productivity not only pushes up the overall growth of the economy, but its spill over effect is substantial at the individual level, too. This is expected to increase the wage level in general. Subsequently, one could expect a higher level of household's living standard, generate more savings and investment (Bloom, Canning and Graham 2003; Lorentzen, McMillan and Wacziarg 2005), generate new employment opportunities and pull out a vast majority of these living in poverty. Evidences suggest that good health is positively related to higher wages. Survey data from Brazil utilising various dimensions of health are assessed in terms of its impact on wages (Thomas and Strauss 1997). While BMI is positively related to high wages, low per capita calorie and positive intake is negatively associated with low wages.

An increase in BMI of one unit is associated with a 9 per cent increase in wages for men in both Ghana and Cote d'Ivoire, whereas for women, an increase in BMI of one unit is associated with 7 per cent increase in wages in Ghana and 15 per cent increase in Cote d'Ivoire (Schultz 1992, 1997).

Taking height and BMI as the indicators for health status, it was found that in Guatemala, males show much stronger non-linear relationship between height, BMI and wages than their female counterparts. While, diminishing returns are operating at higher quantiles of conditional wage distribution, increasing returns appear at lower quantiles (Calderon 2007).

Based on the 1989 Health and Nutrition survey (PNSN) of Brazil, the height of individuals born from 1929 to 1969 (age 20 to 60 at the time of survey), it was shown that an additional centimeter in height is associated with men receiving 3 per cent higher wages, and women 4.6 per cent higher wages.

In the Indian context, Gupta and Mitra (2003) found a positive two-causal relationship between economic growth and health. Further, the results reveal that health status is positively associated with per capita public health expenditure while poverty declines with better health. Studies in the recent past in India show a strong negative association of income/consumption expenditure to morbidity (Duraisamy 1998, 2001) implying less morbidity leading to higher living status of households. Life spans in low-income countries like India have increased impressively and it is argued that these increases reflect improvements in health (Ram and Schultz 1979). Their argument follows the proposition that improvements in health account for the longer life spans, and also that better health results in more and better work by the labour force.

In literature, it is found that many studies are based on self-reported health status. Among the cohort of self-reporters, physical health has a substantially stronger impact on labour productivity than mental health: precisely the opposite patterns were obtained when physical and mental health statuses were reported by proxy respondents (Lourex, Rizzo, and Sickles 2003). They suggest that the self-reporter may lead to a bias in estimating labour productivity costs of physical versus mental health on labour force participation by overestimating the importance of good physical health and underestimating the role of good mental health.

Health, labour productivity as well as labour supply – all these variables generate problem of *endogeneity*. To tackle this problem, different studies use several *instruments*. The instruments used by various studies fall into three categories: prices, farm assets, and household size and age distribution, with prices and certain household characteristics, such as family size, being excluded from the production function.

Under the assumption of neoclassical economics labour productivity is reflected in wages; but for individuals who are not engaged in wage work, for example, the cultivators or large farmers who work in their own farm and do not receive any wages in cash or in kind, the productivity can be measured using the concepts of average productivity and marginal productivity. In that case, health is reasonably related to the farm production. However, empirical works on the **effect of health on farm production** are very scant in literature.

In India, Deolalikar (1984) paved the way by characterising the farm production as a function of health and other inputs and environmental variables to study the effect of health of farm operators on farm production in rural South India. The production function followed the form of a Cobb-Douglas one, which included the interaction of family labour with average height for age and weight for height as inputs in addition to other inputs. The production function was estimated using OLS and Instrumental Variable methods. It was found that every percentage point increase in the weight for height of a worker would increase his marginal productivity of labour by 0.03, whereas, daily calorie intake did not show a significant relationship with the total value of output (Deolalikar 1988). Based on the empirical results, the study suggests the need for studying the relationship between different kinds of food consumption and weight for height.

In a study using cross-section data on farm households in Sierra Leone, it was tested whether the higher calorie intake increases the family farm labour productivity by estimating an agricultural production function for Sierra Leone. The simultaneity between inputs and calorie choices has been accounted for in the estimation of farm production. Family calorie intake has a sizeable, statistically significant output elasticity of 0.34. In fact, the magnitude of output elasticity of calorie intake widely ranging from low levels of calorie intake to high levels of calorie intake is found in the study (Strauss 1986). However, it was found that effective family labour defined as a function of actual labour and per capita daily calorie intake or health status is a significant input in production. In case of Pakistan, both the Body Mass Index and height are found to be important to have effect on value of varied crop outputs in different seasons for male workers, but, surprisingly, there was no nutrition effect for female workers (Fafchamps and Quisumbing 1997).

Using ICRISAT farm-level data for semi-arid region in India, the impact of nutrition and health on farm production was analysed. Average calorie intake and weight for height are used as inputs in the Cobb-Douglas production while controlling the unobserved time persistent individual and household effects in the estimation of farm production function. The health status indicator, namely weight for height, has a strong positive effect on farm production in both fixed and random effects estimation. However, calorie intake (nutritional status) has no significant effect on farm production. The output elasticity of weight for height is ranging from 1.3 to 1.8 across the specifications (Deolalikar 1984).

