IMPACT OF FEMALE LITERACY RATE AND INCOME ON CHILD MORTALITY RATE

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**ABSTRACT**

*This study examines the impact of Female Literacy Rate and Income on Child Mortality Rate within a country. This paper studies a range of low and middle income countries from different regions across the globe. The data for Adult Female Literacy Rate, Per Capita Gross National Product and Child Mortality Rate has been collected for 86 countries from reliable sources including World Bank and UNICEF. Through regression analysis, it was found that both Adult Female Literacy Rate and Per Capita GNP have a significant influence on the Child Mortality Rate of a country. It was found that the data suffers from the problem of heteroscedasticity. In order to correct for the same, weighted least squares method has been used in the regression analysis. The study shows that the impact of Adult Female Literacy Rate on Child Mortality Rate is much greater than the impact of Income on Child Mortality Rate. The objective of this research is to add to the already existing studies on the factors affecting Child Mortality Rate. By studying the impact of Female Literacy and Income on Child Mortality, the paper aims to suggest policy measures and initiatives to lower Child Mortality in a country.*

**INTRODUCTION**

A country’s level of development is measured by various socio-economic indicators such as income, education level and the health status of that country. The health status of a country’s population plays a major role in a country’s growth and development. David E. Bloom, an economist and demographer said “Healthier means Wealthier.” Health is both an outcome as well as a cause of economic growth. A healthier workforce is a more productive workforce and helps in the alleviation of poverty. Child Mortality Rate is defined as the number of deaths among children under the age of 5 per 1000 live births. Child Mortality Rate is considered as a crucial indicator of the health status of the population of a country. It is also a measure of the effectiveness of the health policies implemented by the government of a country. Child Mortality is a proxy for population health. It is presumed to affect labor quality and productivity. Fall in child mortality rates are thus expected to promote higher GDP per worker. The Child Mortality Rate of a country is affected by various factors such as female literacy rate, fertility rates, female labor force participation, access to safe water, per capita income, etc. This paper focuses on the two most significant factors affecting child mortality: female literacy rates and income levels. Both these factors are expected to have a negative influence on the rate of child mortality of a country. A better educated mother is likely to be better able to take care of her child so that he/she is better nourished. Higher household incomes translate into better diets both in terms of quantity and quality and better access to healthcare whichhelps reduce child mortality. A fall in Child Mortality Rate has a significant impact on the fertility rates. Fertility declines after a fall in child mortality because families realise that fewer births are needed to reach their target of surviving children. A fall in the fertility rates further slows down the rate of population growth and provides an economic boost to a country. Over the years, the overall levels of child mortality have declined due to the improvement in the accessibility of healthcare facilities. The world average for child mortality dropped from 93 in 1990 to 41 in 2016. However, there are many countries whose child mortality rates are still very high. This is true, specifically of the low income and developing nations. Globally, the risk of a child dying in the country with the highest child mortality rate is about 60 times higher than in the country with the lowest child mortality rate. The Sub Saharan African region has the highest child mortality rates in the world with Somalia as the country having the highest child mortality rate. Likewise, there are disparities between the wealthy and poor households in developing countries. In India, children from the poorest households are 3 times more likely to die before their 5th birthday than those from the richest households. A reduction in child mortality requires better education, better healthcare and higher levels of income. It can be reduced by focusing on girl child education and alleviation of poverty. This paper builds upon the vast literature available on child mortality and examines the impact of female literacy rate and income on the rate of under 5 mortality within a country. The information of this paper can then be used to suggest policy makers for combatting child mortality in order to ensure higher levels of socioeconomic development.

**LITERATURE REVIEW**

There are several studies available on the topic of child mortality and its causes. Md. Arfanuzzaman (2014) studied the impact of female literacy rate and per capita income on child mortality rate of the low and middle income countries around the world. His study was conducted using data from World Bank for 62 low and middle income countries around the world. The dependent variable was child mortality while female literacy rate and per capita gross national product were the independent variables. Multiple regression model was used to examine the influence of the two independent variables on the dependent variable. White’s method was used to check for heteroscedasticity while skewness and kurtosis test was conducted to verify the normality assumption of the residuals. It was found that both per capita GNP and female literacy rates are negatively related with child mortality. It can be stated from the results that if female literacy rate increases by 1 unit, child mortality will decrease by 1.93 units. Similarly, per capita GNP increases by 1 unit, child mortality will fall by 0.02 units. Both the heteroscedasticity and normality tests verified the absence of heteroscedasticity and the presence of normality of residuals.

