SUMMER TRAINING

REPORT

BY

SHIVANI SHAKTI RAO

MBA HOSPITAL AND HEALTH MANAGEMENT

2019-2021

IIHMR UNIVERSITY

ACKNOWLEDGMENT

I am extremely indebted to IIHMR University for giving me this opportunity to learn.

I would like to extend my gratitude to Dr. P.R. Sodani, Dean Academics, IIHMR University.

I am extremely obliged to my mentor Dr. Shweta Aggarwal, who assisted me in the completion of this research paper, providing the necessary support to prepare the report, always being available and interested in my ideas. Her valuable experience and illuminating views profound knowledge has given me constant encouragement to perform better and achieve the task allotted.

I am grateful to Ms Zeenat for providing guidelines, without her active co-operation the report would not have been completed.

I express my warm regards to Dr. Asish Jha, Professor, Harvard T.H. Chan School of Public Health and EdX Platform for such a knowledgeable content.

I would like to thank all my family and friends present in my life, who has somehow contributed to my achieving, had a lot of patience and gave me all the support, to achieve my goals.

TABLE OF CONTENT

ABBREVIATIONS

BPL- Below Poverty Line

COEFF – Coefficient

GDP – Gross Development Product

IMR – Infant Mortality Rate

LBW – Low Birth Weight

MLR – Multiple Linear Regressions

MMR – Maternal Mortality Rate

NCBI - National Center for Biotechnology Information

NFHS – National Family Health Survey

NMR- Neonatal Mortality Rate

SRB – Sex Ratio at Birth

PART-1

RESEARCH PAPER

ON

FACTORS AFFECTING IMR OF RURAL, URBAN and WHOLE INDIA.

ABSTRACT

INTRODUCTION

Infant mortality is defined as the probability of dying between birth and exactly 1 year of age, expressed per 1,000 live births (UNICEF, 2019). Infant mortality not only reflects the health status of infants rather explains the health system of country. Infant mortality is one of the major concerns as public health issues for every country especially for developing nation like India. Looking at the past surveys and reports, clearly mark the status of India and decreased infant mortality rate. According to National Family Health Survey reports, infant mortality rate declined from 79 deaths per 1,000 live births in the five years before the 1992-93 NFHS survey to 41 deaths per 1,000 live births in the five years before the 2015-16 NFHS survey. Decline in infant mortality rate can be clearly appreciated despite progress; however this is far beyond satisfactory results. Studies conducted previously have separately and exclusively explored the factors affecting IMR for rural, urban, or specific states/districts. This study aims on highlighting on the factors which have combinable affect the IMR in urban, rural and whole India.

METHOD

Datasets from NFHS-4 (2015-16), was used to identify the factors associated with infant mortality which was conducted in states and union territory of India. Multiple Linear Regression method and Stepwise regression has been used on the data extracted from the NFHS-4 reports (NFHS).

RESULTS

Data analysis on urban population resulted that 34% of variation in IMR of India can be explained by these independent variables, which were selected. Early marriage among women ($p<0.05$), anaemic pregnant women ($p<0.05$) and schooling among women ($p<0.05$) are significant. Data on rural population after analysis resulted that 19% of variation in IMR of India can be explained by these independent variables, which were selected. Data on total overall India after analysis resulted that 38% of variation in IMR of India can be explained by these independent variables, which were selected. For both rural and total India, only women schooling (more than 10 years) is significant ($P<0.05$).

CONCLUSION

This study aims to explore the factors affecting infant mortality of urban, rural and entire India. This study revealed the significance of female literacy for urban, rural and entire India. Other than this, early marriage and maternal anemia were significant for urban India. The findings from the study back the policy makers and government in revising the program and schemes for achieving selected variables in a positive way. Further, this study also contributes in achieving the universal health coverage by accomplishing SDG's. To ensure improvement in infant mortality rate of urban, rural and total India, institutional deliveries should be promoted, maternal anemia needs to be treated, sex ratio need to be focused, female education need to focus and marriage before 18 years to be monitored.

INTRODUCTION

Early childhood indicators explain the well-being and healthcare system of the entire nation. In developing country like India, high infant mortality is a major public health priority. NFHS reports that Infant mortality rate has declined from 79 deaths per 1,000 live births (NFHS, 1993) to 41 deaths per 1,000 live births (NFHS, 2016). This decline in IMR is a good sign of progress; however this is far beyond satisfactory results. Objective of this study is to find out the factors affecting IMR of urban, rural and entire India. Mortality among infants is defined as *the death of a child/infant before reaching the age of one in a specific year or period. In other words, it is defined as the possibility of dying between birth and closely 1 year of age, expressed per 1,000 live births* (UNICEF, 2019).

The cause of infant mortality rate varies significantly across urban and rural regions of India. Chances of survival of an infant depend not only on where and to whom the child is born but also other factors like income and gender, to name a few . In addition, IMR may be caused by malnutrition, lack of adequate public health infrastructure, widespread illiteracy, poverty, premature birth, low birth weight, neonatal infections, poor maternal health, and poor parental education. (Lancet Child Adolesc Health, 2019; Ladusingh , Gupta, & Yadav, 2016)

Past studies have explored different determinants of IMR which include gender, use of cooking fuel, sanitation, drinking water, religion in which child is born, income, parity, maternal age, birth spacing, birth asphyxia, low birth weight, ,prematurity , geographical diversity; plains or mountains/hilly areas, and infections (Rutstein, Effects of Preceding Birth Intervals on Neonatal, Infant and Under-Five Years Mortality and Nutritional Status in Developing Countries: Evidence From the Demographic and Health Surveys, 2005; Gouda, Gupta, & yadav, 2015; Morakinyo & Fagbamigbe, 2017; Rai, 2017). These studies also emphasized importance of socio-cultural norms in eliminating the gender bias to reduce IMR (Sahu, Nair, Singh, Gulati, & Pandey, 2015) . Khadka et al(2015) explored relationship between socio-economic factors, infant mortality rate, Millennium Development Goal (MDG) and Sustainable Development Goal (SDG).

Research gap

Earlier research has focused on rural or urban area with socio-culture similarities but not exclusive effects of same variables on urban, rural and entire India. Therefore, this study aims to explore other determinants of IMR of urban, rural and entire India.

So, the present study focuses on the following research question;

- What are the different factors; affecting IMR of Urban, Rural and Whole India?

This research question diverts to the Objectives for this study which are:

- To assess the relationship between sex ratio at birth with IMR in India.
- To assess the relationship between early marriage with the changing IMR in India.
- To evaluate relationship between schooling of women more than 10 years and IMR of India.
- To establish relationship between maternal anemia and IMR of India.
- To establish relationship between institutional delivery and IMR of India.

To further study and know more about these objectives and research question, comprehensive literature review has been done, which is the next part of this report.

LITERATURE REVIEW

SEARCH STRATEGY

Several studies have been published which explains the different factors which affect the infant mortality of country. Literature review for this study is Non-systematic literature review, which includes the published study and research papers from Google Scholar, PubMed (ncbi) site, Research Gate. Inclusion criteria for literature review is that all the papers which included the health related factors affecting infant mortality rate of urban-rural (separately), different states of India, India as a whole and different countries. Studies which included NFHS as source of data have also been included in this review.

Extensive literature review was done including papers which were published globally. These studies identified the similar variables which were seen in context to Indian studies. Study done in England and Wales collected data concluded that on collected data analysis interpret that higher infant death in South Asian and Black infants does not appear to be explained by socio-demographic characteristics. Higher proportions of very premature infants have explained the increased risks in Black infants but not in South Asian groups. Strategies targeting the prevention and management of preterm birth in Black groups, suboptimal birth weight and adjustable risk factors for congenital anomalies in South Asian groups might help reduce ethnic inequalities in infant mortality (Li, et al., 2018).

Study done in Bangladesh resulted that mother's age and father's education were significant covariates for child mortality. Comparison was done for the factors affecting infant mortality of 2011 and 2014. This study found that household factors like toilet, drinking water, etc. Parental education was found to be significant in both studies in 2011 and 2014 (Maniruzzaman, et al., 2018)

Studies have performed the comparative analysis between two surveys to identify the factors changing and there effect on infant mortality. Study done in Nepal revealed that geographical difficulties and service coverage had influenced infant mortality; therefore, it is essential to increase the access and availability of health care services in hard-to-reach areas. Risk factors for both the time period were found to be different except 'succeeding birth interval'; this was significant for both study periods. Factors identified were ecological region, birth interval, delivery assistant type, and infant birth size and breastfeeding status as significant predictors of infant mortality (Lamichhane, Zhao, Paudel, & Adewuyi, 2017).

Study using Geospatial Analysis explained that the state and regional disparities in infant and under-five mortality in India over the past two decades using surveys and data from NFHS (1992–1993), NFHS (1998–1999) and DLHS (2002–2004). This study revealed that areas which were unfortunate in terms of education, nutrition were likely to be disadvantaged in terms of child survival quotient. This study focused on the economic status in describing the child survival and engrossed the importance of female education. This study

identified the hotspot and cold spots in term of poverty, female education, and child malnutrition (Singh , Pathak,, Chauhan, & Pan, 2011).

Study done in India explained the trends, patterns and predicting factors with the help of maps and resulted that majority of the states have witnessed over 50% reduction in both infant and under-5 mortality rates from NFHS-I to NFHS-4. This study reported that though there is reduction in rates but the improvements are not evenly distributed, and there is huge variation in performance between states over time. They used regression analysis for comparing the high-performing and low-performing states which revealed that female infants and women with shorter birth intervals had greater risk of infant deaths in poor-performing states. This paper recommended for the strategies which can help in reducing child and infant mortality among the high-impact states where good results in terms of improvement can be expected, including the need to address neonatal mortality (Bhatia , Dwivedi, Ranjan , & Dixit, 2019).

GAP IN LITERATURE REVIEW

On literature review, there are few variables which are common in every study; be it globally or in India. These factors are Maternal Anemia, early marriage, sex ratio at birth, institutional delivery and female schooling. Further, literature review was done related to above mentioned factors in relation to infant mortality rate.

Maternal Anaemia

One of the studies done in India and Pakistan concluded that maternal mortality was not associated with anaemia. But Foetal and neonatal mortality was associated with severe anaemia in form of stillbirth and neonatal mortality. This study established the relation that exists between infant and neonatal mortality with severe maternal anaemia (Parks , et al., 2019). Study in eastern rural Maharashtra, India explained that even mild anaemia at time of delivery increased the risk of stillbirth, neonatal death or low birth weight babies. If anaemia existed at time of pregnancy then this increased the risk of having stillbirth, infant mortality or LBW babies. This risk was at its highest peak when anaemia exists with underweight during pregnancy (Patel , Prakash, Das, Gupta, Pusdekar, & Hibberd, 2018).

