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Health Infrastructure Efficiency and Mothers' Health and Child Immunization: An Overview of Empirical Studies

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1. Introduction

Study of health economics is one of the most important disciplines of economics today. Health is one of the most important fundamental human rights. Health is defined by different professionals in different ways. Medical professionals define health in terms of illness, which, in turn is expressed in terms of mental or physical disorders. World health organization does not consider health only as absence of disease rather it defines health as complete physical, mental and social well-being. The status of health has an important effect on economic scenario of a country as well as the globe also. An improved state of health leads to a better condition of the economy. Similarly, an adverse state of health can deteriorate the position of economic condition of the nation. As the contribution of the human capital is directly included in the level of economy, the poor status of health indicates a poor level of economy as the unhealthy population of the economy cannot become a proper resource for it. The United Nations Organisations in September 2000 has adopted the Millennium Declaration. The 189 member states of UNO had unanimously signed the declaration. The declaration announced eight goals that to be achieved within 2015. Fourth and fifth goals of the declaration ask for reducing child mortality and improving maternal health. After the declaration various countries have initiated different objectives to achieve the goals. India is no exception in this regard. The country adopted various health related initiatives to develop the health scenario and achieve the Millennium Development Goals. Despite the enormous efforts, the health issues are still existent worldwide. Researchers conducted various studies to investigate the reasons behind this backwardness. Fay et al., (2005), found in their study that other than the traditional variables like income, asset, education etc. the variable like health infrastructure has an important role to play in the health outcome of the children. The expenditure on health sector is an important determinant of child immunization (Arik and Arik, 2009). From the various studies it is revealed that there are various factors that influence mothers' health and child health. Mothers' health alone is a prime factor that influences child immunization. Thus we see that health

infrastructure, mothers' health, child immunization all are closely related with each other. There are various empirical studies which show the interdependence of all these factors. Analysing these studies gives us a clear view of the connectivity more specifically.

The paper proceeds as follows: the next section gives a brief discussion of the literary works done in the field of health infrastructure efficiency, followed by discussing mothers' health and child immunization and the factors related to child immunization. The paper ends with a conclusing remarks.

2. Technical Efficiency: How it Affects Health?

Kumbhakar, et al., (1991), measured technical and allocative efficiencies in the USA dairy farms. Authors found that farmer's education and knowledge, farm size enhanced technical and allocative efficiencies.

Squires, and Tabor, (1991), in their study found that more labour intensive technology boosted irrigation and yields in smaller farms.

Sankar, and Kathuria, (2004), studied on the efficacy of the rural public health systems in improving the health outcomes in rural areas. They also studied to find the best performing state in this regard and the non-health related factors that influence the relative performance of the states. They considered rural infant mortality rate (IMR) as the output variable and the number of health centers, doctors, paramedical staffs, availability of hospital bed and percentage of institutionalized delivery as the input variables. The methodology used by them was stochastic production frontier and panel data literature. The researchers found in their study that the level of health infrastructure in terms of various facilities and availability of skilled professionals like doctors and paramedical staffs etc. have positive effect on the health outcome. They also found that education is the most important non-health related indicator which influences the level of efficiency of the health system.

Jacobs (2011) conducted a study to compare the efficiency ranking of the hospitals obtained by two different measures of efficiency namely DEA and SFA. The researcher also considered the possibility of inconsistency between the produced efficient estimates. The data used was cross sectional dataset of NHS trusts. Using data Envelop Analysis and Stochastic Frontier Analysis the study made an comparison with the same dataset. In the study the researcher showed that there existed differences in efficiency scores obtained by the different measures of efficiency. The author opined that those differences might be due to some random 'noise' effect or deficiency in data. The author suggested to use several specifications for developing ranges of efficiency to act as a signalling devices rather than point estimation.

Khai, and Yabe, (2011), used Cobb Douglas production function to measure technical efficiency of rice producers in Vietnam.

Kumbhakar, and Tsionas, (2011), explored the current advances in the study of stochastic frontier approach (SFA). They discussed input oriented and output oriented technical efficiency.

Suriyakala, et al., (2016), studied to relate the infant mortality rate with fertility rate, national income, women's employment status, health care expenditure, female literacy rate and health care infrastructure. The data was obtained from indiastat.com for states and union territories in India for the year 2001 to 2011. Using regression analysis and technical efficiency analysis they found that the major states are performing well whereas some states like Andaman and Nicobar Island, Mizoram, Arunachal Pradesh, Jammu and Kashmir are performing poorly.

3. How Mothers' Health Affects Child Immunization?

A study conducted by Martin et al., (1983), found relationship between level of economic development and mortality of the nation. They also have examined mortality differentials by socio-demographic and environmental factors, both at aggregate and individual levels within a nation.