Lisa Wheatley (2015) conducted a study on the factors affecting child mortality. The study was conducted for a range of low income countries from different regions including Sub Saharan Africa, Middle East and North Africa, East Asia and the Pacific, Europe and Central Asia, South Asia and Latin America. The data in the study has been collected for 74 countries from reliable databases including the World Bank, the CIA World Fact Book, UNESCO and the World Health Organisation. The dependent variable of the study is child mortality rate and the independent variables include adult female literacy rate, total fertility rate, adult female labor force participation rate, prevalence of human immunodeficiency virus, rate of immunization for tuberculosis, gross domestic product per capita and access to an improved water source. Female literacy rate, fertility rates, access to improved water source and prevalence of HIV were found to be statistically significant while per capita GDP, rate of immunization of tuberculosis and adult female labor force participation rate were found to be statistically insignificant which suggests that suitable proxies for these variables should be used. It was also concluded that female literacy rate, rate of immunization of tuberculosis, per capita GDP and access to improved sources of water have a negative relation with child mortality while fertility rates, adult labor force participation and prevalence of HIV have a positive impact on child mortality.

Aristide Romaric Bado and A. Sathiya Susuman (2016) conducted a study to analyse the relationship between mother’s educational level and child mortality rate in Sub Saharan Africa from 1990 to 2015. The data used in this study has been collected for 8 countries from different Demographic and Health Surveys of Sub Saharan countries. The dependent variable of this study is the child survival status. The explanatory variables are wealth indexes, the mother’s educational level and the place of residence. The study used the method proposed by Buis which decomposes the total association between a categorical, discrete or continuous variable and an outcome from a direct and an indirect effect. The mother’s educational level is the main dependent variable by which we seek to quantify the direct effect and place of residence and wealth index quantifies the indirect effect. Country specific results confirmed an inverse relationship between mother’s educational level.

Jahidur Rahman Khan and Nabil Awan (2017) conducted a study to identify the factors associated with child mortality in Bangladesh. Data from Bangladesh Demographic and Health Services for the year 2007, 2011 and 2014 were used. A stratified two stage sampling method was used to collect data on child and maternal health in these surveys. Cox’s proportional hazards models (frailty model) with community and mother level random effects were fitted to identify the factors affecting child mortality. This study revealed that urban rural disparity in child mortality has decreased overtime. The frailty models suggested that birth order, preceding birth interval length, sex of the child, maternal age at birth, mother’s working status and parental education were important factors affecting child mortality.

Joyce Emmanuel (2013) analysed whether women’s illiteracy results in higher maternal and child mortality or not with a special focus on Lafia, a town in Nigeria. The data was collected from both primary and secondary sources. The primary source included a questionnaire for 141 women while secondary source included several journals and publications. The responses from the questionnaires were presented in tabular forms which were converted to frequencies and percentages which formed the basis of the findings. The study established that women in Lafia had little knowledge on health issues relating to child and maternal mortality. The study further established that the level of women’s knowledge about health issues has a negative relation with the level of child and maternal mortality. Thus the study confirms that women’s illiteracy leads to higher child and maternal mortality.

P. Prashanth Kumar and Gemechis File (2010) conducted a study to identify the factors affecting child mortality in a developing country like Ethiopia. The study used data from the Ethiopia Demographic and Health Survey 2005. A total of 9861 live births during the survey had been taken as the sample of the study. The dependent variable was child mortality while the independent variables included education of mother, standard of living index, place of residence, birth order, sex of child, birth interval with previous child and mother’s age at the birth of the child. The cross tabulation analysis was used to analyse the impact of the above mentioned factors on child mortality. The findings suggested that mother’s education is the most important predictor of child mortality and is negatively related with it. Other factors such as place of birth, birth order and standard of living index also have substantial impact on child mortality.

**DATA ANALYSIS**

The variables used in the model include child mortality rate, adult female literacy rate and per capita GNP. The definitions of these variables and their data sources are summarised in the table below.

**Table 1: Description of the variables of the model**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Nature of the variable | Definition | Source of the data |
| Child Mortality Rate (CM) | Dependent Variable | The number of deaths of children below the age of 5 per 1000 live births | UNICEF |
| Adult Female Literacy Rate (FLR) | Independent Variable | Ratio of total literate female population aged 15 years and above to the total female population aged 15 years and above | UNICEF |
| Per Capita Gross National Product (PGNP) | Independent Variable | Total value of all the goods and services produced by the residents of a country in a year divided by the total population of the country | World Bank |

**Summary Statistics:**

**Table 2: Summary Statistics of the variables**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Minimum | 1st Quartile | Median | Mean | 3rd Quartile | Maximum |
| Child Mortality | 2.545 | 9.965 | 20.418 | 32.762 | 47.54 | 119.914 |
| Adult Female Literacy Rate | 25.74 | 64.31 | 91.57 | 78.4 | 96.22 | 100 |
| Per Capita GNP | 740 | 4008 | 10510 | 16602 | 18935 | 124300 |