Early Marriage

According to study done in India which is focusing on maternal age at marriage and the effects on pregnancy resulted that early maternal age at marriage substantially increases the risk of adverse pregnancy outcomes. On the basis of study and analysis, it was suggested the need of strengthening laws and policies to increase age at marriage of girls, and effort to improve health status of married adolescents. This explained that the girl getting married early results in adverse pregnancy outcomes in the form of stillbirth or early death of infant (PAUL, 2018). Another Study in India explained the effect of early marriage on mortality and morbidity of children. This study resulted that risk of low birth weight, malnutrition, infant diarrhoea and mortality was

observed and stunting with underweight was resulted to be significant in relation to infant healthcare. This study explained that Early motherhood is the one the cause for infant mortality (Raj, et al., 2010).

Sex Ratio at Birth

Study explained the correlation between mortality indices and Sex ratio at birth (SRB) was statistically significant at the national level worldwide. All the analysis showed that mortality rates were significant predictors of sex ratios, whether using either individual mortality rates (IMR, MMR, U5MR and AMR) or averaged mortality indices. Life expectancy and mortality rates impose considerable influence on reproductive and parental investment strategies in humans. Study discussed that, life expectancy and mortality rates have distinct predictive power beyond fertility, wealth and latitude. **(Dama, 2011)**. Study suggested that females have an advantage over males, with a better outcome in the perinatal period, particularly after preterm birth. These type of study concluded that mothers giving birth to female infants experienced less complication when compared with the mothers of male infants. This resulted in better pregnancy outcome with female infants than male infants (Renzo, Rosati, DonatiSar, Cruciani, & Cutuli, 2007).

Institutional Delivery

Study done on neonatal mortality and maternal care utilization in Bihar focused on the need of institutional delivery. This study explained the causes and reasons for institutional delivery by skilled staff and proper facility for controlling the neonatal and infant mortality in that region. This study analysed that when the delivery was performed by in institution (hospital) by skilled staff resulted in decrease of infant mortality in that particular area (Kumar, Dandona, Chaman, Singh, & Dandona, 2014). Study done in Gujarat which focuses on institutional delivery among tribal women resulted in the need of improvement in institutions .This study highlights the vital role of institutional delivery in preventing neonatal mortality among newborns of susceptible (BPL or tribal) women who experienced complications during delivery in such setting. Efforts to improve vulnerable women's access to obstetric care are crucial in such setting if NMRs are needed to be decreased. This study analyzed that neonates born to mothers with reported obstetric complications during delivery had a NMR twice higher than those born to mothers without childbirth complications (Altman , Sidney, Costa, Vora, & Salazar, 2017). Study done in a rural community of North India concluded that there exists area in rural community where avoidable infant mortality is present which are already under continuous health and demographic shadowing There is necessity to enhance home-based preventive care to enable the mother to identify and respond to danger signs. Verbal autopsy and social autopsy could be routinely done to guide policy interpolation aimed at reduction of infant mortality (Rai K. S., 2017).

Female Schooling

Study done in Nepal explained the role of female education in improving the health of their children by analysing the data of infant mortality with female literacy. This study explained the reason for decreasing rate of infant mortality in Nepal in preceding years of study. This study concluded that mother's literacy and involvement in healthcare decision making appear to be the most powerful predictors for reducing infant mortality (Adhikari & Sawangdee, 2011) . Study in India concluded that education empowers women to apply the right knowledge in the form of home based care and prompt referral of a child in an illness. This study explained that females who are educated can use their knowledge in improving their family and child health status. (Saurabh, Sarkar, & Pandey, 2013). Another Study resulted that Female literacy and empowerment were inversely associated with infant death. The results indicated intervention by enabling the education-infant death association and effect reformation by household wealth. Both empowerment and education had strongest inverse association with infant death among women from the richest households (Alemayehu, Theall, Lemma , Hajito, & Tushune , 2015).

LITERATURE review has given the gist of causes of infant mortality which can be Malnutrition, household infrastructure, Widespread Illiteracy , Poverty, Premature birth and low birth weight, Neonatal infections, Poor maternal health, maternal education, etc., which may vary from region to region, urban to rural, rich to poor, male to female, etc.

Majorly , studies in past have separately and exclusively explored the factors affecting IMR for rural, urban, scheduled tribe/caste or specific states/districts and have focused on the geographical diversity; plains or mountains/hilly areas, rural or urban area with socio-culture similarities or differences, etc.; but not combinable on urban, rural and whole India

Considering this literature review and other published study , there is a lack of studies which would exclusively concentrating on the factors affecting IMR of rural, urban and whole India altogether. Also, study establishing the relationship between sex ratio at birth and infant mortality are lacking. Studies related to early marriage and infant mortality is concluding both the alternative as well as null hypothesis. There are many published study regarding institutional delivery, maternal anemia (anemia during pregnancy) and female literacy for particular state/region/area but not for rural, urban and total India as a whole. This study aims on highlighting only on the factors and there effect on the IMR in urban, rural and whole India. For the particular study, the variable for female literacy was taken in consideration to number of years of schooling for women. This was done to check whether the number of years for schooling have any effect on infant mortality or not. This study aims to find and establish relationship between Sex Ratio at Birth, early marriage, female schooling, maternal anaemia and institutional delivery with IMR of rural, urban and total India.

SO, Hypothesis formulated for the present paper after literature review are (**ANNEXURE-13)**

- H1: Sex ratio at birth and IMR
  - There is no relationship between sex ratio at birth and increasing IMR of urban, rural and whole India.
  - There is a relationship between sex ratio at birth and increasing IMR of urban, rural and whole India.
- H2: Early marriage and IMR
  - There is no relationship between marriage before 18 years and increasing IMR of urban, rural and whole India.
  - There is a relationship between marriage before 18 years and increasing IMR of urban, rural and whole India.
- H3: Women Schooling and IMR
  - There is no relationship between schooling of women more than 10 years and increasing IMR of urban, rural and whole India.
  - There is a relationship between schooling of women more than 10 years and increasing IMR of urban, rural and whole India
- H4: Maternal anemia and IMR
  - There is no relationship between maternal anemia and increasing IMR of urban, rural and whole India
  - There is a relationship between maternal anemia and increasing IMR of urban, rural and whole India
- H5: Institutional birth and IMR
  - There is no relationship between Institutional delivery and increasing IMR of urban, rural and whole India.
  - There is a relationship between Institutional delivery and increasing IMR of urban, rural and whole India.

METHOD

The main aim of this study is to analyse the risk factors affecting the infant mortality rate of rural, urban and whole India. Specifically, the aim is to establish the relationship between sex ratio at birth, early marriage, maternal anaemia, female literacy and institutional delivery with infant mortality rate.

Data source

To test the above mentioned hypothesis, data regarding the mentioned variables were extracted from the NFHS-4 reports and was used in present study (secondary data). NFHS-4(2015-2016) reports are recent published reports which contain data of India, which is a large-scale, multi-round survey for all the states and union territory of India (NFHS). NFHS-4 interviewed approximately 571,660 households, up from about 109,041 households in NFHS-3, which is expected to yield a total sample of 628,826 women for the mentioned variables and data (NFHS). Data was collected by agency/collection teams using Computer Assisted Personal Interviewing (CAPI) on mini-notebook computers; as this will eliminate the need for a separate data entry operation and for data editing in the field.

Inclusion and Exclusion Criteria

For this Study, the data required was Sex ratio at birth for children born in the last five years (females per 1,000 males), Women with 10 or more years of schooling (%), Infant mortality rate (IMR) , Institutional births (%) , Pregnant women age 15-49 years who are anaemic (<11.0 g/dl) (%) and Women age 20-24 years married before age 18 years (%) from NFHS-4 (2015-2016) reports. Data of all states and union territory was included which was available in the report. None of the states or union territory was excluded. There were many states whose data for different variables were absent. Thus, the missing values were treated by replacing them with the median for that particular category.

Selection of Technique

On literature review, most of the studies have used regression method, chi-square test on the data which is either primary or secondary collected. So, for this study Multiple Linear Regression method and Stepwise regression has been used on the data extracted from the NFHS-4 reports, which establish a mathematical relationship among a number of random variables i.e.; this examines how multiple independent variables are related to one dependent variable.

To study the hypothesis formulated by regression method, dependent and independent variable were selected. Dependent variable for the study was Infant Mortality Rate of Rural, Urban and Total India. Independent

Variable for the study were Sex ratio at birth for children born in the last five years (females per 1,000 males) , Women with 10 or more years of schooling (%) , Institutional births (%) , Pregnant women age 15-49 years who are anaemic (<11.0 g/dl) (%) and Women age 20-24 years married before age 18 years (%).
In this current paper, Women with 10 or more years of schooling (%) is denoted by female literacy variable, Pregnant women age 15-49 years who are anaemic (<11.0 g/dl) (%) is denoted by maternal anaemia, and Women age 20-24 years married before age 18 years (%) is denoted by early marriage.

Sex ratio	Sex ratio at birth for children born in the last five years (females per 1,000 males)
Maternal Anaemia	Pregnant women who were anaemic women in the age group 15-49 (<11.0 g/dl) (%)
Institutional Delivery	Institutional births (%)
Early Marriage	Women married before marriageable age of 18 years (%)
Female Schooling	Women with 10 or more years of schooling (%)
Infant Mortality rate	Death of a child/infant before reaching the age of one in a specific year or period

Multiple linear regression analysis makes several key assumptions, which were tested for the data. Assumptions tested were of Linearity, Multicollinearity, Normality, Auto-correlation and Homoscedasticity. Linearity assumption can be tested with the help of scatterplots. MLR analysis requires normality in data that can be checked with help of histogram or Q-Q plot or with a goodness of fit test (Kolmogorov-Smirnov test). MLR assumes that there should be no multicollinearity in the data, which occurs when the independent variables are highly correlated with each other. This can be checked by correlation matrix or Variance inflation factor (VIF).
Other assumption for MLR is homoscedasticity, which can be checked using Scatterplot of residuals versus predicted values.

All this estimation was done using Microsoft Excel 2010 and IBM SPSS STASTISTICS 22.

RESULT

NFHS-4 data was analysed using regression method and was run separately on urban, rural and total India data against the same variable. From output summary, Adjusted R Square, beta-coefficient and p-value is considered to identify the relationship between dependent and independent variable.

URBAN POPULATION and IMR

Analysis on data for the urban population gives the following summary output which results that adjusted r-square is 0.348, 34% of the following variables affect the IMR of India. In another words this tells that 34% of variation in IMR of India can be explained by these independent variables. [**ANNEXURE-1]**

For the given data, coefficient for sex ratio at birth came out to be -0.015.For institutional delivery came out to be -0.305, for anaemia in pregnant women coefficient is 0.485. Schooling among women (more than 10 years) coefficient is -0.512. Early marriage i.e. marriage before 18 years for women coefficient is -0.759.

P-value for early marriage among women is 0.009, for anaemic pregnant woman is 0.025, for schooling among women is 0.03. p- Value for sex ratio at birth is 0.27 and for institutional delivery is 0.071.

