Relationship Between Maternal Education and Childhood Health Status in Myanmar

MPP Professional Paper

In Partial Fulfillment of the Master of Public Policy Degree Requirements
The Hubert H. Humphrey School of Public Affairs
The University of Minnesota

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May 15, 2024

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Abstract:

This study examines the relationship between maternal education and childhood health status measured by the child's height-for-age Z-score (HAZ), weight-for-height Z-score (WHZ), and whether the child has received two full doses of the measles vaccine. The paper utilizes IPUMS's 2015 Myanmar Demographic and Health Survey (DHS) data. The paper employs a standard ordinary least square (OLS) regression and a cluster fixed effects regression. The study shows that a mother's education is not significantly related to her child's WHZ, and the relationship between her education and her child's HAZ becomes insignificant after controlling for socioeconomic variables. The child's measles vaccine status, on the other hand, is significantly correlated with the mother's education, even after controlling for socioeconomic variables. After adding cluster-fixed effects, the relationship between the mother's education and the child's WHZ and HAZ disappears. Still, the mother's education and the child's measles vaccine status remain significant at the 10% significance level.

Introduction

This study looks at the effect of maternal education on a child's health status, measured by the child's height-for-weight Z-score (HAZ), weight-for-height Z-score (WHZ), and measles vaccination status. HAZ is an indicator often used to evaluate a child's long-term nutritional status. A value of -2 or below indicates stunting. WHZ, on the other hand, measures the child's body mass to height, which is usually used to evaluate short-term nutritional status. A WHZ value of -2 or below indicates childhood wasting. The binary measles variable indicates whether the child received two full doses of the measles vaccine. The study employs two methods - standard linear ordinary least square (OLS) regression and OLS regression with cluster fixed effects. The results show that a mother's education is not significantly related to her child's WHZ, and the relationship between her education and her child's HAZ becomes insignificant after controlling for socioeconomic variables. The child's measles vaccine status, on the other hand, is significantly correlated with the mother's education, even after controlling for socioeconomic variables. After adding cluster-fixed effects, the relationship between the mother's education and the child's WHZ and HAZ disappears. Still, the mother's education and the child's measles vaccine status remain significant at the 10% significance level.

Some of the existing literature on the relationship between the mother's education and child health and mortality finds the significant impacts of maternal education on a child's health across many populations worldwide. Studies such as Soe et al. (2019), a study I am building on, looked at the effect of maternal education on neonatal, infant, and under-5 mortality rates in Myanmar using the 2015 Myanmar Demographic and Health Survey

(DHS) data. The authors concluded that a higher level of mother's education correlates with lower infant and under-5 mortality rates in Myanmar. This idea is further supported by Güneş (1997), who took advantage of a compulsory schooling law change in Turkey by utilizing it as a natural experiment. He concluded that higher maternal education leads to better health outcomes for children. Abuya et al. (2011), who used logistic regression and focused on Kenya, found that maternal education positively correlates with child immunization rates. Additionally, Aslam and Kingdon (2012), who used an instrumental variable (IV) method, highlighted that maternal education, compared to fathers' education, had a more pronounced impact on long-term child health outcomes in Pakistan.

On the other hand, Mensch, Chuang, Melnikas, and Psaki (2019) critiqued methodologies of studies that suggested a direct causal link between maternal education and childhood health status by employing a systematic review process. The study stated that while maternal education can positively impact the child's health outcomes, the effects tend to be weakened after addressing endogeneity issues. Desai and Alva (1998) used a stratified sampling design and analyzed the relationship across 22 developing countries. They concluded that the effect of maternal education on a child's nutritional and mortality status diminishes significantly when socioeconomic variables are controlled for. Similarly, Le and Nguyen (2020), who used a sister fixed effects model (that compares the health outcomes of children whose mothers are biological sisters), found that while maternal education continues to be associated with better health outcomes across 68 developing countries, this relationship is complex and influenced by unobserved family heterogeneity. Furthermore, Frost, Forste, and Haas (1998) used logistic regression and stated that the pathway through which the mother's education affects the child's nutritional status can be mediated by factors such as health knowledge, socioeconomic status, and the general attitude toward healthcare. Moreover, Glewwe (1999), who looked at the effect of maternal education on the child's health outcome in Morocco using ordinary least squares (OLS) and fixed effects model, stated that maternal education improves the child's health outcomes mainly through the health knowledge gained by the mothers.

In the following sections, the paper briefly discusses Myanmar's background. Afterward, it discusses this study's methodology, variables, and data before looking into the descriptive statistics of the DHS dataset used for the study. Finally, it discusses the analysis section, discussion, limitations, and conclusion.

