Preview of “Female Secondary Education Is Imperative For Improved Health Outcomes In Nigeria”

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Abbreviations: MDG; Millennium Development Goals

Abstract
We performed statistical analysis of the 2013 Nigerian National Bureau of Statistics report to study factors linked to improved health outcomes. Female secondary education was identified as critical for improving health indices such as a reduction in infant and maternal mortality. Interestingly, other development indices such as female primary school, access to improved water sources, and sanitation services were not statistically associated with improved health outcomes. While national averages suggest recent improvements in health of the Nigerian populace, these averages do not provide a complete picture due to the great diversity in Nigeria. Our analysis reveals a polarized healthcare landscape with a dramatic trend of poor health outcomes for Nigerians living in Northern Nigerian states where women have a highly significantly lower percentage of percent women employed (p<0.001), women in decision-making power (p<0.001), and lower secondary education. Our analysis revealed that usage of available public health services was strongly correlated to female secondary education, which supports that the education of the girl child to at least secondary school is imperative for improved health outcomes in Nigeria. Our recommendation is that intervention policies should consider the diversity and geopolitical divide in Nigeria to be successful.
Introduction

Nigeria, Africa’s most populous nation and largest economy, has an estimated population of 178 million and a 2013 GDP of ~$509.9 billion. Poverty is wide-spread in Nigeria and its 36 states contain unique cultural complexities and hundreds of distinct language and ethnic groups. Over 90% of Nigerians are Christians or Muslims with equal percentages adherents of both religions. The diverse cultural, ethnic, and religious traditions influence all spheres of life in Nigeria and extend to the judicial system, which includes Sharia (Islamic) and customary (traditional) courts. Sharia is currently practiced in some capacity in the twelve northern states of Zamfara, Sokoto, Kebbi, Niger, Kano, Katsina, Kaduna, Jigawa, Yobe, Bauchi, Borno, and Gombe. While the current Nigerian constitution explicitly states that there will be no state religion, Sharia law predominate in these Northern states and is reflective of a conservative culture in these states. Nigeria’s North-South divide is also geographical with the river Niger and its tributary the Benue separating northern and southern Nigeria. The 36 states in Nigeria are divided into 6 geopolitical zones; North West (Kebbi, Sokoto, Zamfara, Katsina, Kano, Jingawa and Kaduna), North East (Bauchi, Yobe, Borno, Gombe, Adamawa Taraba), North Central (Niger, Kwara, Kogi, Nasarawa, Benue, Plateau), South West (Oyo, Ondo, Ogun, Osun, Lagos, Ekiti), South South (Edo, Delta, Bayelsa, Rivers, Akwa Ibom, Cross River) and South East (Enugu, Imo, Anambra, Abia, Ebonyi).

Nigeria was created by the amalgamation of the Northern and Southern protectorates by the British in 1914. These colonial boundaries were draw without any consideration of historical, cultural or existing boundaries. Nigeria is a relatively young nation that gained its independence from Britain in 1960. Within six years, the democratically elected government was overcome by a military coup. Since then Nigeria had 22 years of military dictatorship punctuated by civilian rule and military coups before beginning the current period of democratically elected civilian leadership in 1999. In 2000, after only one year of civilian rule, Nigeria was one of the 148 nations that embraced the eight millennium development goals (MDGs) and set out to achieve them by the end of 2015. The eight MDGs are time-bound targets aimed at addressing extreme poverty in quantifiable educational, health and economic areas. The specific MDGs are: 1) eradicate extreme hunger and poverty; 2) achieve universal primary education; 3) promote gender equality and empower women; 4) reduce child mortality; 5) improve maternal health; 6) combat HIV/AIDS, malaria and other diseases; 7) ensure environmental sustainability; and 8) develop a global partnership for development.
The mid point assessment in 2007 showed that Nigeria had made far less progress in the first seven MDGs than in MDG-8, reflective of Nigerian’s improving economy. A 2010 report predicted that only MDG-8, was within reach by 2015. Interestingly, both MDG-1, to eradicate poverty and hunger and MDG-5, to improve maternal health, were reported as being off track and lacking a supportive environment. Despite major challenges, the government of Nigeria continued to commit resources to the MDGs, notably by establishing the MDG acceleration framework (MAF), which resulted in significant decreases in the national maternal death rates. At this time, a tremendous geographic disparity in maternal death rates due to “socio-cultural and religious barriers to the use of maternal health services” was identified as a “critical bottleneck” in 2013. The MDG End-Point report in September 2015 showed that despite progress in many areas Nigeria only fully met one of the eight goals, MDG-8, to develop a global partnership for development. The objective of our current analysis is to identify the variables associated with these negative health outcomes and to evaluate which interventions should be targeted for improved health outcomes in Nigeria.