Several assumptions were tested on the data, which included Normality, Homoscedasticity, Auto correlation, Multicollinearity and linearity. For Normality, Kolmogorov-Smirnov test and Shaprio-Wik significance were checked, which resulted more than 0.05 i.e. 0.200 and0.612 for urban India **(Annexure-4).** For auto-correlation, Durbin-Watson came out to be 2.212[**Annexure-7 (a)].** Multicollinearity was tested by checking vif which came out to be less than 5 for each independent variable (**Annexure-9**). Linearity and Homoscedasticity were checked using scatter plots, which are violated. [**Annexure-11(a),12 (c)**]

RURAL POPULATION and IMR

Data for rural population of India gives the following summary output which results that adjusted r square is 0.193, that 19% of the following variables affect the IMR of India. In another words this tells that 19% of variation in IMR of India can be explained by these independent variables. **[ANNEXURE-2]**

For the given data, beta coefficient for sex ratio at birth is -0.017, for schooling among women (more than 10 years) is -0.455. For the anaemic pregnant women's coefficient came out to be 0.159 and for early marriage (marriage before 18 years) is -0.126. Coefficient for institutional delivery is 0.009. P-value for schooling among women (more than 10year) is 0.037. p- Value for sex ratio at birth and anaemic pregnant women are 0.406 and 0.433 respectively. P-value for early marriage and institutional delivery came out to be 0.616 and 0.945 respectively.

Several assumptions were tested on the data, which included Normality, Homoscedasticity, Auto correlation, Multicollinearity and linearity. For Normality, Kolmogorov-Smirnov test and Shaprio-Wik significance were tested, which resulted more than 0.05 i.e. 0.200 and 0.617 for rural India (**Annexure-5).**

For auto-correlation, Durbin-Watson came out to be 2.234[**Annexure-7(B)].** Multicollinearity was tested by checking vif which came out to be less than 5 for each independent variable (**Annexure-8**). Linearity was checked using scatter plots, which was violated [**Annexure-11(c)**]. Heteroscedasticity was seen using scatter plots [**Annexure-12(a)**].

TOTAL POPULATION and IMR

Data for total population of India gives the following summary output which results that adjusted r square is 0.389 that is 38% of the following variables affect the IMR of India. In another words this tells that 38% of variation in IMR of India can be explained by these independent variables. **[ANNEXURE-3]**
For the given data, beta coefficient for sex ratio at birth is -0.037, for schooling among women (more than 10 years) is -0.735. For the anaemic pregnant women's coefficient came out to be -0.068 and for early marriage (marriage before 18 years) is -0.164. Coefficient for institutional delivery is -0.077. P-value for schooling among women (more than 10year) is 0.005. p- Value for sex ratio at birth and anaemic pregnant women are 0.245 and 0.182 respectively. P-value for early marriage and institutional delivery came out to be 0.520 and 0.564 respectively.

Several assumptions were tested on the data, which included Normality, Homoscedasticity, Auto correlation, Multicollinearity and linearity. For Normality, Kolmogorov-Smirnov test and Shaprio-Wik significance were checked, which resulted more than 0.05 i.e. 0.200 and 0.892 for total India **(Annexure-6)**.

For auto-correlation, Durbin-Watson came out to be 2.013[**Annexure-7(C)**]. Multicollinearity was tested by checking vif which came out to be less than 5 for each independent variable (**Annexure-10**). Linearity and Homoscedasticity were checked using scatter plots, which were not completely violated [**Annexure-11(B),12(B)**].

STEPWISE REGRESSION

Stepwise regression was done using SPSS on the same data and same variables. This resulted that:
For urban population; only institutional delivery had beta-coefficient of -0.411 with significance of .013.
For rural population, schooling more than 10 years for women had beta-coefficient of -0.524 with significance of 0.001 and for total population, again schooling more than 10 years for women had beta- coefficient of -0.644 with significance of 0.000.

DISCUSSION

On performing regression, findings were not same for urban, rural and whole India population.

URBAN POPULATION:

Data on urban population after analysis resulted that 34% of variation in IMR of India can be explained by these independent variables, which were selected. This means that there are still 66% of some other factors present which affects IMR for urban population of India apart from these chosen independent variables. Early marriage among women, anaemic pregnant women and schooling among women are significant whereas sex ratio at birth and institutional deliveries are not significant. This means that we can reject null hypothesis for early marriage i.e. early marriage is one of the factor related to IMR. Thus, the same can be followed for anaemic pregnant women and schooling among women, where null hypothesis for these variables can be rejected for urban population of India. This result

- There is a significant relationship between marriage before 18 years and increasing IMR of urban India.
- There is a significant relationship between maternal anemia and increasing IMR of urban India.
- There is a significant relationship between schooling of women more than 10 years and increasing IMR of urban India.

There is profusion of literature present which explains the factors associated with Infant Mortality. According to data related to urban population early marriage, maternal anaemia and female schooling are the factors which are significant. Above analysis on data results that early marriage needs to be increased in order to decrease infant mortality rate and such results are uncommon and conflicting in nature. Early marriage does not lead to infant mortality rather early motherhood is considered to be the factor affecting infant mortality (Raj, et al., 2010). Among the births to young women in India, maternal child marriage is not predictive of low infant birth weight or infant mortality. Such associations between maternal child marriage and low infant birth weight with infant mortality seem to be a consequence of early motherhood, low maternal education, and other indicators of poor maternal health and socioeconomic status (Ganchimeg, et al., 2014). Not only health related issues but also, socio-economic factors affect maternal health and infant mortality. This can lead to girl undernourishment and underweight in child marriage which can have lasting effect on infant and maternal health (Efevbera, Bhabha, Farmer, & Fink, 2019). On analyzing data, the maternal anemia results out to be significant for urban population hence to decrease infant mortality, maternal anemia need to be decrease. Severe maternal anemia is associated with higher risks of poor maternal, infant, and neonatal outcomes or mortality; but other degrees of anemia are not. (Parks , et al., 2019) Anemia may be the result of socio-economic state, which results in under- nourishment and poor care during and after pregnancy. Low Hb levels during pregnancy, moderate or severe anemia are associated with increased risk of low birth weight, maternal

and child mortality. Children born to anemic mothers are more likely to be anemic early in life and it has been reported that iron deficiency may irreversibly affect the cognitive performance and development and physical growth of infants (Rosas, Regil, Malave, Urrutia, & Dowswell, 2015). Analysis on data signified that to decrease infant mortality in India, female education need to be increased. Education is strongly related to health seeking behavior and overall health outcomes with gender equality. Better education is reflected by higher literacy rates, further associated with higher incomes and better health indicators such as lower infant mortality rates (IMRs). This means that population which has better female literacy rates have improved health indicators. In such areas, females are economically independent. (Saurabh, Sarkar, & Pandey, 2013).

On data analysis, sex ratio at birth and institutional delivery came out to be insignificant. Though they are insignificant but still affect infant mortality. Sex selected abortion and females being advantageous over male infants, resulting in increased infant mortality. (Renzo, Rosati, DonatiSar, Cruciani, & Cutuli, 2007; Smith, Saikia, Bishai, & Romo, 2019). Institutional deliveries can save and support infants as well as their mother from complications, which arise during or after delivery without supervision of skilled staff and proper services. (Kumar G. A., Dandona, Chaman, Singh, & Dandon, 2014).

RURAL POPULATION

After analysis on rural population, data resulted that 19% of variation in IMR of India can be explained by these independent variables, which were selected. This means that there are still 81% of some other factors present which affects IMR for rural population of India apart from these chosen independent variables. Although the results are not satisfactory as these variables contribute less towards the Infant mortality of rural India. Only women schooling (more than 10 years) is significant. This means that we can reject null hypothesis as women education affects the infant mortality in rural India. This result

- There is a significant relationship between schooling of women more than 10 years and increasing IMR of rural India.

Considering rural population, there are some of the other factors which affect the infant mortality which may or may not applicable for urban population of India. According to data related to rural population, female schooling is the only factor significant. Education is strongly related to health seeking behavior and females can use their knowledge in improving their family and child health status. This empowers women to apply the right knowledge in home based care during pregnancy and prompt referral of a child in any illness whenever required. Education brings better social standing of women resulting from wider literacy and likely to give them decision making roles with regard to nutrition, immunization, vaccination, thereby improving child health and uplifting infant mortality. (Saurabh, Sarkar, & Pandey, 2013). Though the results are not satisfactory for rural population, there exist several other variables which can be the factors associated with infant mortality. Infection due to open defecation, improper sanitation habit and population density can be factors affecting (Hathi , Haque, Pant, Coffey, & Spears, 2017). Birth asphyxia and LBW/prematurity were

the most important causes of neonatal mortality, followed by sepsis or pneumonia and congenital anomaly (Rai K. S., 2017). Such conditions can overcome by utilizing institutional delivery facility. All the above mentioned conditions and situation can be easily solved if the education system holds a strong back in providing proper education to females of rural India. There exist some societal and cultural practices which results in early marriage of girls. Maternal child marriage is predictive of infant and child malnutrition (Ganchimeg O. M., 2014). Other variables on data analysis resulted as insignificant which include sex ratio at birth, early marriage, institutional delivery and maternal anemia for rural population. Though all these independent variable are crucial for improving infant mortality but the result explains that there are other significant factors affecting infant mortality for rural population.

TOTAL INDIA

Data on total overall India after analysis resulted that 38% of variation in IMR of India can be explained by these independent variables, which were selected. This means that there are still 62% of some other factors are present which affects IMR for total population of India apart from these chosen independent variables.

Analysis explains that women schooling (more than 10 years) is the only significant factor for entire India. This means that we can reject null hypothesis for women schooling more than 10 year for Indian population. This result

- There is a significant relationship between schooling of women more than 10 years and increasing IMR of total India.

On complete review of India's population, factors affecting infant mortality can differ which may have the combined effect on rural and urban population. Such factors are those which may not be the major cause of death in different geographical region but when altogether analysed results in greater proportion. On data analysis, number of years for female education came out to be the significant factor for affecting infant mortality of total India. Though different data released in relation to female education claims significant increase in enrolment of females for primary, secondary and higher education but the result in development is still not achieved. This thrust toward the requirement of further increase in enrolment of females for education at different levels of schooling. Not only to decrease infant mortality, but to improve the variables mentioned before can be sought out just by improving the literacy status of Indian females. Better education is reflected by higher literacy rates, further associated with higher incomes and better health indicators such as lower infant mortality rates (IMRs) (Saurabh, Sarkar, and Pandey, 2013). This means that population which has better female literacy rates have improved health indicators. In such areas, females are economically independent. Also, States and Uts with higher literacy rates were found to have lower birth rates and IMRs. Education brings independent income for women who can spend it on essential and required child care. Better social standing of women resulting from wider literacy is likely to give them decision making roles with

regard to nutrition improving child health (Adhikari & Sawangdee, 2011). Moreover, education empowers women to apply the right knowledge in the form of home based care and prompt referral of a child in an illness. This can lead to healthy life of infant as well as family (Saurabh, Sarkar, & Pandey, 2013). Not only the mentioned variables, but the variables which require healthy decision making and awareness can be sought on improving the female education at least more than 10 years.