Background

Myanmar, also known as Burma, is a Southeast Asian country bordering China, India, Bangladesh, Laos, and Thailand. It is a diverse country comprised of over 135 officially recognized indigenous ethnic groups. Myanmar is a former British (briefly Japanese) colony that gained independence from British rule in 1948. Ever since its independence, Myanmar has faced numerous challenges, such as civil wars, brutal dictatorships, and general underdevelopment. Myanmar is also predominantly agrarian; according to the 2014 census, 70% of the population resides in rural areas (Lowy Institute 2024). Even though the healthcare quality in Myanmar has improved dramatically (especially in urban areas) since the country was open for foreign investments around 2011, significant challenges remain. For instance, according to the Myanmar Ministry of Health and Sports

(2015), 29% of children under five are stunted, with 5% being severely stunted, and 7% of the children are wasted, with 1% being severely wasted. The 2015/2016 period was crucial in Myanmar's history as it hosted its first free election in decades. The election resulted in a landslide victory for the civilian government. Unfortunately, democracy in Myanmar lasted for only five years, as in 2021, the Burmese military staged a coup and arrested most of the elected lawmakers, falsely accusing them of rigging the election (Human Rights Watch 2021).

Methodology, Data, and Variables

This study employs a multifaceted approach to understanding the relationship between maternal education and children's health outcomes. Firstly, ordinary least square (OLS) regression is used to understand the impact of maternal education on a child's health status, such as the child's height-for-age Z-score (HAZ), child's weight-for-height Z-score (WHZ) and child's total dose of measles vaccine status, by controlling for other factors that could influence those outcomes. In addition to the OLS regression, the study employs a cluster fixed effect model that controls for unobserved variables that are constant within clusters but may vary across them.

I use the data from the 2015 Myanmar Demographic and Health Surveys (DHS) for children and women, using the IPUMS DHS data. These data for Myanmar originate from the Demographic and Health Survey (DHS) program, which collects, analyzes, and disseminates representative data on population health, nutrition, and demographics from over 90 countries. This dataset includes comprehensive information on various indicators, such as the child's health, the mother's education, and the household's socioeconomic status and environmental factors. The 2015 DHS survey for Myanmar mainly focuses on issues crucial to parental and child health, so it collected data on education levels, health outcomes, and nutritional status, among other variables. The key explanatory variable for the study is the mother's education in years, from 1 to 13 years, as the survey only includes education levels up to high school. I also examined the categorical variable of this explanatory variable to see if there are differences across different education levels. Additionally, I tried the logarithmic and squared transformations of the variable but did not include them in the final analysis since they were insignificant. The dependent variables (the variables of interest) are:

- *Child's Height-for-Age Z-score (HAZ)*: This variable indicates the difference, measured in standard deviations (Z-scores), between the child's height and the World Health Organization (WHO) defined mean height for healthy children of the same age (in months) and sex. A Z-score equal to or less than -2 standard deviations is defined as stunting, which reflects chronic malnutrition or other long-term health issues. It is a crucial measure for identifying children who are significantly shorter in age relative to the World Health Organization (WHO) standard. This variable is generally used to better understand a child's long-term health status.
- *Child's Weight-for-Height Z-score (WHZ)*: Similar to the Height-for-Age Z-score (HAZ), this variable also looks at the difference in standard deviations (Z-scores) between child's weight and the World Health Organization (WHO) defined mean weight for healthy children of the same height and sex. A Z-score of -2 or lower is defined as wasting, which indicates acute malnutrition or other short-term health

challenges. While HAZ is used to understand the child's long-term nutritional and health status, WHZ is generally used to understand the child's short-term health and nutritional status.

- *Child's vaccination status*: This binary variable indicates whether the child received a total dose of the measles vaccine (both first and second courses). Due to the limited data on other types of immunization records, this variable is meant to act as a proxy for the child's overall immunization status against common preventable diseases. It indicates parental involvement in their child's essential health matters. In a developing country like Myanmar, addressing measles is important. According to the World Health Organization (2024), it is a highly contagious virus that can lead to severe health complications such as pneumonia and encephalitis (inflammation of the brain). Additionally, limited healthcare infrastructure (mainly in rural areas) and the absence of herd immunity (as in many developed countries) make it a critical public health issue in Myanmar.

I have also identified several control variables for this analysis to account for other factors that might influence the dependent variable such as:

- *Father's education*: Similar to the mother's education, the father's education may be crucial for the child's health status and is likely to be positively correlated with the mother's education. Therefore, including the father's education as a control enables the study to focus on the effect of maternal education by isolating the impact of the father's education. I also tried the logarithmic and squared transformations of the variable but did not include them in the final analysis since they were insignificant.