Another study conducted in Somalia by LaFond, (1993), identified the factors influencing acceptance of immunization in two Somali communities. The author adopted a retrospective, qualitative approach to assess individual and community experience both with immunization and with the immunization programme. Data was collected from focus group discussions, informal interviews and observation. The researcher found the need of redesigning both the overall approach of the immunization programme and the content and style of health messages by programme managers and health workers with information.

Desai, and Alva, (1998), investigated the effect of maternal education on infant mortality, children's height for age and immunization status. Data was collected from first round of Demographic and health Surveys for 22 developing countries. The study concluded that, maternal education strongly influence children's immunization status.

Masham, et al, (1999), studied to assess the role of income changes and other changes over time in determining infant mortality rate and total fertility rate. They also studied the `relative performance of India to other countries and also of the Indian states within the country. The input variable of the study was per capita income and over time changes like technical change, female literacy, age of female marriage and access to medical facilities etc. The output variable was infant mortality rate and total fertility rates of each states and country as a whole. GLS method of estimation was used to analyze the data. The finding of the study was that income and IMR/TFR are inversely related. The study also found that the relative performance of the states fluctuates due to non-income state specific related factors rather than income variations. The study pointed to the importance of immunization and family planning programmes in reducing infant mortality rate and not only of the income factors.

Das, and Dasgupta, (2000), critically evaluated a broad macro-perspective of immunization programme on demographic trends and child health. Data was collected on 15 major states starting from the beginning of the 1980s to mid-1990s.But mainly the data was collected from the censuses of 1981 and 1991, sample registration system (SRS) annual surveys and reports and annual reports and yearbooks of MHFW. The analysis found a slackening of the initial thrust (1990-91) of the EPI, which was concerned from the point of vaccine preventable diseases (VPDs). The task of providing full coverage was suppressed in the underperforming states at that time as the size of net infants was increasing in all states. The study found the notion of 'herd immunity' on the right track despite of its controversy but

although at the aggregate level VPD occurrence was lowered but the local epidemic was not abolished. It was clear from their study that the immunization programme was lacking not because of shortage of financial or physical resources rather the cause was incentive and management. The study reveals that the success of immunization proramme also requires better political performance.

Harrington, et al, (2000), conducted a study to assess the impact of mothers' satisfaction with the services during immunization process on completion of immunization. The study was conducted by interviewing the mothers of 1-2 years of aged children. They found in their study that mothers reacted emotionally during the process and they reported that the services offered during the immunization processes by health centers and health personnel are rough and inhuman. This kind of behavior deterred the mothers from completion of the process of immunization and resulted in defaulting behavior.

Agnihotri, (2001), analyzed the district and state level infant and child mortality data in space and in time for West Bengal. The researcher found that state specific analysis was necessary to deal with the problem of infant and child mortality.

Ozcan, (2002), studied to assess the effect of declining mortality on fertility, education and economic growth. The researcher took land which is of fixed supply and human capital determined by fertility and schooling choices of parents as the input variable of the study. The dependent variable was total output. Partial and general equilibrium model was calibrated by using historical and contemporary data on income and survival probabilities to estimate the data. The result of the study was that decline in mortality promotes economic growth through increased education and reduced fertility. The reduction in fertility is due to the fact that when survival probability increases population growth decreases.

Fishman et al, (2004), conducted a study on five years aged underweight children. The study was based on longitudinal data. The researcher found that underweight resulted in an increased risk of mortality, particularly from infectious diseases like diarrhea and acute respiratory infection (ARI).

Giapponi, (2004), found a positive effect of maternal education on child immunization status in United States. Author used two-stage least squares model to conduct the study.

Berg, et al., (2006), conducted a research to assess the effect of socio-economic conditions of early life on individual mortality rate. The input variable of the study was macroeconomic condition early in life (notably GNP), inflation rate and the share of agricultural share in annual GNP. The methodology used by them was a non-parametric comparison between the lifetimes of individual born in boom and recession that followed boom. For individual mortality a duration model was used. The study found that the children born in a recession lives a few years less than the children born in a boom. Authors also found in their study that there is a negative causal effect of economic condition early in life on mortality rate later in life. The study suggested that during recession the special focus should be on children aged zero by providing food, housing and health care provision as the effect bad economic condition may result in higher mortality in later life.

Acemoglu, and Johnson, (2006), conducted a research to find out the effect of life expectancy at birth on economic growth. They took improvement in life expectancy as their input variable; the improvement was due to International Epidemiological Transition in the year 1940. And the outcome variable considered by them was population, total births, GDP, GDP per capita, GDP per working age population and years of schooling. They used OLS estimation to analyze the data collected from National Health statistics of League of Nations (until 1945) and World Health Organization and United Nations (after 1945). The result obtained from the study was that there was no statistically significant effect of increase in life expectancy on total GDP. Moreover, relative growth rate of GDP per capita show some decline with increase in life expectancy as the improvement in the said resulted in increase in population. Similarly, there was no increase in human capital investment associated with improvement in life expectancy.