Other variables on data analysis turned out insignificant which include sex ratio at birth, early marriage, institutional delivery and maternal anemia for entire population of India. Though all these independent variable are crucial for improving infant mortality but the result explains that there are other significant factors affecting infant mortality for entire population of India.

CONCLUSION

This study aims to explore the factors affecting infant mortality of urban, rural and entire India. Data analysis revealed that for urban population 34% of variation, for rural population 19% of variation and for entire India 38% of variation in IMR of India can be explained by the selected independent variables.This study revealed the significance of female literacy for urban, rural and entire India. Other than this, early marriage and maternal anemia were significant for urban India. Over the recent years, several policy and regulations have been introduced by government for female education. It's recommended that efforts on increasing the number of educational schemes like Sakshar bharat mission, Kasturba Balika Vidyalaya, National Program for Education of Girls at Elementary Level, Mahila Sangha (rural), Rahstriya Madhyamik Shiksha Abhiyan, Dhanlakshmi scheme and institutes should be encouraged for empowering females with higher education and better decision making capability in terms of health. Government has already started many initiatives for girl child education which still needs to improve. Initiatives need to be taken in order to reduce child marriage, delay childbirth among those married as minors, and support nutritional vulnerabilities of young mothers which is important for improving the health and decreasing the mortality among infants and young children in India. Also, the varied results can be the cause of misreporting by people as they often do not reveal such information knowing that marriage before 18 years of age is illegal. Regarding maternal anemia national programme like Iron Supplementation Program for adolescent girls and pregnant women, need to be evaluated for any gaps present especially in areas with high rates of anemia. Various initiatives by government like PMSMA, Anemia Mukt Bharat (AMB), etc. have been started to control maternal anemia.

The findings from the study back the policy makers and government in revising the program and schemes for achieving these variables in a positive way. Further, this study also contributes in achieving the universal health coverage by accomplishing SDG's. To ensure improvement in infant mortality rate of urban, rural and total India, institutional deliveries should be promoted, maternal anemia needs to be treated, sex ratio need to be focused, female education need to focus and marriage before 18 years to be monitored.

STRENGTH AND LIMITATIONS

STRENGTH

Use of well- recognized data from NFHS-4, which is the nationally representative data for health and health related indicators. Questionnaires used are validated and uses standardized method of data collection. They have large sample size, which represents rural, urban and whole population of India.

LIMITATIONS

Data for some of the states for few categories are missing in the fact sheets of NFHS-4, which are replaced by the median of that category may have resulted in alteration of final results.

Linear regression has some limitations:

-They are sensitive to outliers, which would swing the final regression results and may result in inaccuracy or extrapolation in model.

-It is easy to over fit your model such that your regression begins to model the random error (noise) in the data, rather than just the relationship between the variables.

-This assumes the linearity between the dependent and independent variables of the data. In real-world data, it is not easily available for predicting the output because the dataset is rarely linear that can be separable.

REFERENCE

Alemayehu, Y. K., Theall, K., Lemma , W., Hajito, K. W., and Tushune , K. (2015). *The Role of Empowerment in the Association between a Woman's Educational Status and Infant Mortality in Ethiopia: Secondary Analysis of Demographic and Health Surveys.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4762974/

Bhatia , M., Dwivedi, L. K., Ranjan , M., and Dixit, P. (2019). Trends, patterns and predictive factors of infant and child mortality in well-performing and underperforming states of India: a secondary analysis using National Family Health Surveys.

Dama, M. S. (2011). *Sex Ratio at Birth and Mortality Rates Are Negatively Related in Humans.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3161077/

Adhikari , R., and Sawangdee, Y. (2011). *Influence of women's autonomy on infant mortality in Nepal.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3101134/

Altman , R., Sidney, K., Costa, A. D., Vora, K., and Salazar, M. (2017). *Is Institutional Delivery Protective Against Neonatal Mortality Among Poor or Tribal Women? A Cohort Study from Gujarat, India.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5391377/

Bapat, U., Alcock, G., More, N. S., Das, S., Joshi , W., and Osrin, D. (2012). *Stillbirths and newborn deaths in slum settlements in Mumbai, India: a prospective verbal autopsy study.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3405477/

Baqui, A. H., Darmstadt, G. L., Williams, E. K., Kumar, V., Kiran, T. U., Panwar , D., et al. (2006). *Rates, timing and causes of neonatal deaths in rural India: implications for neonatal health programs.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2627477/

Hathi , P., Haque, S., Pant, L., Coffey, D., and Spears, D. (2017). *Place and Child Health: The Interaction of Population Density and Sanitation in Developing Countries.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5306240/

Khadka, K. B., Lieberman, L. S., Giedraitis, V., Bhatta, L., and Pandey, G. (2015). The socio-economic determinants of infant mortality in Nepal: analysis of Nepal Demographic Health Survey. *bmj*.

Kumar, G. A., Dandona, R., Chaman, P., Singh, P., and Dandona, L. (2014). *A population-based study of neonatal mortality and maternal care utilization in the Indian state of Bihar.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4287469/

Ladusingh , L., Gupta, A. K., and Yadav, A. (2016). Ecological context of infant mortality in high-focus states of India. *pubmed*.

Lamichhane, R., Zhao, Y., Paudel, S., and Adewuyi, E. O. (2017). Factors associated with infant mortality in Nepal: a comparative analysis of Nepal demographic and health surveys (NDHS) 2006 and 2011.

Li, Y., Quigley, M. A., Dattani, N., Gray, R., Jayaweera, H., Kurinczuk, J. J., et al. (2018). *The contribution of gestational age, area deprivation and mother's country of birth to ethnic variations in infant mortality in England and Wales: A national cohort study using routinely collected data*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5896919/

Lim , S. s., Dandona, L., Hoisington , J. A., James, S. L., Hogan, M. C., and Gakidou, E. (2010). *India's Janani Suraksha Yojana, a Conditional Cash Transfer Programmed to Increase Births in Health Facilities: An Impact Evaluation.* Retrieved from https://pubmed.ncbi.nlm.nih.gov/20569841/

Padilla, C. m., Kihal-Talantikit, ,., Vieira , V. M., and Deguen, S. (2016). *Infant and Neonatal Mortality Clusters: Links with Socioeconomic and Air Pollution Spatial Patterns in France.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4924081/

Parks , s., Hoffman, K. K., Goudar, S. S., Patel, A., Saleem, S., Ali, S. A., et al. (2019). Maternal anaemia and maternal, fetal, and neonatal outcomes in a prospective cohort study in India and Pakistan.

Patel , A., Prakash, A. A., Das, P. K., Gupta, S., Pusdekar, Y. V., and Hibberd, P. L. (2018). *Maternal anemia and underweight as determinants of pregnancy outcomes: cohort study in eastern rural Maharashtra, India*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6089300/

Raj, A., Saggurti, N., Winter, M., Labonte, A., Decker, M. R., Balaiah, D., et al. (2010). The effect of maternal child marriage on morbidity and mortality of children under 5 in India: cross sectional study of a nationally representatuve sample.

Renzo, G. C., Rosati, A., DonatiSar, R., Cruciani, L., and Cutuli, A. M. (2007). *Does fetal sex affect pregnancy outcome?* Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S1550857907800040

Russo, L. X., Scott, A., Sivey,, P., Dias, J., and Brownie, S. M. (2019). *Primary care physicians and infant mortality: Evidence from Brazil*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6544253/

Sahu, D., Nair, S., Singh, L., Gulati, B., and Pandey, A. (2015). Levels, trends and predictors of infant and child mortality among Scheduled Tribes in rural India. *Indian journal*.

Saurabh, S., Sarkar, S., and Pandey, D. K. (2013). *Female Literacy Rate is a Better Predictor of Birth Rate and Infant Mortality Rate in India.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4649870/

Bapat, A. M. (2012). Stillbirths and newborn deaths in slum settlements in Mumbai, India: a prospective verbal autopsy study.

Baqui, D. W. (2006). Rates, timing and causes of neonatal deaths in rural India: implications for neonatal health programs.

Black , R. E., Taylor, C. E., Arole, S., Bang, A., Bhutta, Z. A., Mushtaque, A., et al. (2017). *Comprehensive review of the evidence regarding the effectiveness of community–based primary health care in improving maternal, neonatal and child health.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5475312/

Black, and etal. (2017). Comprehensive review of the evidence regarding the effectiveness of community–based primary health care in improving maternal, neonatal and child health.

cha, S. (2017). The impact of the worldwide Millennium Development Goals campaign on maternal and under-five child mortality reduction: 'Where did the worldwide campaign work most effectively? *ncbi*.

Gouda, J., Gupta, K. A., and yadav, A. K. (2015). Association of child health and household amenities in high focus states in India: a district-level analysis.

Hathi, H. P. (2017). Place and Child Health: The Interaction of Population Density and Sanitation in Developing Countries.

Lim, D. H. (2010). India's Janani Suraksha Yojana, a Conditional Cash Transfer Programmed to Increase Births in Health Facilities: An Impact Evaluation.

Malhotra, S., Zodpey, S. p., Vidyasagaran, A. L., Sharma, K., Raj, S. S., Neogi, S. B., et al. (2014). *Assessment of Essential Newborn Care Services in Secondary-level Facilities from Two Districts of India.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4089081/

Malhotra, Z. V. (2014). Assessment of Essential Newborn Care Services in Secondary-level Facilities from Two Districts of India.

Maniruzzaman, M., Suri, H. S., Kumar, N., Abedin, M. M., Rahman, M. J., El-Baz, A., et al. (2018). *Risk factors of neonatal mortality and child mortality in Bangladesh.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5928324/

Morakinyo, and Fagbamigbe. (2017). Neonatal, infant and under-five mortalities in Nigeria: An examination of trends and drivers (2003-2013). *NCBI*.

NFHS. (n.d.).

Padilla, T. V. (2016). Infant and Neonatal Mortality Clusters: Links with Socioeconomic and Air Pollution Spatial Patterns in France.

PAUL, P. (2018). Maternal Age at Marriage and Adverse Pregnancy Outcomes: Findings From the India Human Development Survey, 2011-2012.

Rai, K. S. (2017). Causes of and contributors to infant mortality in a rural community of North India: evidence from verbal and social autopsy. *BMJ*.

Rutstein. (n.d.). Effects of Preceding Birth Intervals on Neonatal, Infant and Under-Five Years Mortality and Nutritional Status in Developing Countries: Evidence From the Demographic and Health Surveys. *ncbi*.

Singh , A., Pathak,, P. K., Chauhan, R. K., and Pan, W. (2011). Infant and Child Mortality in India in the Last Two Decades: A Geospatial Analysis 2011.

UNICEF. (2019, SEPTEMBER). Retrieved from https://data.unicef.org/topic/childsurvival/under-five-mortality/

Worrall, J. S., Pace, N., Bapat , U., Das, S., More, N. S., Joshi, W., et al. (2011). *Maternal and neonatal health expenditure in Mumbai slums (India): A cross sectional study.* Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3061914/

Worrall, P. B.-M. (2011). Maternal and neonatal health expenditure in Mumbai slums (India): A cross sectional study.