- *Urban/rural status*: This variable indicates whether the respondent lives in an urban or rural area of Myanmar. In Myanmar, metropolitan cities such as Yangon and Mandalay have disproportionately better access to medicine, doctors/nurses, and hospitals than rural areas. By including this variable as a control, the study isolates the effects of location-specific factors on the child's health status.
- *Location (states and provinces plus capital city)*: This variable shows which one of the 14 Burmese states and provinces (in addition to the capital city Naypyitaw) the respondent is from. Myanmar is diverse, and different states have varying diets, cultures, socioeconomic statuses, and living standards. By including location at the state level as a control variable, the study aims to keep the effects of regional characteristics constant in the regression.
- *Primary source of drinking water*: This set of variables indicates the household's primary source of drinking water. The original variable from IPUMS DHS consisted of 14 detailed options, but I narrowed the options to seven sources for simplicity. They are: collected water (such as rainwater); delivered water (such as tanker truck and bottled water); piped water (such as water that is piped into a house or yard); public access water (such as public tap); unprotected surface water (such as water from lake, pond, or river); protected spring water; protected and unprotected well water; and other source (water from any other sources not listed above). Controlling for drinking water sources is essential, as households with unsafe drinking water can be more prone to waterborne diseases, which can significantly affect the child's health status.
- *Type of toilet facility* - Similar to the drinking water variable, this variable also had 13 detailed options, but I narrowed it down to six major categories. They are

bucket/hanging toilets (such as toilets over water source or bucket toilets); composting toilets, flush toilets (any toilet with a flush mechanism); pit latrines (with or without a slab); other (none of the toilet type mentioned above); and no toilet facility. Controlling these toilets is important as unsanitary toilet facilities can expose household members to diseases such as cholera and dysentery (intestinal infection). The type of toilet facility is likely to be correlated with the mother's education, so controlling for the variable can reduce the estimates of the causal effect of the mother's education on the child's health. However, the toilet variables were insignificant or jointly significant in any regressions, so they were excluded from the model.

- *Child's age in months and its square, cubed, and fourth-power term*: These variables measure the child's age in months in a very flexible way (since the relationship between the child's age and health status might not be linear). Age is a crucial variable in assessing the child's health as the nutritional status, resistance to certain types of illness, and physical development vary greatly across children in different stages of life. For example, most children are exclusively breastfed for the first four to six months, which minimizes pathogens that cause diarrhea. Introducing other foods typically leads to diarrhea, which often results in large negative effects on HAZ and WHZ scores. Measuring the child's age in months (rather than years) provides a more precise measurement, especially in the early stages of the child's developmental period.
- *Mother's age and its square term*: The square of the mother's age is also included to capture potential non-linear effects. Controlling for this is important because the mother's age (and experiences) can significantly influence her and her child's

health outcomes. A mother's age could be correlated with her education because younger women tend to have higher levels of education than older women. Therefore, controlling for the mother's age and the square term will ensure that a mother's age does not bias the relationship between maternal education and the child's health outcomes.

- *Amount of agricultural land*: This variable measures the extent of agricultural land owned by the household (in tenths of a hectare). Since Myanmar is predominantly agricultural and rural, land ownership can be seen as a measure of wealth, food security, and socioeconomic status, all of which could be correlated with a mother's education. Controlling for this variable will help to ensure that the estimates of the mother's education on the child's health outcome are not biased by land ownership status. Since most respondents in the dataset did not know how much land they owned, I used a binary variable that indicates whether the household owns land.
- *Access to electricity*: This variable indicates whether the household has access to electricity. Access to electricity can indicate several factors, such as good local infrastructure and wealth, such as whether the household is generating electricity through solar or generators. Additionally, access to electricity indicates a better standard of living as it provides better lighting, food preservation (if refrigeration is available), and access to media (if the household has televisions or smartphones). Thus, this is also likely correlated with the mother's education.
- *Wealth indicator index and square term*: This variable represents a household's wealth index, which measures its overall economic status. The DHS calculated the index by combining scores from wealth indicators such as property, possessions,