Methods
All data analyzed in this study is publicly available and had been collected and published by the Nigerian government. This report included 22,000 households interviewed by trained personnel in all 774 local government areas and was downloaded as an excel spreadsheet from (http://nmis.mdgs.gov.ng/). The Descriptive statistics were used to define the median and interquartile ranges for the variables evaluated in this analysis. Variables were categorized into the following groups: access to public health services, female education, adolescent marriage and motherhood, and health outcomes. Linear regression was performed to assess correlation between usage of public health services with health outcomes and female education. Additionally, linear regression was used to stratify female education with health outcomes and adolescent marriage and motherhood. Specifically, female literacy was further classified and analyzed as either primary school education and secondary or higher education. Lastly, to appraise the geopolitical relevance of the four categories, we performed logistic regression with odds ratio and 95% confidence intervals. We identified Northern States with and other states without Sharia law were the defining categorical variable for logistic regression. All statistical analyses were performed using STATA v12.0 (College Station, TX, USA). MapInfo Professional v11.5 (Pitney Bowes, Stamford, Connecticut, USA) was used for spatial analysis of variables by state stratification. This software was also used for generation of the geographic figure.

Results
In an effort to evaluate achievement of MDG-4 (reduce child mortality), we assessed usage of five public health services and health outcomes by state stratification were analyzed (Table 1). Access to improved water services was neither statistically associated with a decrease in infant mortality (p=0.272) nor child mortality (p=0.297). Usage of improved water and sanitation sources was also neither statistically associated with a decrease in infant mortality.
(p=0.830) nor child mortality (p=0.857). However, female literacy was statistically associated with usage of improved water sources (p=0.002).

To assess national achievements towards fulfillment of MDG-5 (improve maternal health), we evaluated usage of women’s health services. Usage of publically available women’s health services were significantly associated with positive health outcomes (Table 1). Decreases in both infant mortality and child mortality were statistically correlative (p<0.02) with births having trained health personnel present and percent of mothers accessing antenatal care. Percent of women using contraceptives neared significance for decreases in infant mortality (p=0.08) and child mortality (p=0.08). Female literacy was highly correlative (p<0.001) with usage of all three women’s health services.

A general trend that female literacy was correlative with usage of various public health services was identified, indicating a potential interplay of MDGs 2, 3, 4 and 5. Therefore we performed additional analysis to further explore this association (Table 2). Female literacy was highly correlative (p<0.001) with reduction in infant mortality, child mortality, childhood brides, and adolescent pregnancies. Similarly, female literacy was highly correlative with children receiving all recommended vaccinations. When education was stratified by school level, attendance of primary school was not statistically associated with any of the aforementioned outcomes, whereas completion of secondary school was positively correlated (p<0.001) with the aforementioned outcomes. Similar statistically results were obtained when net attendance of female versus male at different educational levels was used instead of female literacy. Linear regression analysis revealed a significant gender difference in the net attendance rates of secondary school (p<0.001) and for completion of secondary school (p<0.001). In all states, men were statistically more likely to have higher attendance and completion of secondary school than their female counterparts (Figure 2).

To further validate our findings, we performed logistic regression at three varying interquartile range cut-offs (25%, 50%, and 75%) of variables that evaluated male versus female education. At all three interquartile levels higher male attendance of primary and secondary school were noted. Furthermore, lower female education attendance (compared to male attendance) was consistently associated with poor health outcomes (DOI: 10.6084/m9.figshare.4197708).

We observed a North-South divide in female literacy in Nigeria and female literacy diverged most dramatically in states with Sharia law (Figure 1). The utilization of public health services was statistically lower in states with Sharia law. In particular, 73% of pregnant women reported that a skilled health professional was present during labor and delivery in states without Sharia law versus only 16% in states with Sharia law. This trend continued for antenatal care, with three-fourths of pregnant mothers seeking care prior to delivery in states without Sharia law as opposed to one-third in states with Sharia law. Adolescent marriages and motherhood were significantly higher in states with Sharia law where 58% of girls under 18 years are brides and 55% have at least a child, compared to 6% and 15%, respectively, in non-Sharia law states (Table 3). Literacy rates and secondary school completion was significantly
different, with 68% of girls obtaining a secondary school education in non-Sharia law states compared to 16% of girls in Sharia law states. Additionally, infant and child mortality were significantly higher in Sharia law states with a median 71,000 infant deaths per year (interquartile range: 58,000 to 86,000) and 111,000 children deaths before their 5th birthday each year (interquartile range: 89,000 to 138,000).