ANNEXURE-1

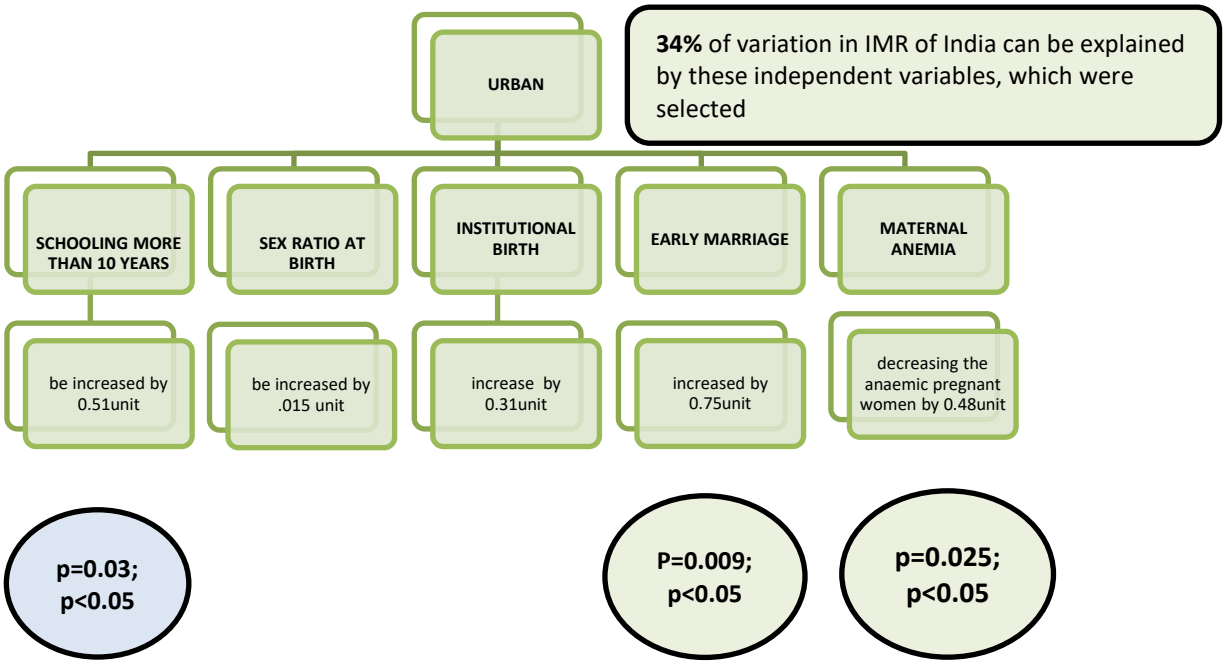
Table showing the summary output obtained after running regression on data for Urban Population of India:

URBAN POPULATION

Adjusted

R Square 0.348

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	84.050	23.727	3.542	0.001	35.593	132.508
Sex ratio at birth last 5 yrs (f/1,000M)(urban)	-0.015	0.013	-1.109	0.276	-0.041	0.012
married before age 18 years(urban)	-0.759	0.271	-2.799	0.009	-1.313	-0.205
Institutional births(urban)	-0.305	0.163	-1.869	0.071	-0.638	0.028
Pregnant women age 15-49 years who are anaemic(urban)	0.485	0.206	2.357	0.025	0.065	0.906
schooling more than 10 year(urban)	-0.512	0.230	-2.226	0.034	-0.981	-0.042



ANNEXURE-2

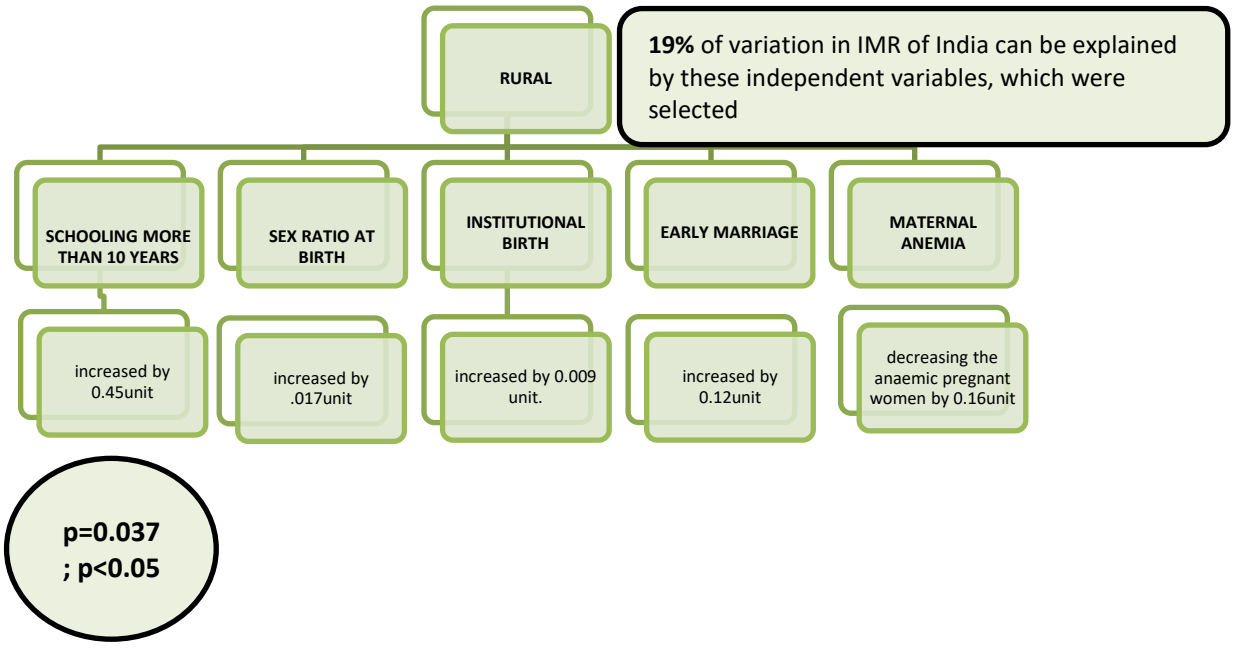
Table showing the summary output obtained after running regression on data for Rural Population of India:

RURAL POPULATION

Adjusted

R Square 0.193

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	62.686	23.995	2.612	0.014	13.681	111.691
married before age 18 years(rural)	-0.126	0.249	-0.507	0.616	-0.636	0.383
Institutional births(rural)	0.009	0.125	0.069	0.945	-0.246	0.263
Pregnant women age 15-49 years who are anaemic(rural)	0.159	0.201	0.794	0.433	-0.250	0.569
Sex ratio at birth last 5 yrs (f/1,000M)(rural)	-0.017	0.020	-0.843	0.406	-0.059	0.024
schooling more than 10 year(rural)	-0.455	0.208	-2.189	0.037	-0.880	-0.030



ANNEXURE-3

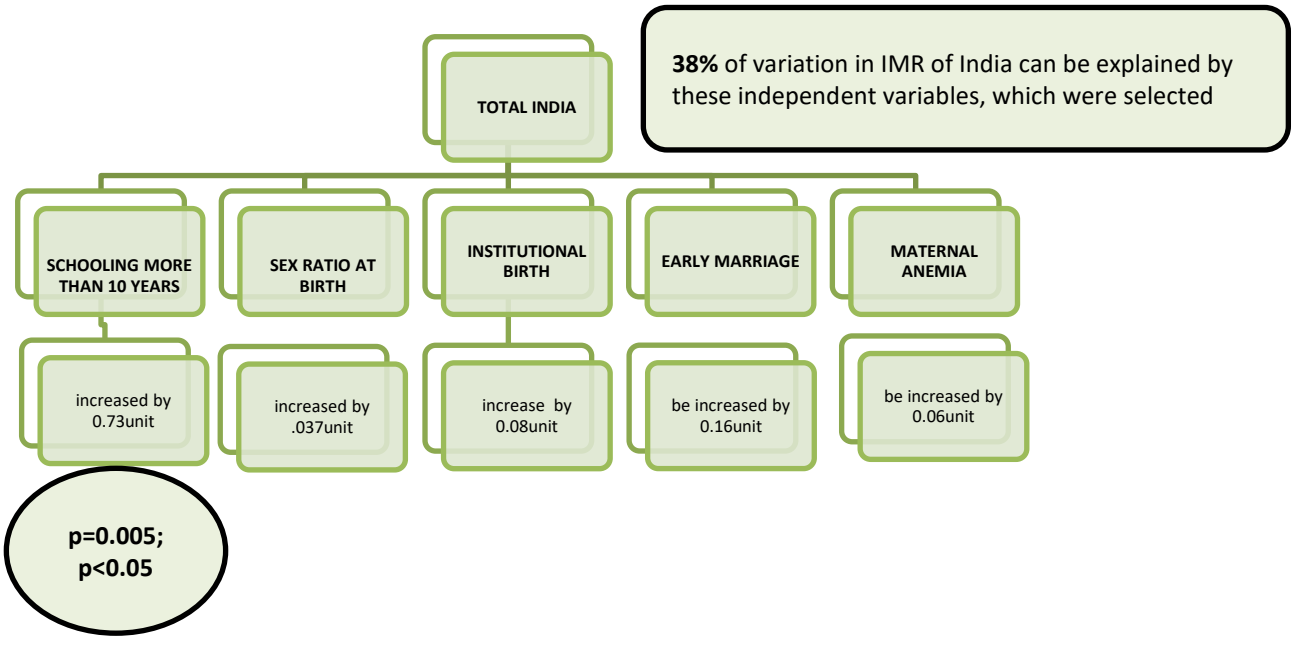
Table showing the summary output obtained after running regression on data for Rural Population of India:

TOTAL POPULATION

Adjusted

R Square 0.389

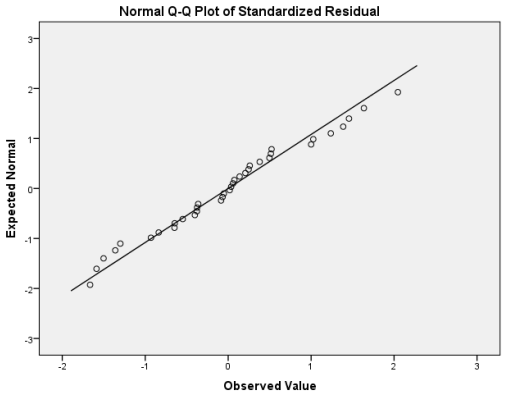
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	108.185	33.423	3.237	0.003	39.926	176.443
Sex ratio at birth last 5 yrs (f/1,000M)(total)	-0.037	0.031	-1.187	0.245	-0.100	0.026
married before age 18 years(total)	-0.164	0.252	-0.651	0.520	-0.679	0.351
Institutional births(total)	-0.077	0.133	-0.583	0.564	-0.348	0.193
Pregnant women age 15-49 years who are anaemic(total)	-0.068	0.050	-1.366	0.182	-0.171	0.034
schooling more than 10 years	-0.735	0.243	-3.025	0.005	-1.231	-0.239