Dancer, et al., (2007), investigated the impact of gender differences on child nutrition and survival probabilities. He collected the data from Bangladesh Demographic Health Survey 2004. The study was methodologically improved than previous researches as it allowed a preferred fit to emerge amongst a variety of self-selection models that differ according to copula specification. The study found that health interventions are important predictors of better survival and nutritional outcomes.

Sharma, (2007), examined the status and performance of the child immunization programme in India, U.P. and Uttarakhand during 1980-2004. The data was collected from the National Family Health Surveys and RCH Surveys in U.P. Uttarakhand and all over India. The study concluded that despite a focused and intense immunization programme since 1985 Uttarakhand could not reach the goal of universal immunization coverage.

Patra, (2006), studied the causes of poor immunization coverage in India. In his study the dependent variable was full immunization of a child and among many, some of the predictor variables were sex of the child, birth order of the child, mother's education, standard of living index, residence, religion etc. The data was obtained from the National Family Health Survey (NFHS) -2 (1998-99). The methodology used in the study was bivariate (unadjusted) and multivariate (adjusted) binary logit regression tool. The study resulted that the sex of the child is an important factor of immunization. The female children are most vulnerable of immunization. The later child born in a sequence received lower immunization coverage than the child born first or second in a family. Mother's educations, her awareness, mother's Empowerment Index (MEI), standard of living etc. are directly and positively related to the chance of immunization coverage. Further the study found that the urban area children are more likely to be immunized than the rural area children. Muslim children are least immunized whereas Christian and other community children are most likely to be immunized, found in the study.

Chaudhary, et al., (2010), focused to identify factors associated with child immunization or non-immunization and they identified immunization as most cheap and easy methods for the child survival. The study concluded that for non-immunization of children ignorance of the factors of immunization are responsible.

Kaldewei, (2010) prepared a technical note to examine the determinants of infant and under-five mortality in Jordan and recommended policy to achieve that goal. Logit regression model and an alternative survival analysis approach was used as methodology and the data was collected from 2007 Jordan Population and Family Health Survey (JPFHS). The study found that Jordan needs to beat the past achievements by giving efforts to further reduce infant and under-five mortality, in order to achieve MDG 4. The study suggested public awareness campaigning for gender equality in education and health care. The study also suggested reducing the case of smoking mothers, increase in birth intervals and the time of breastfeeding to attain the goal of reducing mortality much before the time of 2015.

Pushkar, and Gupta, (2011), examined impact of democracy on health, in terms of infant mortality rates and highlighted the significant variation in IMRs across states. The paper studied the validity of the democracy advantage thesis with reference to Indian states.

Ray, and Sinha, (2011) compared the state of health of 0-3 years of aged children between China, India, and Vietnam, and found that India was lagging behind China and Vietnam in case of both stunting and wasting. They found that though from 1992-93 to 2005-06 there was an improvement in the situation of stunting in India as the rate lowered from 50.20% to 41.40% but the situation of wasting remained unaltered at around 20%. But in china the rates were 21% for stunting and 6.50% for wasting respectively.

Ghosh, (2013) tried to identify the most vulnerable groups for immunization coverage and to identify the socio-cultural and socio-economic variables which affect immunization coverage. She described in her paper the child immunization status of some selected blocks of Darjeeling district. The study was entirely based on primary data collected from field survey. The outcome variable was the immunization status. And the determining factors were birth order, education of the parents, mothers' education, income of the father, mothers' age. The researcher used Logistic regression (binary) analysis and YULES' Coefficient of Association as methodology. The determining factors were behaving normally in the study. Higher birth order child receive higher immunization coverage. The study found a positive direct relation between parents' education, mother's education, income, age etc. and mortality rate. For overall development of the country importance of full immunization coverage for children should be emphasized as suggested by the researcher.

Kumar, and Vollmer, (2013), searched the impact of access to improved sanitation on diarrheal morbidity for children less than 5 years of age in India. They used District Level Household Survey 3 data set to quantify this. The researcher found that the access to improved sanitation reduces the risk of contracting diarrhea by 2.2 percentage points by using the propensity score matching technique.

Maitra, and Ray, (2013) analyzed child health indicators like – child malnourishment, prenatal, infant, and child mortality rates in West Bengal. It showed that these rates vary with the gender of the child, parental education, and the wealth status of households. Second and third rounds of the National Family Health Surveys (NFHS-2 and NFHS-3) were the data source of the study. The study found that though west Bengal was doing well in comparison to all India figures and east India but was lagging behind south India. In case of mortality its position was better than

India as a whole and was competing fair with south India. It found a positive effect of mothers' education on child health and also suggested the requirement of effective policy to delink maternal health and child health.