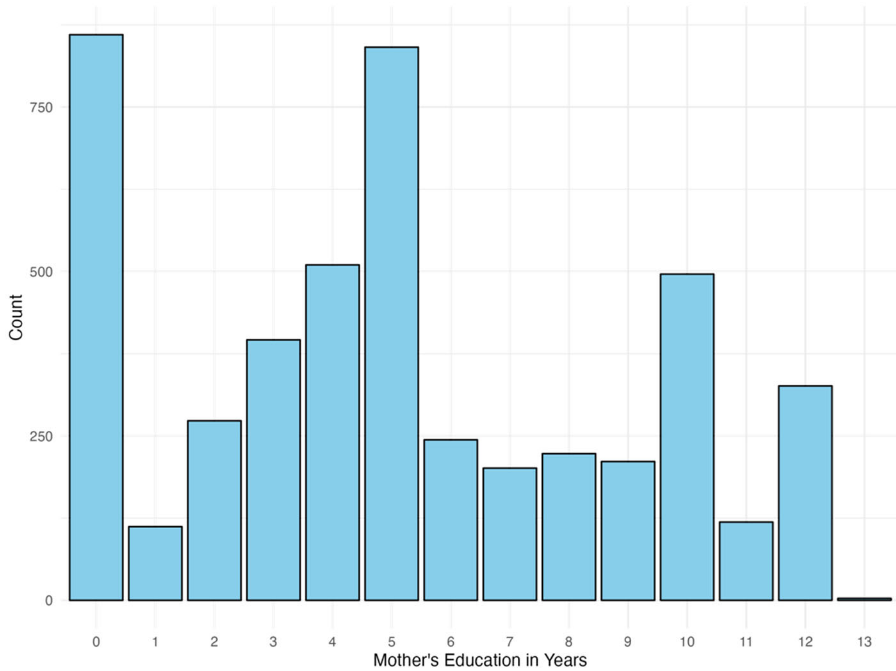
and income. Therefore, controlling for the wealth index and its square term (to allow for a non-linear relationship) will help ensure that maternal education's effect on the child's health outcome is not biased due to its correlation with wealth and socioeconomic conditions.

Descriptive Statistics

This section provides descriptive statistics from the 2015 Myanmar Demographic and Health Survey (DHS) data from IPUMS. The unit of analysis for the data is an individual child under five years old, whose information is provided by their mothers. The dataset has 439 individual clusters. Clusters are the smallest geographical units used by the DHS surveys. They consist of adjacent households within a defined geographic area, such as a village.

The average years of education for mothers is 5.2, with a standard deviation of 3.7. Fathers' average years of education is 5.5, with a standard deviation of 3.7. The histogram for the key variable of interest, the mother's education in years, is shown in Figure 1.

Figure 1: Histogram of Mother's Years of Education

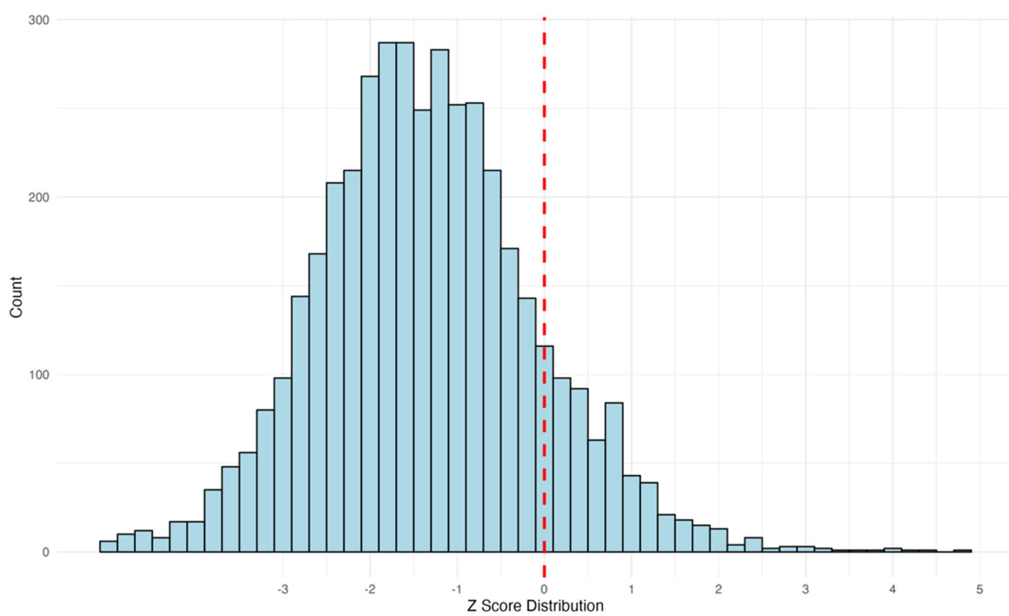


The average age of mothers is 30.9 years, with a standard deviation of 6.6. The average age of fathers is 36.8 years, with a standard deviation of 15.2. The average child age is 29.4 months (2.45 years), with a standard deviation of 17.

A child's height-for-age Z-score (HAZ) is defined as the difference, in standard deviations, of a child's height relative to the median height of a child of the same age and sex in the World Health Organization's data on height-for-age for a population of healthy children. An HAZ of 0 indicates that the child is of normal height given his or her age, and an HAZ of -2 or lower is defined as the child being stunted. I dropped the HAZ observations above +5 and below -5 to remove outliers (24 out of the initial 4,162 observations were dropped). The average height-for-age Z-score for the dataset is -1.3, with a standard deviation of 1.3.

This means that, on average, the 2015 Burmese children were on the shorter end of the height-for-age range of a normal healthy child population. The histogram of the HAZ scores is depicted in Figure 2.