Though empirical evidences on the effect of education on farm production is plenty in the literature, very few studies are there that try to examine the effect of health of the farm operator on his own farm production. Besides, in most of the studies, household and farm decisions are separated. But, in a country like India, farm production decisions and household decisions are often associated with each other. In many parts of the rural areas of India, an individual often work as the "off-farm" as well as "on-farm" worker. It would be interesting to examine the effect of their health status on own farm production as well as on total wages. Labour supply behaviour of an individual as an agricultural labourer and, at the same time, as a cultivator may also be an interesting as well as an important area to be researched. However, in this case also, measurement of health plays a very crucial role.

Challenges to Further Research

Labour productivity is quite often measured in terms of average productivity or marginal productivity reflected in wages under certain assumptions of neoclassical economics. However, it is extremely difficult to measure productivity in an unbiased way using only quantitative aspects of labour due to heterogeneities in the labour quality. Labour supply decision is basically the outcome of certain behaviours, which depend not only on the formal intuitional factors, but also on the informal institutional factors. Formal institutional factors compared to the informal institutional factors are easily captured in empirical studies. Informal institutional factors are basically the position of an individual in social ladder, his/her preference and other psychological factors, etc., that influence his/her behaviour, and quite often take over the decades or centuries to change. Estimation of labour supply function or wage function therefore needs to be adequately substantiated by the concepts of formal and informal institutional factors to explain the mechanism through which health influences labour supply decision.

The framework used in estimating the effect of adult morbidity on labour productivity in two small homogeneous underdeveloped countries, Côte d'Ivoire and Ghana (Schultz and Tansel 1997), is useful to understand the economic consequence of health hazards, particularly on labour productivity and wages, but may be inappropriate to understand these linkages in a country like India which has a broader perspective with substantial heterogeneities in terms of labour market structure, institutional set-up, regional and cultural variations etc.

The few empirical tests of the relationship between health, labour productivity as well as labour supply and wages did not control for the effect of other important economic variables and other unobserved individual-specific effects. Also, the existence of endogeneity problem in health-labour productivity and labour supply linkages necessitates the selection of proper instruments.

Health outcomes are often analysed in terms of labour productivity or labour supply decision at the household-level. But the manifestation of health hazards in terms of creating heavy burden of diseases on labour household is not well captured in the literature. It will relate the whole health-labour productivity issue into the broad quest of wellbeing. It will further be interesting to examine how health affects the labour market outcomes and the welfare considering neighbourhood effects.

It has been shown that there is a close nexus between health and poverty suggesting that better health enhances the capability to work, which in turn enhances productivity and income (Kumar and Mitra 2009). However, the study didn't throw any light on the inequality in health endowment and

entitlement and its subsequent consequences on the labour market outcomes. Health in terms of productive labour force is a functional of both the entitlement and endowment of health status. Entitlement coupled with high level of endowment may result in proper functioning of health status. Entitlement is realised in high investment, and the return to investment is high level of productivity reflected in high wages. Health entitlement is found to be effective not only through public initiatives, but also through channels of individual characteristics like age, sex, level of education, social group, etc. Though the channels of individual characteristics through which health influences the individual's productivity are addressed in the literature, the question of ethnicity is not well explored. Besides, the functioning of political economy in explaining the health inequality and its impact on labour market outcomes also remains an uncharted land. Entitlement to health status largely depends on the structure of political economy and the political ideology. There are some strong theoretical as well as empirical works suggesting a number of channels leading from inequality to economic growth and performance, specifically the dampening effect of inequality on human capital accumulation (Perotti 1993; Barro 2000). However, the potential effects of governments' political ideologies on the relation between inequality in health status and growth have not been well explored. It is well recognised that the differences in political ideology continue to be reflected in individuals' beliefs and result in the socio-economic outcomes (Scott *et al* 2001; Michelbach *et al* 2003; Bjørnskov 2008). The association between health and labour productivity or labour supply behaviour may arguably be mediated through the reactions of the political institutions, precisely government, yet no studies to date have explored whether the ideology of the incumbent government affects this association. A huge scope for further political economy research may lie with the relaxation of the assumption that all governments follow similar goals with similar means and thus it will leave a room to allow for the ideology of the government to affect real economic relations and welfare.

Conclusion

There are two broad alleyways through which health-productivity linkage has been examined in the literature: one which is evident in micro-level study showing the effect of health status on labour productivity and labour supply decision at the individual or household or community level, and another which shows the impact of improved health status on productivity growth and its sustainability at the macro level.

Review of studies on health status, labour supply and farm production indicates that the extensive body of literature assumes separability between household and farm decisions, and examines the household and farm decisions separately. Moreover, non-availability of data or the difficulties in getting the complete set of household and farm production information constrains the use of an integrated approach. Recently, some attempts have been made to integrate theoretically the family and farm decisions in a unified framework under the umbrella of household production model for an agricultural household. Although there are a few studies that have tried to test some of the implications of such a household model where both the farm and household decisions are integrated, none of the studies has used data on consumption, labour supply and farm production collected on same households in a survey designed for a household model.

Consideration of different health measures and different group of individuals in the analysis may be helpful in order to achieve more target-oriented policies. However, in addition to the policy implications, research works bringing the economic theories of household production function and wage theories in the background of different political ideology, contracts and labour market institutions are expected to carry immense theoretical importance. Moreover, a very good field research may render an outstanding contribution to our knowledge of the labour market outcomes and its linkage with the health status by providing a close-up view of exactly what happens from the vantage point of the participants.

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Price: Rs. 30.00 ISBN 978-81-7791-100-8

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