**Correlation Matrix:**

**Table 3: Correlation Matrix**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Child Mortality | Adult Female Literacy Rate | Per Capita GNP |
| Child Mortality | 1 | -0.8739263 | -0.4865202 |
| Adult Female Literacy Rate | -0.8739263 | 1 | 0.4331376 |
| Per Capita GNP | -0.4865202 | 0.4331376 | 1 |

**METHODOLOGY**

Data as described above for 86 low and middle income countries from different regions of the world were analysed using a linear regression model. The following regression equation was estimated:

CM = β1 + β2FLR + β3PGNP + ut

where, CM= Child Mortality Rate

FLR = Adult Female Literacy Rate

PGNP = Per Capita Gross National Product

ut = Stochastic Error Term

β1 is the intercept term. β2 and β3 measure the impact of FLR and PGNP on CM respectively. A priori, we expect β2 and β3 to have negative signs i.e. a negative relationship between Adult Female Literacy Rate and Child Mortality Rate; and Per Capita GNP and Child Mortality Rate.

The Weighted Least Squares (WLS) method has been used to estimate the above regression equation. The choice of WLS is due to the presence of heteroscedasticity in the model which was tested using the Breusch Pagan Test.

**RESULTS**

**Estimates of Multiple Regression Model (WLS):**

The following results were obtained after applying the Weighted Least Squares (WLS) method of estimation.

**Table 4: WLS estimates of the regression model**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Coefficient | Standard Error | t statistic | Prob |
| Intercept | 116.2 | 6.538 | 17.768 | 0.0000 \*\*\* |
| FLR | -1.032 | 0.07826 | -13.19 | 0.0000 \*\*\* |
| PGNP | -0.0001640 | 0.00005894 | -2.783 | 0.0066 \*\* |
| No. of Observations | 86 | Standard Error of Regression | 4.941 |  |
| Multiple R squared | 0.7414 | F statistic | 119 |  |
| Adjusted R squared | 0.7352 | Prob( F statistic) | 0.0000 |  |
|  |  |  |  |  |

Note: \*\*p<0.01, \*\*\*p<0.001

It is evident from the regression that both per capita GNP and adult female literacy rate are negatively related with child mortality and statistically significant at 1% and 0.1% level respectively. The coefficients indicate that a 1% increase in female literacy rate will lead to a fall in the average child mortality rate by 1.032 while a $1 increase in per capita GNP will lead to fall in the average child mortality rate by 0.000164. Thus, the impact of per capita GNP on child mortality is quite negligible.

CM = 116.2 -1.032FLR -0.000164PGNP + ut

Furthermore, if female literacy rate and per capita GNP are 0, then the child mortality rate will be 116.2, on average. The adjusted R squared value of 0.7352 indicates that the 73% of the variation in child mortality can be explained by female literacy rate and per capita GNP combined. The high value of F statistic is an indicator of the goodness of fit of the model.

Note: The corresponding estimates for the regression model using the Ordinary Least Squares (OLS) method are given in the Appendix Table A1.

**Detection of Heteroscedasticity:**

To examine whether the data has heteroscedasticity problem, the Breusch Pagan Test has been applied to the data.

The Hypothesis for the Breusch Pagan test is: H0: There is presence of homoscedasticity in the data. Ha: There is absence of homoscedasticity in the data.

The results of the Breusch Pagan Test are as follows:

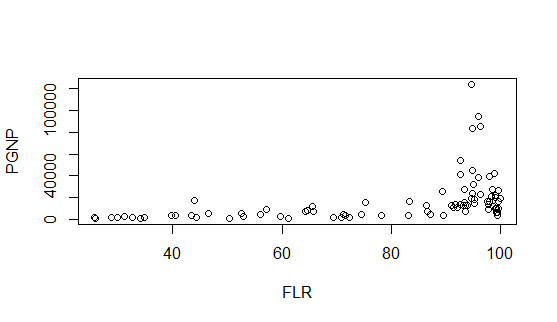
**Table 5: Results of Breusch Pagan Test**

|  |  |  |
| --- | --- | --- |
| BP statistic | Degrees of Freedom | Prob |
| 10.858 | 2 | 0.004388 |

Since the p value 0.004388 < 0.05, therefore we reject the null hypothesis of homoscedasticity. Thus, the data suffers from the problem of heteroscedasticity. This test justifies the use of Weighted Least Squares method of estimation for the regression equation.

**Detection of Multicollinearity:**

To examine whether the data suffers from the problem of multicollinearity, we plot per capita GNP as a function of adult female literacy rate. The graph obtained is given below.