Figure 2: Histogram of Child's Height-for-Age Z-Scores

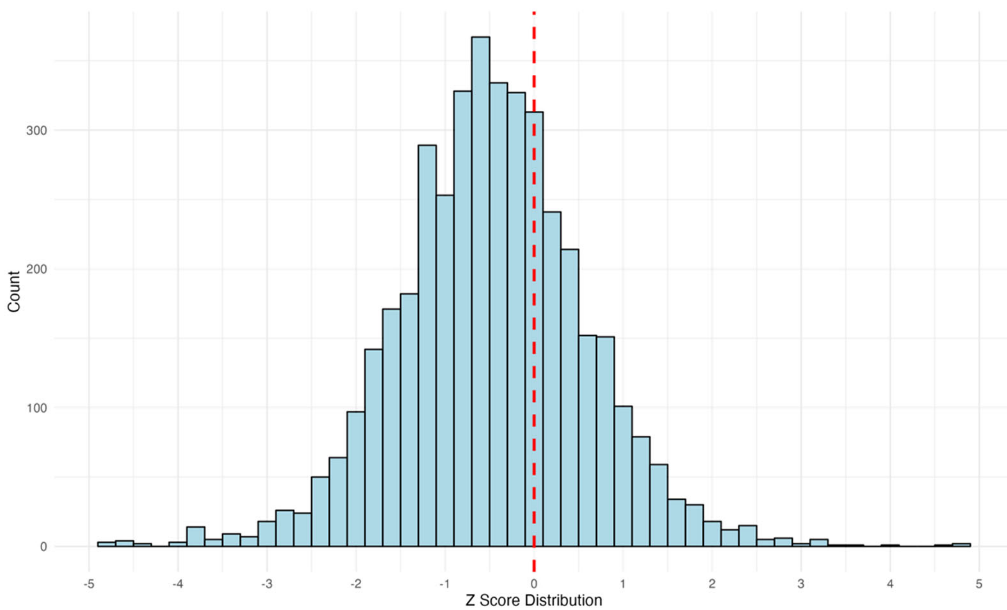


Note: The red lines indicate 0 HAZ (ideal HAZ for the child)

A child's weight-for-height Z-score (WHZ) is the difference, measured in standard deviations, of the child's weight from the median weight in World Health Organization's data from a population of healthy children with the same height and sex as the child. A WHZ of 0 indicates that the child is of average weight given his or her height, and a WHZ of -2 or lower indicates malnutrition and is defined as wasting. As with the analysis of HAZ, I also restricted the sample to be within -5 and +5 (no observations were dropped from the remaining 4,162 observations). The mean WHZ for the dataset is -0.5, and the standard deviation is 1.1. While the WHZ score of -0.5 is still on the lower end of the

WHO's recommended level, it is closer to the international standard than the average HAZ score (-1.3). The histogram for the WHZ scores is presented in Figure 3.

Figure 3: Histogram of Child's Weight for Height Z-Scores



Note: The red lines indicate 0 WHZ (ideal WHZ for the child)

The measles vaccine variable is a binary variable that indicates whether the child has received a full dose (2 doses) of the measles vaccine. The survey contains more information about this variable, such as the number of doses and whether this information was obtained from the child's vaccination or the mother's report. However, for the sake of simplicity, I use a binary variable that indicates whether the child received the total two doses of vaccine without making a distinction regarding the source of the information. The mean of this variable is 0.45, meaning that 45% of children had received the full dose of the vaccine. However, after restricting the variable to children between 2 and 4 years of age (which is a more realistic age to have received both doses of the vaccine), the mean increases to 0.67 or 67%.

In Myanmar, administrative divisions are classified into states, regions (also called divisions), union territories (such as the capital Naypyitaw), and self-administered zones (which are not collected in the DHS data). States (such as Kachin, Kayah, Kayin, Chin, Shan, Rakhine, and Mon) are mostly populated by ethnic groups of the same name, and regions (such as Sagaing, Taninthayi, Bago, Magway, Mandalay, Yangon, and Ayeyarwaddy) are the areas populated by the majority Bamar ethnic group. Table 1 shows the breakdown of the geographic units (states, regions, and capital) by the number of children and the percentages from each state, sorted from the least populated to the most populated. Among these units, 21% of the sample is from Myanmar's urban areas, and the remaining 79% is from rural areas. Individual-level sample weights are applied to enhance the sample's representativeness.