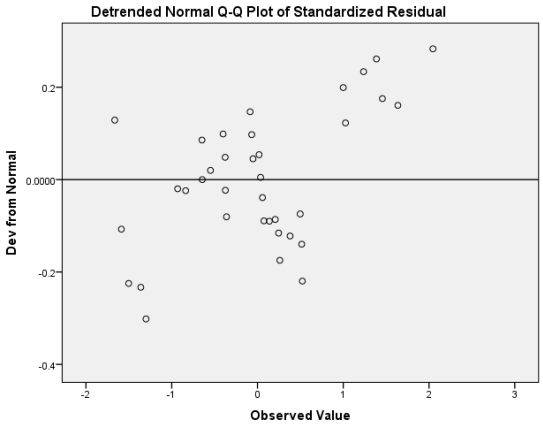


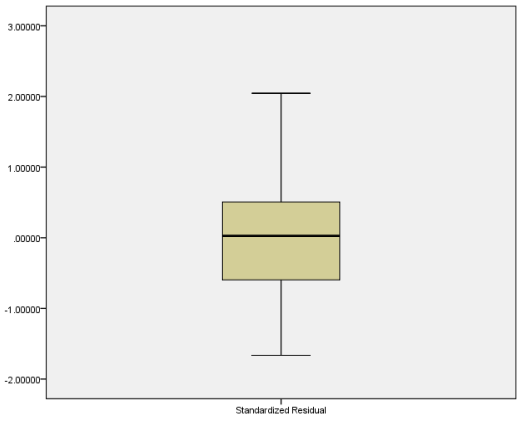
ANNEXURE-4

Tests of Normality-URBAN

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.092	36	.200*	.976	36	.621



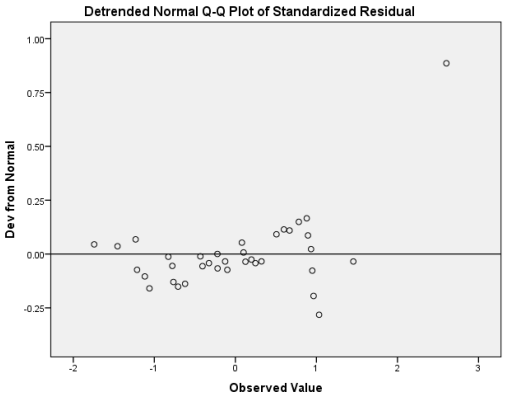


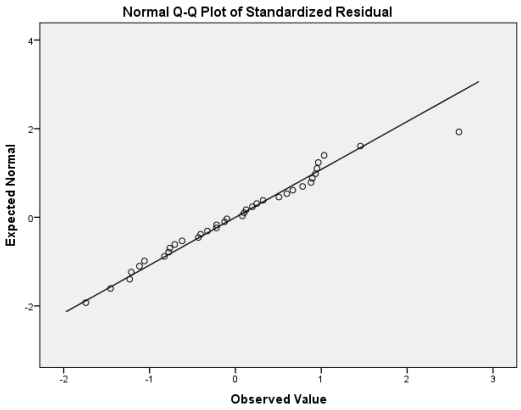


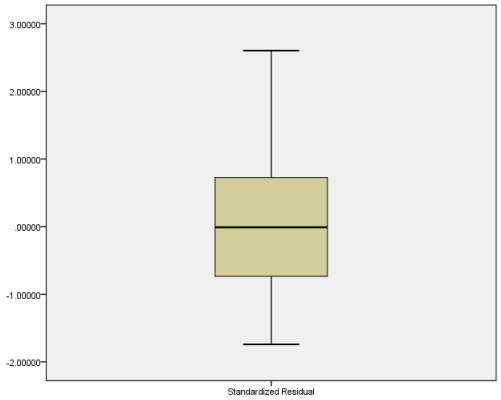
ANNEXURE-5

Tests of Normality-RURAL

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.077	36	.200*	.976	36	.617



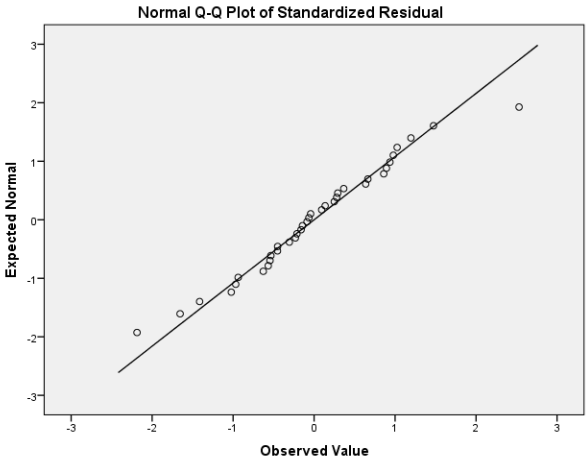


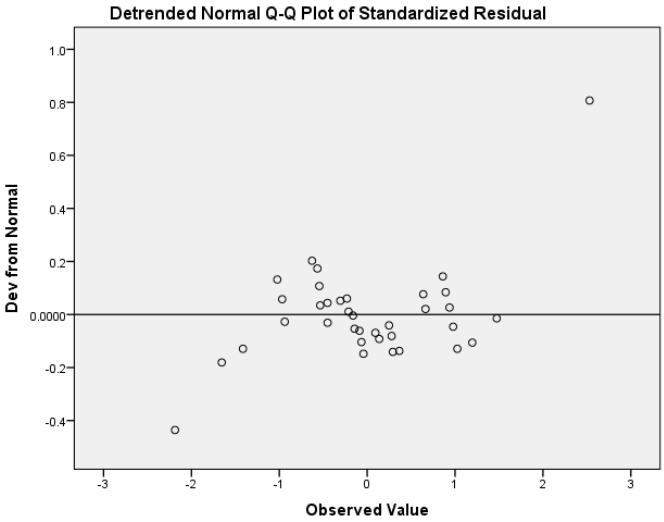


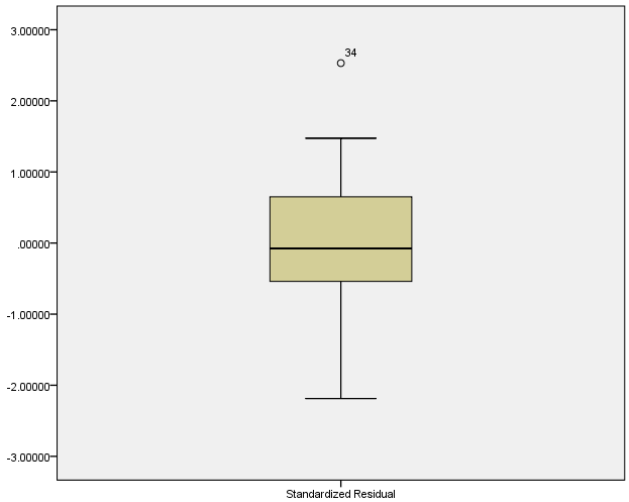
ANNEXURE-6

TEST OF NORMALITY-TOTAL

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.082	36	.200*	.985	36	.892







ANNEXURE-7

AUTOCORRELATION

A

Model Summary-URBAN

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.664[a]	.441	.348	8.4137	2.212

a. Predictors: (Constant), schooling more than 10 year(urban), Sex ratio at birth last 5 yrs (f/1,000M)(urban), Institutional births(urban), Pregnant women age 15-49 years who are anaemic(urban), married before age 18 years(urban)

b. Dependent Variable: imr (urban)

B

Model Summary-RURAL

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.556[a]	.309	.193	10.2330	2.234

a. Predictors: (Constant), schooling more than 10 year(rural), Sex ratio at birth last 5 yrs (f/1,000M)(rural), Pregnant women age 15-49 years who are anaemic(rural), Institutional births(rural), married before age 18 years(rural)

b. Dependent Variable: imr (rural)

C

Model Summary-TOTAL

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.677[a]	.458	.368	9.6152	2.013

a. Predictors: (Constant), schooling more than 10 years, Sex ratio at birth last 5 yrs (f/1,000M)(total), Pregnant women age 15-49 years who are anaemic(total), Institutional births(total), married before age 18 years(total)

b. Dependent Variable: imr (total)

ANNEXURE-8

MULTICOLLINEARITY

Coefficient-RURAL

MODEL		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	62.686	23.995		2.612	.014		
	married before age 18 years(rural)	-.126	.249	-.127	-.507	.616	.367	2.725
	Institutional births(rural)	.009	.125	.013	.069	.945	.630	1.586
	Pregnant women age 15-49 years who are anaemic(rural)	.159	.201	.145	.794	.433	.696	1.437
	Sex ratio at birth last 5 yrs (f/1,000M)(rural)	-.017	.020	-.130	-.843	.406	.973	1.028
	schooling more than 10 year(rural)	-.455	.208	-.576	-2.189	.037	.332	3.009

a. Dependent Variable: imr(rural)

Collinearity Diagnostics[a]

Dimension	Eigenvalue	Condition Index	Variance Proportions					
			(Constant)	married before age 18 years(rural)	Institutional births(rural)	Pregnant women age 15-49 years who are anaemic(rural)	Sex ratio at birth last 5 yrs (f/1,000M)(rural)	schooling more than 10 year(rural)
1	5.609	1.000	.00	.00	.00	.00	.00	.00
2	.307	4.276	.00	.11	.00	.00	.00	.07
3	.033	13.013	.02	.40	.15	.03	.08	.19
4	.026	14.716	.01	.11	.02	.90	.04	.01
5	.022	16.129	.00	.32	.82	.01	.00	.68
6	.003	41.569	.97	.05	.00	.05	.88	.05

a. Dependent Variable: imr(rural)

ANNEXURE-9

MULTICOLLINEARITY

Coefficients-URBAN

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	84.050	23.727		3.542	.001		
Sex ratio at birth last 5 yrs (f/1,000M)(urban)	-.015	.013	-.154	-1.109	.276	.961	1.040
married before age 18 years(urban)	-.759	.271	-.539	-2.799	.009	.503	1.988
Institutional births(urban)	-.305	.163	-.272	-1.869	.071	.882	1.134
Pregnant women age 15-49 years who are anaemic(urban)	.485	.206	.427	2.357	.025	.569	1.758
schooling more than 10 year(urban)	-.512	.230	-.404	-2.226	.034	.567	1.764

ndent Variable: imr(urban)

Collinearity Diagnostics[a]

ension	Eigenvalue	Condition Index	Variance Proportions					
			(Constant)	Sex ratio at birth last 5 yrs (f/1,000M)(urban)	married before age 18 years(urban)	Institutional births(urban)	Pregnant women age 15-49 years who are anaemic(urban)	schooling more than 10 year(urban)
	5.774	1.000	.00	.00	.00	.00	.00	.00
	.175	5.751	.00	.00	.34	.00	.01	.01
	.026	14.811	.00	.00	.47	.03	.68	.03
	.013	20.850	.00	.76	.01	.12	.13	.03
	.009	25.730	.01	.04	.16	.42	.02	.78
	.003	45.813	.99	.19	.01	.43	.17	.15

ndent Variable: imr(urban)