Discussion

Our analysis systematically exposed a previously under-described factor influencing Nigeria’s development, female secondary education, which appears to be a vital factor for improving health outcomes. Reduction in infant and child mortality is statistically associated with high female literacy \(^9\) (Table 2). In addition, a synergistic relationship between health service use and female secondary education was evident since government-led initiatives to increase access to public health services were only effectively utilized in states with high female secondary education (Table 1). Since lower female literacy rates correlate with poorer health outcomes and higher mortality rates of children, future interventions to improve the health of Nigerians hinge on female secondary education. Completion of secondary school in Nigeria takes twelve years—6 years of primary school, three years of junior secondary school and three years of senior secondary school \(^{10}\).

The value of female education has been demonstrated in other countries. In India, inconsistency of school attendance and school dropout are highest among children from uneducated women \(^8\). Similar to our findings, child mortality is also inversely proportional to maternal education in India \(^9\). In fact, risk of child mortality has been shown to drop 2-5% for each additional year of maternal education \(^{10}\). Prior evidence suggests that traditional Muslim cultures are open to the concept of female education. Within Nigeria, southwestern states have large Muslim population with high levels of female secondary education as well as high health indices, a legacy of the historical push for comprehensive health and education in this region by Chief Awolowo, the first Premier of the South Western region of Nigeria. Following the Nigerian civil war in 1970, a push for a nationalized public education system failed because it was too popular even in predominantly Muslim northern states; overcrowding in schools led to a backlash that resulted ultimately in further regional separation and isolation \(^{11}\). A classic study of Muslim women’s attitudes and perceptions of female education was published in 1984 \(^{12}\). The vast majority of women interviewed stated that female education was as or more important than male education. In fact, all women interviewed stated that women are capable of rigorous studies and maintaining professional responsibilities. However, all interviewees also stated that parental or spousal approval was necessary prior to pursuit of higher education or employment \(^{12}\). A survey of African countries reported that residents value education as a means for upward mobility \(^{13}\). Post review of our paper we found a manuscript that revealed that women residing in states that implemented Sharia law states reported significantly lower house-hold decision-making autonomy and levels of female employment states (Table 3) \(^{14}\). States that implemented Sharia law share cultural and historical factors that were not analyzed...
in this paper due to limited empirical data, and we caution that these factors need to be taken into account when developing education and health care policies in Nigeria.

Our study points to a lack of female secondary education as being more directly linked to poor health outcomes than other measures of poverty including sanitation, or access to clean water. Nigeria’s development is at a critical cross-road with the current economic crisis due to a fall in oil prices, and the emergence of terroristic groups like Boko Haram that actively wage war against Western education. Community education campaigns should focus on increasing male awareness of the value of female literacy, especially secondary level education, as a means of up-ward mobility. While most development agencies and government interventions focus on primary education, our analyses suggest that primary education is insufficient to attain the desired health outcomes and the minimal focus should shift to at least secondary education (Table 2). Our recommendation based on this study is that future interventions to improve the health of Nigerians should take into consideration the diversity of Nigeria and emphasize a minimum of secondary education instead of primary education.

Availability of supporting data: All data utilized in this study are publicly available at http://nmis.mdgs.gov.ng/ and was previously published at http://www.ng.undp.org/content/dam/nigeria/docs/MDGs/UNDP_NG_MDGsReport2013.pdf

Competing Interests
The authors have no conflicts of interest to declare.

Author’s contributions
Oluwatoyin A. Asojo conceived the project, analyzed and interpreted data and helped write the manuscript, Melissa N Garcia performed all statistical analysis, interpreted data, revised manuscript critically for important intellectual content, Sarah K Nelson, revised manuscript critically for important intellectual content and helped write the manuscript, and Nathaniel W Wolf revised manuscript critically for important intellectual content, and helped write the manuscript.

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Figure 1: There is a North South divide in female literacy in Nigeria. Literacy rates for Nigerian women range from a low of 7.2% in Yobe state to a high 96.4% in Imo state.
Figure 2: Male Nigerians have higher secondary school attendance and completion than female.
### Table 1: Linear regression analysis of public health infrastructure and associated health outcomes