Table 1: Geographic Distributions of Children

Geographic Units	Frequency	Percent
Naypyitaw	221	5.31
Yangon	222	5.33
Shan	222	5.33
Magway	239	5.74
Mandalay	239	5.74
Bago	259	6.22
Ayeyarwaddy	267	6.42
Mon	227	5.45
Taninthayi	301	7.23
Kachin	302	7.26

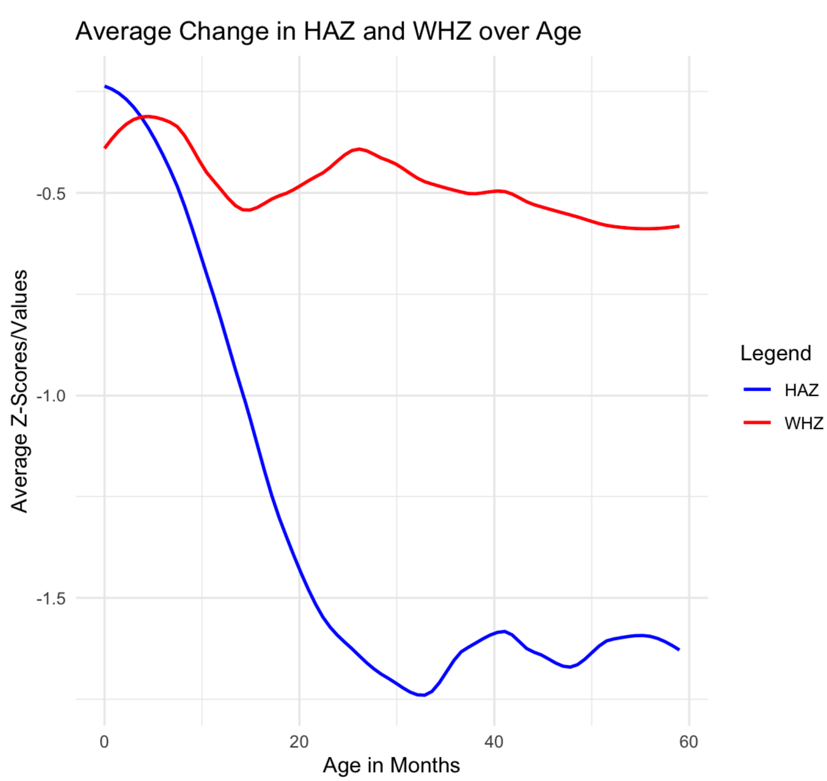
Rakhine	298	7.16
Kayin	311	7.47
Sagaing	319	7.66
Kayah	333	8.00
Chin	402	9.66
Total	**4,162**	**100.00**

As for the type of toilet used in the household, 0.3% reported having other types of facility not listed in the survey option, followed by 1.8% for bucket/hanging toilet and 2.0% for composting toilet facilities, 15.3% reported having no toilet facility, followed by 38.7% reporting using flush toilet facilities. The most used toilet facility in the dataset was pit latrines, with 41.9% of households using the facility. Regarding the household's primary source of drinking water, the least common sources were other sources (0.2%), collected water (1.1%), and public access water (4.4%). Delivered water, unprotected surface water, and piped water accounted for 11.9%, 9.3%, and 12.4%, respectively. Protected spring water and unprotected wells comprised 2.6% and 10%, respectively. The most common type of water source was protected wells, with 48.2% of respondents reporting wells as their primary source of drinking water.

Regarding agricultural lands, 38.7% of the households reported owning land. Additionally, 53 percent of respondents reported having access to electricity. The study also looks at the wealth index variable complied by IPUMS DHS. This index is calculated from multiple wealth indicators by combining standardized scores and factor loadings. The mean value of the wealth index is 1.8, with a standard deviation of 0.9. While this continuous variable is better for controlling due to its precision, a more intuitive way to look at household wealth is through a quantile wealth index derived from the wealth index variable. This approach simplifies wealth status into five distinct categories: poorest to richest. According to the index, 29.8% of the respondents belong to the “poorest” quantile, followed by 22.7% in the second “poorer” state. 18.6% of the respondents are in the “middle” quantile, followed by 16.9% in the “richer” quantile. 12.1% of the respondents in the data belonged to the “richest” quantile.

I also looked at how the averages of HAZ and WHZ change as the child ages. As shown in Figure 4, the child’s WHZ has slightly declined since birth from around -0.25 to -0.6. On the other hand, within a few months after birth, the child’s HAZ dramatically drops from around -0.25 to -1.75, indicating that Burmese infants are experiencing stunting from a very early age, likely due to factors such as inadequate nutrition or healthcare facilities.

Figure 4: Averages of HAZ and WHZ by Child’s Age in Months



Analysis

This study examines the impact of maternal education on children's health outcomes using two analytical approaches: ordinary least square (OLS) regression and cluster fixed-effects regression. I investigate the relationship between maternal education and children's nutritional status indicators: height-for-age (HAZ), weight-for-height (WHZ), and full-measles vaccine doses. Individual-level weights are applied to enhance the sample's representativeness, and the standard errors are clustered at the cluster level.