ANNEXURE-10

MULTICOLLINEARITY

Coefficients-TOTAL

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	87.563	33.301		2.629	.013		
	Sex ratio at birth last 5 yrs (f/1,000M)(total)	-.028	.031	-.124	-.895	.378	.936	1.069
	married before age 18 years(total)	-.222	.277	-.191	-.802	.429	.318	3.144
	Institutional births(total)	-.087	.135	-.111	-.642	.526	.604	1.657
	Pregnant women age 15-49 years who are anaemic(total)	.161	.180	.150	.891	.380	.637	1.571
	schoolsing more than 10 years	-.623	.236	-.671	-2.645	.013	.281	3.558

a. Dependent Variable: imr(total)

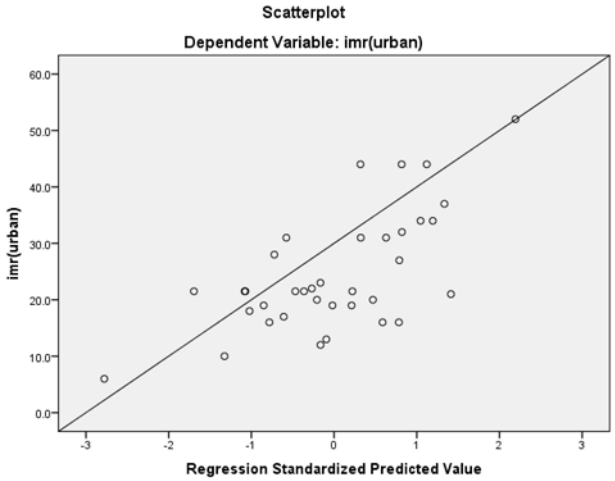
Collinearity Diagnostics[a]

imensio	Eigenvalue	Condition Index	Variance Proportions					
			(Constant)	Sex ratio at birth last 5 yrs (f/1,000M)(total)	married before age 18 years(total)	Institutional births(total)	Pregnant women age 15-49 years who are anaemic(total)	schoolsing more than 10 years
	5.655	1.000	.00	.00	.00	.00	.00	.00
	.278	4.508	.00	.00	.13	.00	.01	.03
	.032	13.339	.00	.00	.39	.07	.78	.01
	.021	16.396	.02	.05	.01	.37	.16	.00
	.013	21.002	.01	.01	.48	.47	.02	.95
	.001	63.832	.97	.93	.00	.08	.03	.00

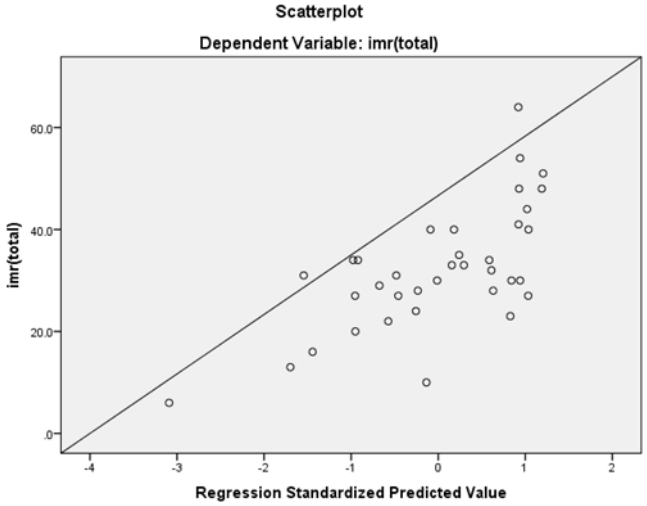
ANNEXURE-11

LINEARITY

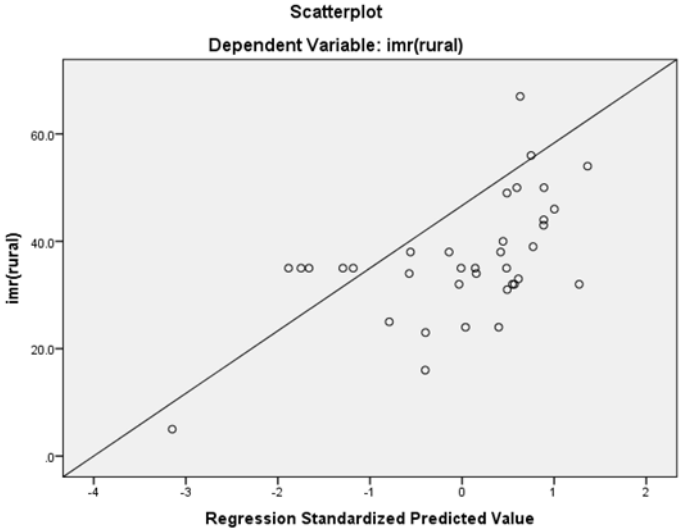
A



B



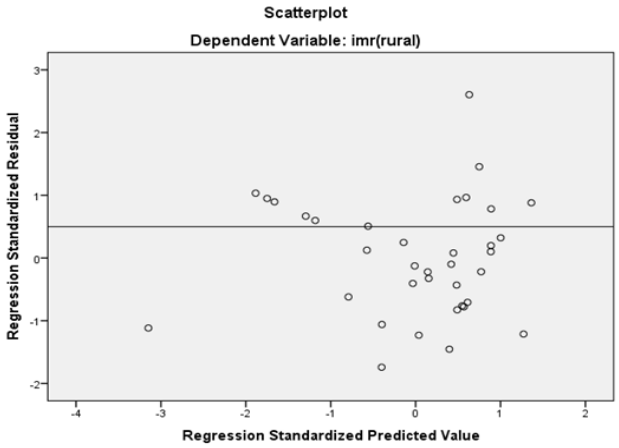
C



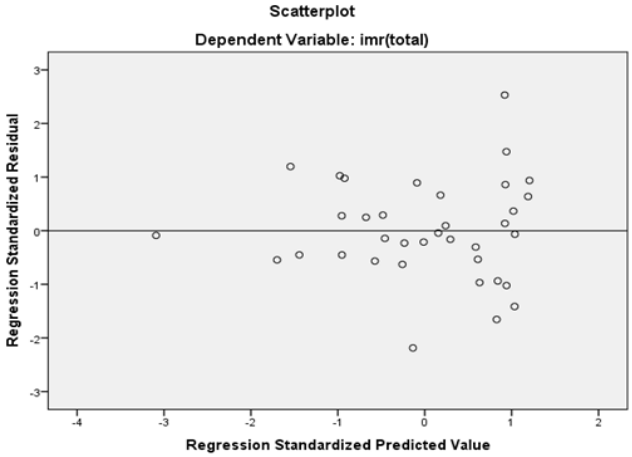
ANNEXURE-12

HOMOSCEDASTICITY

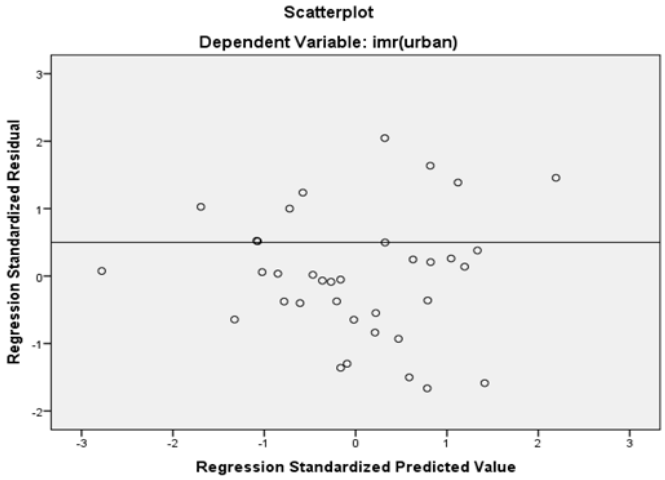
A



B



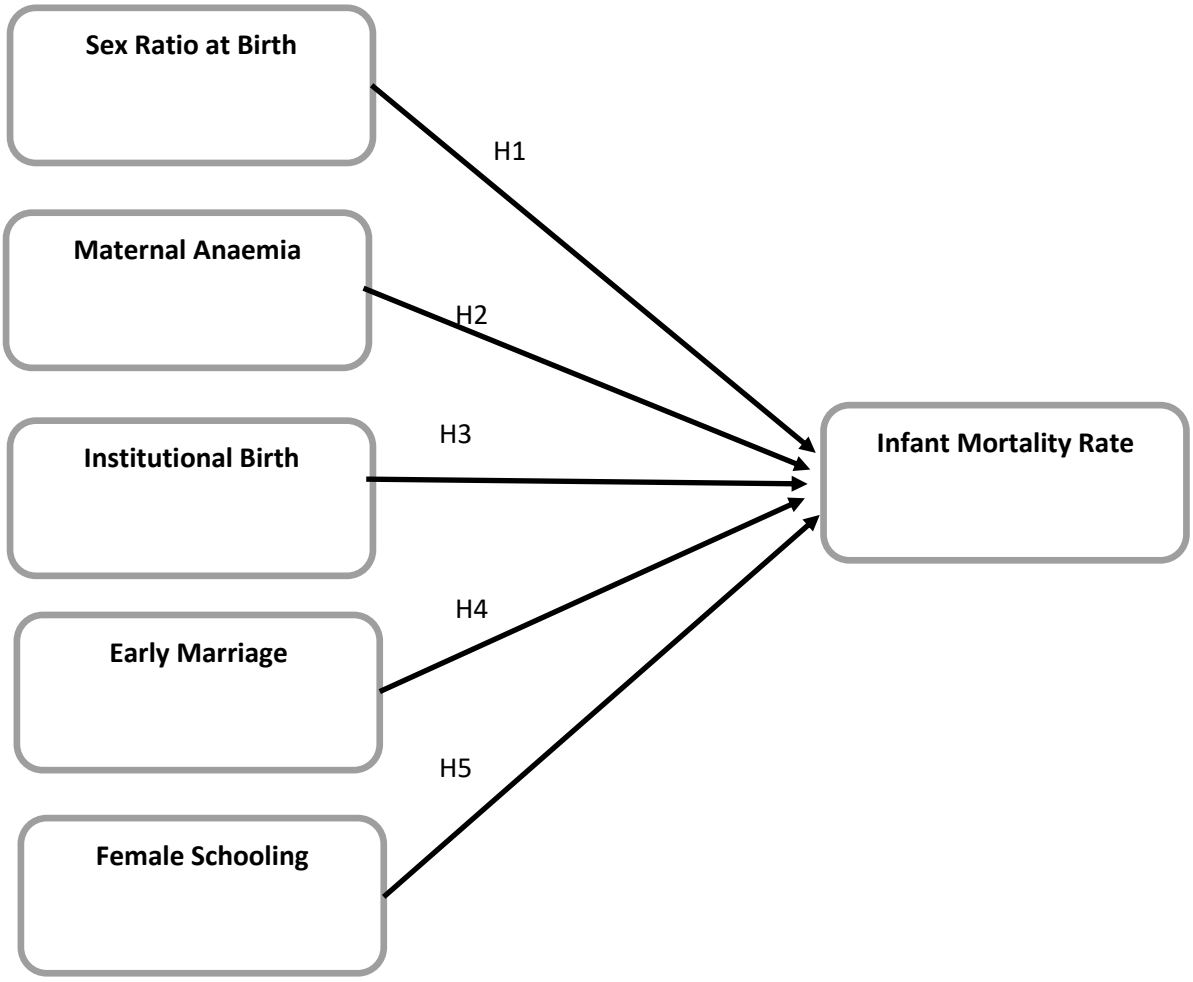
C



ANNEXURE-13

RESEARCH MODEL

Factors Affecting IMR of Urban, Rural and Whole India.