Vollmer, et al., (2014), aimed to assess whether macroeconomic growth resulted in reductions in early childhood under-nutrition in low-income and middle-income countries. The outcome variables of the study were stunting, underweight and wasting. The independent variable was per capita GDP. Logistic regression model was used to estimate the association between changes in per-head GDP and changes in child under-nutrition outcomes. The researchers found that there was the need of direct health investments to improve the nutritional status of children in low-income and middle-income countries.

Mawson et.al, (2016) conducted a study to compare the health outcomes of vaccinated and unvaccinated children on a larger range. The researchers also tried to find out the existence of any association between vaccination and neuro developmental disorders and significance of the association after factor adjustment. Data were collected through a cross sectional survey of mothers of 6-12 years age group in four states. Using logistic regression model the study concluded that vaccinated children are less likely to be affected by some diseases like chickenpox and pertusis but at the same time it was also observed that diseases like pneumonia, otilis media, allergies and neuro developmental diseases are more reported in vaccinated children.

4. What Determines Child Immunization?

Zahid, (1996), examined the mother's health-seeking behaviour and childhood mortality in Pakistan. The data for the study was collected from the 1990-91 Pakistan Demographic and Health Survey (PDHS), which covers all four provinces of the country. The researcher found that the children whose mothers are less than 20 years of age are having highest rate of neonatal, infant, and child mortality. Likewise first and higher order births children are having high infant and child mortality rate than among births of second or third order children. He further found that if the length of the birth interval increases mortality declines. The study also found positive effect of mothers' education on the neonatal, infant and child survival. Health services during the birth, antenatal care and immunization also influenced neonatal, infant and child mortality. It was suggested in the paper that health services and general education as well as mothers' education in particular should be improved in Pakistan.

Harpham, et al., (2005), conducted a study on four developing countries (Ethiopia, India, Vietnam, and Peru) to test the relation between maternal common mental disorders (CMD) and child nutritional status. The researcher took child stunting and underweight as the outcome variable. Household poverty, household composition, maternal characteristics such as age and education, child characteristics such as birth weight, age, and sex was taken as the potential confounding factors of the study. Possible mediating factors included the child's physical health and breast feeding status. He used logistic regression model to conduct the study. The researcher found a relation between high maternal CMD and poor child nutritional status in India and Vietnam. However, Peru and Ethiopia did not provide clear evidence for such similar association. The study suggested that child nutrition programmes in Asia should also considered promotion of maternal mental health.

Kahn, et al., (2005), conducted a study to assess whether low socioeconomic status and child behavior problems as well as maternal health conditions and behavior are associated with each other. The study concluded that behavioral problems in the subsequent generation may be affected by social disparities in women's health conditions.

Mwabu, G., (2008), conducted a study to investigate the relation between mothers' immunization against tetanus during pregnancy and birth weight of children and found a strong association between the two.

Pandey, (2009), examined whether under-five mortality was affected by maternal health. The data was collected from third wave of micro-level National Family Health Survey 2005-06 data for rural India. The study suggested that policies should be framed to attain Millennium Development Goal of reduced child mortality to avoid the generational transfer of poor health from a mother to her child.

Another study was conducted on Kerala, India by Kumar, and Devi, (2010), to examine the health status of women. The paper concluded that the Kerala needed to set strategies specifically to focus the vulnerable groups in terms of health and issues like problems of old age of women and widows, over medicalization, increasing cost of health care and occupational health of women.

Mishra, and Ray, (2012), found the failure of nutrition programmes to delink maternal health from child health in India as they found a negative relation between the BMI of mothers and child wasting. They found that in India the strength of this association increased over 1998-99 to 2005-06. But the researchers did not find such failure in China as India did not have the nutrition programmes that China had in place. The result was more shocking over the period when India was recording impressive growth rates.

Another study was conducted by Mittal, (2013), in the village Bashahpur of Gurgaon. The researcher observed the nutritional status, dietary intake and morbidity patterns among 100 non-pregnant non-lactating rural women of reproductive age group (18-40 years) through cross- sectional survey of 100 women. The study found the need of improvement of diet quality and education for rural women for economic rise and better nourishment.

5. Conclusions

All the literature that are reviewed contributed in the aspect of health related issues that affect the economy. The literature related to child health, mothers' health and efficiency of infrastructure all contributed to the field of research. Evaluation of the achievements are necessary as there are time and spatial variations. The above discussion reveals that mothers' health and child health, especially immunization are hugely influenced by health infrastructure. The efficient utilization of the infrastructure facilitates a higher level of success regarding health care utilization. Thus an economy should focus more on its health infrastructure upliftment along with other socio-economic and demographic factors for better maternal and child health.

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