OLS Regression on Height-for-Age Z Scores

Table 2 examines the relationship between maternal education and children's height-for-age Z-scores (HAZ). The first column is a bivariate relationship, showing the association between the mother's years of schooling and HAZ. The coefficient is 0.0475, which is significant at the one percent level ($p < 0.01$). This suggests that for an additional year of the mother's education, the children's HAZ score increases by 0.0475 standard deviations; in other words, more educated mothers have taller children. However, this relationship is unlikely to measure the causal effect of the mother's education on the child's HAZ.

The second column in Table 2 controls for other causal factors by entering them into the regression model. The regression adds the father's education, state of residence, and urban/rural status as control variables. The control variables should reduce the omitted variable bias so that the estimate of maternal education's effect on the child's health status is closer to the causal impact. After adding these controls, the coefficient of the mother's education decreased to 0.0244, but the relationship is now statistically significant at the 5% level. The coefficient of the father's education is 0.0189, which is also significant at the 5% level.

The variable for the 14 states and provinces (plus the capital city) is categorical, with Kachin state as the reference group. Positive coefficients indicate higher HAZ scores than Kachin. For example, Kayin state has a positive coefficient of 0.470 ($p < 0.01$), indicating higher average HAZ scores for children there. Other regions, such as Yangon, Taninthayi, and Mon, also have positive and significant coefficients. Yangon is the highest at 0.608 ($p < 0.01$), likely due to its favorable conditions as Myanmar's commercial capital. Naypyitaw and other regions like Sagaing also show significant positive coefficients. Conversely, Kayah state and Ayeyarwaddy province have negative coefficients that are not statistically significant, and Chin and Shan states show no significant difference compared to Kachin. The coefficient for rural areas is -0.15, which is statistically significant ($p < 0.05$). This indicates that, all else being equal, living in rural areas is associated with lower height-for-age Z-scores compared to urban areas by approximately 0.15 standard deviations. This suggests a disadvantage in child health outcomes for those living in rural settings.

Column 3 in Table 2 adds the household's drinking water source. The omitted category for the water variable is water collected by households, such as rainwater. After controlling for the water variable, the effect of the mother's education slightly decreases to 0.0224, but the relationship is still significant at the 5% level. The regions showed slight variations in column 3 with no change in statistical significance. The urban/rural residence coefficient decreased to -0.111, and the relationship is no longer significant. This indicates that the household's primary source of drinking water may partially explain the previously observed differences in child health outcomes between urban and rural areas. As for the water variables, compared to the collected rainwater, which is our reference option, the coefficient for delivered water is 0.843, which is statistically significant at the 5% level. In other words, compared to children in households that drink collected rainwater, children in households who drink delivered water such as water bottles tend to be taller. However, none of the other water variables' coefficients were significant.

Column 4 in Table 2 controls for the mother's age in years (and its square term) and the child's age in months, along with quadratic, cubic, and fourth-power terms for the child's age to account for non-linear age effects on height-for-age Z-scores (HAZ). The coefficient for the mother's education decreases to 0.0186, but the relationship is still statistically significant at the 5% level. However, the coefficient of the father's education is no longer statistically significant after these controls were included. In contrast, the child's age in months shows a statistically significant effect. The coefficient in the linear term -0.0459 at the 10% significance level indicates that the HAZ of the child declines as the child ages, as seen in Figure 4. The squared term of the child's age is significant at 10%, while the cubed and the fourth-power terms are significant at 1%. On the other hand, the mother's age and the square term remained insignificant.

Column 5 in Table 2 introduces additional control variables related to the household's socioeconomic status, such as whether the household owns agricultural land, its wealth index and square, and whether it has access to electricity. The coefficient for the mother's education decreases to 0.00871, and the relationship became statistically insignificant. This means that the wealth variables could explain part of the previous correlation between the mother’s education and the child’s HAZ. In other words, the effect of a mother's education on a child's HAZ is not as direct as previously thought, and some of the correlation can be attributed to the household's wealth status and socioeconomic conditions. The coefficient for land ownership is negative at -0.0627 but not statistically significant. On the other hand, the household wealth index has a coefficient of 0.153 at the 1% significance level, meaning that one standard deviation increase in the wealth results in a 0.153 standard deviation increase in HAZ. Higher wealth status is associated with better child growth outcomes, potentially due to better access to nutrition, healthcare, and living conditions. The last control variable, access to household electricity, has a negative coefficient (-0.0396) but lacks statistical significance.

OLS Regression on Weight-for-Height Z Scores

Table 3 uses a linear regression model to examine the relationship between maternal education in years and a child’s weight-for-height Z-score (WHZ). Column 1 examines the correlation between the mother’s education in years and the child’s WHZ. The coefficient for the relationship is 0.00325. However, the relationship is not statistically significant, indicating that maternal schooling does not have a meaningful association with WHZ among children.