PART-2

ONLINE COURSE

IMPROVING GLOBAL HEALTH: FOCUSING ON QUALITY and SAFETY

(HARVARD: PH555x)

edX Platform

COURSE DESCRIPTION

This course has presented an outline to the evolving field of global healthcare quality. Over the past two decades there has been an increasing realization that in order for healthcare to improve population health, it must be safe, effective, and reliably delivered. Despite this apprehension, the quality of care that the world's citizens receive is not as good as it can and should be. The human toll of poor quality healthcare is important. The most recent data suggest that poor quality of healthcare system as one of the top causes of morbidity and mortality in the world. While there are a number of proposal to improve health care quality in the United States, broad evidence from other high-income countries and emerging evidence from LMICs & MICs suggest that a global focus is crucial.

OBJECTIVES OF THE COURSE

Broad objective of this course is Quality in Healthcare system and its importance. This course has explained the different aspects of healthcare in terms of Quality and Patient Safety. Following are the key objectives of this course:

- The importance of focusing on quality for improving population health.
- A framework for understanding healthcare quality.
- Approaches to quality measurement.
- The role of information and communication technology in quality improvement.
- Tools and contextual knowledge for quality improvement.

COURSE CONTENT

Chapter-1 (BURDEN)

- Causes of burden and harm
- Preventability
- High and low income
- Ambulatory care
- Medication error
- Tb-background and burden
- Scenario of TB in India
- Improvement in post diagnostic TB care
- Measuring quality globally
- Putting ideas into practice

CHAPTER-2 (MEASUREMENT)

- Public private variations
- Geographic variations
- Global issue HR
- Resource allocation
- Overuse and underuse
- Surveillance
- Inpatient care
- Global metrics
- HCQI- indicators of focus, current focus, future
- ICTs (information and communication technology)
- LMICs

CHAPTER- 3 (STANDARDS)

- Legal system and regulation
- Accreditations
- Compensation, Deterrence and negligence

- Defensive mechanism
- Transparency and other factors
- Patient compensation globally

CHAPTER- 4 (IMPROVEMENT)

- Introduction, System Issues
- Building will
- Leadership
- Case study- Rwanda

CHAPTER-5 (IT)

- Definition, HIE (Hospital Information Exchange)
- Promise of health IT (HIT)
- Health Information Exchange and Electronic Health Records
- Evidence and Implementation
- Global perspective and Conclusion

CHAPTER-6 (MANAGEMENT)

- Role of Management
- Management in Healthcare
- Measuring quality of Management
- Why middle managers?
- Importance of finding good people
- Actionable items
- Other industries
- JIPMER-why quality
- After-1 year
- How do you justify?
- What happened as a result?
- Evidence of better care
- Future

CHAPTER-7 (PATIENTS)

- Importance of Patient Centred Care
- Measuring patient experience
- Ambulatory care
- Key determinants
- Consequences
- Consequences –LMICs
- Process improvement-part-1
- Importance of quality in Global Health
- Quality in Maternal and Newborn Care
- Women Delivery Preferences and Understanding Access
- Role of Healthcare Personnel in Quality
- Women Experience in Delivery
- Lancet Commission on Global Health
- Rating Hospital
- Social Media
- Assess Effort

CHAPTER-8 (PUBLIC SYSTEM)

- Introduction
- Quality Movement in Healthcare
- Triple Aim of Healthcare
- Overview of Mexican Health Reform
- Effective Coverage
- Bundles and Quality
- Leadership
- WHO
- World Alliance for Patient Safety
- Service Delivery and Safety

METHODOLOGY

IMPROVING GLOBAL HEALTH: FOCUSING ON QUALITY and SAFETY (HARVARD: PH555x) is a course available online by Harvard T.H. Chan School of Public Health on edX Platform. This course has explained the various aspects of improving Healthcare system which focuses mainly on Quality and Safety of patients in public and private entities globally. The course content has been well explained by different Professors, Health Ministers, Directors and Officers of different Organizations including WHO, OECD, etc. This course has been explained with the help of followings:

- Video Lectures-Conversation Videos of different Professors

  There are 110 videos in this course.
- Case Study

  Case study of Rwanda and JIPMER are explained for better understanding
- Assignments- Discussion Forums

  Discussion forums consisted of question which appeared after completion of every topic.
- Reading Material- Research Paper

  Research Papers are provided at the end of every chapter for better understanding.
- Quizzes

  After every topic Quiz was mandatory for further growth in completion of course.

This course is moderated by the public health professor at Harvard T.H. Chan School of Public Health Dr. Ashish Jha. This course has included many eminent personalities, who have even explained their real life examples related to topics like Jishnu Das (Lead Economist, World Bank Group), Niek Klazinga (Head, Healthcare Quality Indicators Project, OECD Health Division), Agnes Binagwaho (Vice Chancellor, University of Global Health Equity and Former Health Minister of Rwanda), T.S. Ravikumar (Former Director and CEO, JIPMER) and many more.

KEY LEARNINGS FROM THE COURSE

This course has well explained each and every topic in depth with suitable real life examples and case studies in relation with Quality and Safety. Following are the key learning's from this course:

- Understanding the causes of Burden and Harm a patient can witness in Hospital.
  - This explained the major 6 types of risk with their preventive measures and proportions.
  - They were Adverse Drug Events; Hospital acquired infection, fall, Pressure ulcer, surgical complication and deep venous thrombosis. Proper Hand washing Techniques, fall precaution, Regular Manual Check-up for bed sores and proper medication were some of the preventive measures for the above mentioned.
- Understanding the proportion of causes of Burden and Risk in LMICs and HICs
  - This explained that majority risk remain same. Birth Related injuries occur in Low middle income countries.
- Understanding the risk in Ambulatory Care
  - There are different issues in ambulatory care. They are adverse drug event, Lab follow up Surgery, Diagnosis related error and referral issue.
- Understanding of Medication process, error in hospital setting medication process and preventive measures for medication process error.
  - Hospital setting medication error are 10% pharmacy error, 50% administration error, 10% transcribing error, 30% ordering error. Prevention for such errors can be done by using bar coding, smart pumps, computer order entry.

- Understanding of Tuberculosis- background, scenario of TB in India, diagnostic test and improvement in public as well as private sector.
  - This explained the causes of death associated with TB. Also, elucidated the public as well as private sector and their working for TB patients. Well explained the working of countries like china, Pakistan and Bangladesh.
- Understanding of the public private variations, geographical variations in the healthcare setting.
  - This explained the reasons behind the present state of healthcare in India which is due to lack of knowledge, physician interest and efforts, improper diagnostic test, etc. with the help of Know-Do Gap study in North and South regions of India.
- Understanding of the resource allocation, overuse-underuse of services and surveillance in Healthcare system.
  - This explained the need of number of doctors for better quality of treatment, services and treatment with the present condition of patient, and surveillance of different metrics for quality of care by physicians.
- Understanding of the Global metrics- Healthcare QualityIndicators in relation with current and future focus.
  - This explained the working of OECD with HCQI, which focuses on the patient safety and patient experience in terms of quality and better outcomes.

- Understanding of the regulations, legal system, accreditations, compensation, deterrence and negligence for physicians and patient for quality of treatment.
  - This explained the rules and regulations with legality for assuring the high quality of care.
  - This clarified the reasons and importance of accreditation. Also, described the role of malpractice system and Affordable Care Act.
- Understanding of the defensive mechanism, transparency and patient compensation globally for quality of healthcare.
  - This explained the cause of reasons of malpractice test, reasons which drive doctor being sued. Also, explicated the compensation process for patients globally.
- Understanding of the improvement in the healthcare system for better quality outcome.
  - This explained the system issues, responsibility and culture for the quality care in system. Also, focused on the leadership skills, which were more clearly explained with the help of Rwanda case study.

- Understanding of the need of Information communication technology in the healthcare system.
  - This explained the need of information technology in the healthcare sector. This part focused on the uses and benefits of Electronic Health records and need of innovation in future for better and effective quality of care. Also, discussed the evidence and implementation of IT process in healthcare settings with global perspective
- Understanding the role of management for the better and efficient healthcare system.
  - This focused on the need of management for the better and effective healthcare system. This explained the 5 domains i.e. measurement of performance, setting targets, communicating HR target-problem deal, HR management-select, deal, and rewards for quality of care in healthcare setting. This was explained with the help of case study of JIPMER- JQC (JIPMER Quality Committee). JQC reflected as the need for the better outcomes in healthcare settings.
- Understanding the patient centred care, importance of patient experience and consequences of patient experience in Healthcare setting.
  - This explained the importance for positive patient experience by physician and hospital in 6 domains of Healthcare quality i.e. safety, effectiveness, efficiency, timeliness, equitable and patient centred. This resulted in better outcomes in relation to mortality, morbidity, patient adherence and Compliance. This explained HCAHPs for measuring patient experience.
- Understanding the process for improving the patient experience.
  - This explained the centre focusing on the patient experience for quality of care and for betterment of the organisation. This illustrated the intervention for the gaps present for the better patient experience and explained 4 different levels for changes i.e. personal level, unit level, organisational level and external level.
- Understanding the importance of maternal as well as new born care.

- This explained the features of high quality delivery facility for maternal and child care. Also, focused on understanding the women delivery preferences and women experience during delivery process.

- Understanding the importance of rating of hospital, social media and efforts on different platforms in quality of healthcare.
  - This explained the need and importance of rating doctors as well as hospitals for quality and improvement in system. Also, this described the importance of social media for better overview and collection of needed information for future changes and improvement for healthcare system.

- Understanding the quality movement, triple aim for effective healthcare coverage.
  - This explained the quality movements including Era 1(ERA OF HEROISM, Heritage of heroism, professional trust and professional dominance), Era 2(age of accountability, contingency, pay for performance, reporting), Era 3(skills and attitude and knowledge).
  - Also, overviewed the triple aim for effective healthcare i.e. Better care, better population health and lower cost.