|                                | Linear Regression (p-value) |
|--------------------------------|-----------------------------|
| **Percent of households using improved water sources vs.** |                             |
| Infant mortality               | 0.272                       |
| Ages 0-5 yrs. mortality        | 0.297                       |
| Percent female literacy        | 0.002                       |
| Percent girls in Primary school| 0.458                       |
| Percent girls in Secondary school| 0.002                     |
| **Percent of households using improved water and sanitation sources vs.** |                             |
| Infant mortality               | 0.830                       |
| Ages 0-5 yrs. mortality        | 0.857                       |
| Percent female literacy        | 0.227                       |
| Percent girls in Primary school| 0.975                       |
| Percent girls in Secondary school| 0.286                     |
| **Percent of births with skilled personnel vs.** |                             |
| Infant mortality               | 0.001                       |
| Ages 0-5 yrs. mortality        | 0.001                       |
| Percent female literacy        | <0.001                      |
| Percent girls in Primary school| 0.798                       |
| Percent girls in Secondary school| 0.000                     |
| **Percent of women with antenatal care vs.** |                             |
| Infant mortality               | 0.013                       |
| Ages 0-5 yrs. mortality        | 0.014                       |
| Percent female literacy        | <0.001                      |
| Percent girls in Primary school| 0.861                       |
| Percent girls in Secondary school| <0.001                     |
| **Percent of women using contraceptives vs.** |                             |
| Infant mortality               | 0.083                       |
| Ages 0-5 yrs. mortality        | 0.084                       |
| Percent female literacy        | <0.001                      |
| Percent girls in Primary school| 0.977                       |
| Percent girls in Secondary school| <0.001                     |

### Table 2: Linear regression analysis of female education and health outcomes

|                                | Linear Regression (p-value) |
|--------------------------------|-----------------------------|
| **Percent female literacy vs.**|                             |
| Infant mortality               | <0.001                      |
| Ages 0-5 yrs. mortality        | <0.001                      |
| Percent children 12-23 mos. with all vaccinations | <0.001 |
| Percent of 15-19 yr. girls married | <0.001         |
| Percent females (20-24 yrs.) with baby before 18 yrs. | <0.001 |
| **Percent girls in Primary school vs.** |                             |
Table 3: State-stratified logistic regression on the influence of Sharia Law on access to public health parameters

| Metric | Median and Interquartile Ranges in states without Sharia Law | Median and Interquartile Ranges in states with Sharia Law | Logistic Regression (p-value) | Odds Ratio (95% Confidence Interval) |
|--------|-------------------------------------------------|-------------------------------------------------|--------------------------------|------------------------------------|
| **Access to public health services** | | | | |
| Percent using improved water sources | 64.6% (42.2-75.6%) | 51.85% (32.3-59.7%) | 0.091 | 0.96 (0.92-1.01) |
| Percent using improved water and sanitation sources | 15.3% (12.4-33%) | 21.8% (13.2-23.5%) | 0.973 | 0.99 (0.95-1.06) |
| Percent of births with skilled personnel | 73% (40.4-83.8%) | 15.8% (12.3-27.6%) | 0.019 | 0.85 (0.75-0.97) |
| Percent of women with antenatal care | 78.3% (56.2-90.7%) | 35.25% (22.7-57.0%) | 0.003 | 0.91 (0.85-0.97) |
| Percent of women using contraceptives | 20.3% (11.1-30.6%) | 1.85% (1.4-3.1%) | 0.009 | 0.67 (0.52-0.91) |
| **Female education** | | | | |
| Percent female literacy | 83.9% (72.0-92.1%) | 19.9% (15.0-23.1%) | 0.048 | 0.82 (0.67-0.99) |
| **Adolescent marriage and motherhood** | | | | |
| Percent of 15-19 yr. girls married | 6.4% (3.5-16.1%) | 58.3% (41.5-63.6%) | 0.005 | 1.17 (1.05-1.31) |
| Percent females (20-24 yr.) with baby before 18 yr. | 15.3% (6.5-22%) | 55.0% (49.3-60.7) | 0.001 | 1.14 (1.05-1.23) |
| **Female Social Standing** | | | | |
| Percent female employed | 84.55% (78.15-88.17%) | 60.35% (48.05-67.26%) | <0.001 | NC* |
| Females with decision-making power | 2.9 (2.33-3.21) | 0.83 (0.38-1.57) | <0.001 | NC* |
| Health outcomes                                      | Value 1     | Value 2     | p-value | Odds Ratio (95% CI) |
|------------------------------------------------------|-------------|-------------|---------|---------------------|
| Infant mortality                                     | 44,000      | 71,000      | 0.012   | 1.05 (1.01-1.09)    |
| Ages 0-5 yr. mortality                               | 64,000      | 111,000     | 0.012   | 1.03 (1.01-1.04)    |
| Percent children 12-23 mo with all vaccinations      | 25.2%       | 2.4%        | 0.015   | 0.71 (0.54-0.94)    |