The graph shows that there exists a relationship between per capita GNP and adult female literacy rate. However, it can be seen that the relationship is not linear in nature. Thus, we can say that the model does not suffer from the problem of multicollinearity.

A more formal way of testing for multicollinearity among regressors is to compute the Variance Inflation Factor (VIF). The VIF for PGNP and FLR is found to be equal to 1.230933. Tolerance (TOL) - the inverse of VIF- is equal to 0.8123919011. Since TOL is close to 1, therefore we can safely conclude that the model does not suffer from the problem of multicollinearity.

**The Impact of Female Literacy on Infant Mortality Rate in Indian States.**

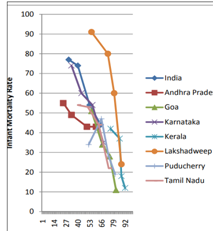
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Figure 1: Female Literacy Rate vs Infant Mortality Rate –South Indian States

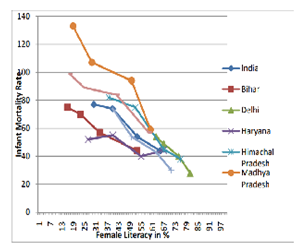


Figure 2. Female Literacy vs Infant Mortality Rate- North Indian states.

Figure 1 and 2 illustrate the significant variation in female literacy and infant mortality between the Southern and Northern states, Figure 1 shows the inverse relationship between IMR and Female literacy in South Indian states,

Similarly Figure 2 shows the same relationship in North Indian states. The rapid decline in IMR when the female literacy rates cross a threshold level of 50% can also be appreciated.

**RESULTS**

On linear regression, an inverse relationship was found between male literacy rates, female literacy rate FIGURE 1, and overall literacy rates with that of the CBR of the respective states and UTs TABLE NO. 2 The slope of -0.325 for female literacy versus CBR suggests that every 1% increase in female literacy is associated with fall in CBR by 0.325/1,000 live births. Fifty-nine percent of the variability in CBR was explained by this relationship, as suggested by the R2 value.

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Object name is JFMPC-2-349-g002.jpg](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4649870/figure/F1/)

[Figure 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4649870/figure/F1/) - Scatter plot and linear regression of female literacy rates vs crude birth rates of states and union territories (UTs) of India (slope = – 0.325, *P* < 0.001, R2 = 0.590)

Results of individual linear regression between literacy rates as a predictor of CBR and IMR of states and UTs of India

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Figure 2 Scatter plot and linear regression of female literacy rates vs infant mortality rates of states and UTs of India (slope = – 0.971, *P* < 0.001, R2 = 0.504)

**CONCLUSION**

The study reveals the importance of female literacy rate and income in trimming down the child mortality rate of a country. The policy measures that should be taken to reduce child mortality and hence improve the health status of the population of a country include increasing the female literacy rate and income levels. Female literacy rate can be improved by encouraging girl child education and spreading awareness about gender equality and women empowerment. The per capita income level can be increased by taking steps towards reducing the growth rate of population and increasing the employment levels of a country. However, these two variables may not capture the entire picture of the reason of child mortality. Some relevant variables like public awareness, access to health care, nutrition, etc. can also play a significant role to reduce child mortality.

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**APPENDIX**

**Estimates of regression Model (OLS):**

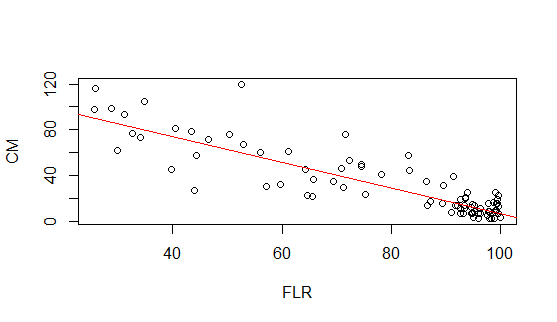
**Table A1: OLS estimates of Regression**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Coefficient | Standard Error | t statistic | Prob |
| Intercept | 117.6 | 5.525 | 21.284 | 0.0000 \*\*\* |
| FLR | -1.043 | 0.07329 | -14.231 | 0.0000 \*\*\* |
| PGNP | -0.0001838 | 0.00007931 | -2.317 | 0.023\* |
| No. of Observations | 86 | Standard Error of Regression | 14.14 |  |
| Multiple R squared | 0.7781 | F statistic | 145.5 |  |
| Adjusted R squared | 0.7728 | Prob( F statistic) | 0.0000 |  |
|  |  |  |  |  |

Note: \*\*p<0.01, \*\*\*p<0.001, \*p<0.05

**Graphs:**

1. Relationship between Child Mortality and Adult Female Literacy Rate:



1. Relationship between Child Mortality and Per Capita GNP:

