Exploring Relationships Between Maternal and Child Health Indicators in India Stephen Campbell¹, Jackie Turnage², and Alexis Wong³

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Abstract

In developing countries, women and children are often the most vulnerable populations with respect to health. Experts suggest that maternal health can have a significant impact on the health of the child from a young age. In our analysis, we endeavored to elucidate the existence of a link between maternal and child health by investigating various factors, such as antenatal care, maternal mortality, and infant mortality that impact the health of these two groups. The relationship between sanitation, per capita income, and health indicators was also studied. The results indicated that no significant correlation existed between maternal health indicators and infant mortality. However we were able to determine that, of the variables studied, per capita income has the greatest impact on the health of mothers and children.

Background

Evidence exists suggesting that the mother's health throughout the pregnancy can determine the baby's health immediately after birth and the impact of maternal health continues to influence the child's development throughout life. The effect of poor maternal health and nutrition is clearly seen in babies with low birth weight, which puts them at high risk for health complications. During pregnancy the baby's nutritional status depends completely on the mother; therefore mothers who are in poor health and cannot eat healthily will not be able to provide nutrients to their babies, thus resulting in less than optimal prenatal development.

Maternal and child health are considered strong indicators of poverty because impoverished populations have less access to healthcare. Health is a limiting factor in the ability of many people in India to escape cyclical poverty. Poor maternal health can result in poor health of children, especially female children, causing the girls to enter a cycle of malnutrition that can perpetuate throughout generations.

The following variables are important in the analysis of health. Infant mortality rate is the number of infant deaths (0-1 year) per 1,000 live births. Full antenatal care (ANC) is defined as three or more antenatal care visits, one tetanus injection, and 100 or more iron folic acid (IFA) tablets. Antenatal care indicates higher access to healthcare and may have an impact on the infant's health. The maternal mortality rate is the number of women who die from pregnancy related causes per 100,000 live births. In order to assess the impact of sanitation on health, the percentage of households with a bathroom was studied. The final variable studied was per capita income of each state in rupees.





Figure 1. This map of India displays a comparison of the states' infant mortality rates and the percentage of women who receive full antenatal care. Areas with darker shades of red represent states with greater ANC coverage. States with a larger symbol size have higher infant mortality rates.



Figure 3. This map compares the states' per capita income in rupees and the percentage of women who receive full antenatal care. Areas with darker shades of green represent states with greater per capita income. States with a larger symbol size have a higher percentage of women who receive full antenatal care.



Figure 5. This graph of per capita income and full antenatal care shows that a direct correlation exists between these two variables



Figure 7. This graph of per capita income and households with a bathroom shows that a direct correlation exists between these two variables.

Results



Figure 2. This map shows a comparison of the states' infant mortality rates and the percentage of households with a bathroom. Areas with darker shades of purple represent states with greater percentage of households having a toilet. States with a larger symbol size have higher infant mortality



Figure 4. This map of India displays a comparison of the states' maternal mortality rates and the percentage of womer who receive full antenatal care. Areas with darker shades of red represent states with greater ANC coverage. States with a larger symbol size have higher maternal mortality rates.



Figure 6. This graph of full antenatal care and maternal mortality shows that a indirect correlation exists between these two variables.



Figure 8. This graph of per capita income and maternal mortality shows that a indirect correlation exists between these two variables.

Our assumption that a strong correlation would exist between sanitation (measured by availability of bathrooms) and mortality was found to be incorrect. It seemed that sanitation would be a good indicator of health. Instead we found that the two variables had a very weak relationship (data not shown, R^2 value = 0.208), which could be attributed to the greater influence of other variables on mortality. Figure 2 demonstrates that there is a general trend of states having fewer households with a bathroom also exhibiting higher infant mortality rates. The moderate correlation between per capita income and number of households with bathrooms and between per capita income and mortality would seem to imply that a strong correlation should exist between per capita income and the number of households with a bathroom. Therefore it is surprising to find that mortality rates are not greatly impacted by the number of households with bathrooms. A possible reason that sanitation does not appear to be correlated to mortality may be because bathroom availability is not the best indicator of sanitation or because the quality of the bathroom facility has not been accounted for in the data used for this analysis.

We hypothesized that by looking at indicators of maternal and child health we would see a direct impact of maternal health on infant mortality rates. We found that there is no strong correlation – direct or indirect – between improved maternal health (measured by percent of women receiving antenatal care) and lower mortality rates (data not shown, R² value = 0.028). There may be several reasons why no correlation was evident. It is possible that state-level data is too coarse for us to make an accurate assessment of the relationship between these indicators. Additionally there may be other factors impacting maternal and child health that we were not able to measure here. Despite the lack of correlation between maternal health indicators and infant mortality, we were able to compare maternal and child health using maps, which allowed us to observe general trends that may agree with our hypothesis. We found that states with poor coverage of full antenatal care usually tend to have higher infant mortality rates than those states with a greater percentage of women receiving full ANC (Fig. 1).

The effect of proper antenatal care on maternal mortality rates was also examined (Fig. 4, 6). We found that there exists a moderate negative correlation between these two variables, indicating that increased coverage of full antenatal care corresponds to a decrease in maternal mortality (Fig. 6, R^2 value = 0.456). This is most likely due to the improved nutritional status of women who receive ANC and the ability of ANC providers to predict future pregnancy complications and intervene if necessary. Per capita income was one of the greatest predictors of child and maternal health status (Fig. 3, 5, 8). Of the other variables examined, it correlated the most strongly to health indicators. We found moderate direct correlations between per capita income and antenatal care (Fig. 5, R² value = 0.355) and between per capita income and households with bathrooms (Fig. 7, R^2 value = 0.494). This confirms the assumption that a greater per capita income allows for greater healthcare coverage and improved sanitation facilities. A moderate indirect correlation was found between per capita income and maternal mortality rate, which is an indication of greater access to improved healthcare, nutrition, and sanitation. We expected antenatal care to exhibit a strong relationship with per capita income; however, we found only a moderate correlation (Fig. 5, R^2 value = 0.355), which may indicate that other factors contribute to women's health besides income. Of the variables we examined, maternal mortality rates were most strongly correlated with per capita income (R^2 value = 0.647) as seen in figure 8. A weak correlation was found between per capita income and infant mortality rates, indicating that increased income does not necessarily directly impact infant mortality (data not shown, R^2 value = 0.179).

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Discussion

Sources of Data