Column 2 in Table 3 adds controls for the father's education, the geographic locations for states and provinces (including the capital, Naypyidaw), and urban/rural residential status. After controlling for the additional variables, the coefficient of maternal education is 0.00143, which is still not statistically significant. Similarly, the father’s education is also statistically insignificant. As for the geographic regions, as the Kachin state is our omitted group, any interpretation will be relative to the Kachin state. Therefore, the significant negative coefficients for many areas, such as Sagaing, Taninthayi, Bago, Magway, Mandalay, Mon, Rakhine, Yangon, Ayeyarwaddy, and Naypyitaw, indicate that children in these areas have a lower WHZ compared to children in Kachin state. This could be due to varying dietary patterns, access to healthcare, and socioeconomic conditions that affect nutritional status across these regions. Additionally, provinces like Kayah and Chin states show positive yet statistically insignificant coefficients for WHZ compared to Kachin state. Compared to living in urban regions, the coefficient for living in rural areas is 0.0527, but the relationship is not statistically significant.

The third column in Table 3 adds the household's primary drinking water source as a control variable. Mother's education variable remains insignificant, with a coefficient of 0.00332. The introduction of these control variables caused the coefficients of the regional variables to vary slightly. The protected spring water variable in the water source group is statistically significant, with a coefficient of 0.549 at the 1% significance level. As collected water is our omitted category, it means that compared to households that drink collected water, children from the households that drink protected spring water are associated with a 0.549 increase in children's WHZ. In other words, children whose households use protected spring water are significantly less malnourished than households who drink collected rainwater. All the other water variables are insignificant.

The fourth column in Table 3 controls for the mother's age in years (and its square terms) and the child's age in months, alongside its square, cubed, and fourth-power terms. The coefficient of the mothers' education decreases to 0.00187, however, without statistical significance. After the age controls, the coefficients of the existing variables slightly declined, without a change in statistical significance or significance power shift. All the newly added variables - mother's age in years and child's age in months (alongside its variations) remain statistically insignificant.

The fifth column in Table 3 adds socioeconomic-related control variables such as whether the household owns agricultural land, its wealth index and square, and its electricity access. The introduction of these variables further decreased the coefficient of the mothers' education to 0.00269, and the relationship remains statistically insignificant. The coefficients of variables from the fourth column also slightly decreased but without any change in significance or the strength of the significance. None of the newly added control variables, however, is statistically significant.

<u>Linear Probability Model of Measles Vaccination Status</u>

Column 1 of Table 4 explores the bivariate relation between the mother's education in years and whether her child has received the two doses of the measles vaccine. The coefficient is 0.0121 at the 1% significant level, indicating that measles vaccine completion rates increase by 1.21 percentage points as mothers get an additional year of education.

After controlling for the father's education, region-specific variables such as state of residence, and urban/rural status in column 2 of Table 4, the coefficient of interest decreases to 0.00784, and the significance level drops from the previous 1% level to the current 5% level. The coefficient on the father's education is not significant. The regional coefficients are interpreted in relation to the Kachin state, our reference group. Kayin State has a significant negative coefficient of -0.170 ($p < 0.01$), indicating lower vaccination rates than Kachin. Similar trends are observed in Rakhine, Ayeyarwaddy, Shan, and Naypyitaw, with significant negative coefficients, suggesting these areas also have lower measles coverage than Kachin. These negative trends may reflect unequal health service distribution or varying health policy effectiveness in Myanmar. There are no significant differences in measles vaccine completion between urban and rural regions.

Column 3 in Table 4 introduces the household's drinking water source variables, all of which are statistically insignificant at the 5% level. In addition, the coefficient of interest - the mother’s education - slightly decreases to 0.00759 but remains significant at the 5% significance level.

Column 4 in Table 4 adds the mother’s age in years (and its square term) and the child’s age in months, alongside its square, cubed, and fourth-power terms, to isolate the causal impact of the mother’s education on the child’s vaccination status. After controlling for the age variables, the coefficient of the mother’s education slightly increased to 0.0129 and became statistically significant at the 1% level again. Additionally, the father’s education coefficient (insignificant since it was introduced in the second column) went from statistically insignificant to significant at the 5% level at 0.00610. This means there might have been confounding variables related to maternal age or the child's age affecting the initial relationship between the father’s education and vaccination rates. The coefficient for the child's age in months is statistically significant -0.0475 ($p < 0.01$), indicating a strong negative relationship between age in months and the likelihood of measles vaccination. The negative coefficient suggests that as children get older, the initial rate of vaccination decreases significantly. Additionally, the higher power terms of age are also highly significant, indicating a complex polynomial relationship where the effect of age on vaccination status changes as children get older. On the other hand, the mother's age in years and its square term are statistically insignificant. Additionally, the coefficient for a water source from delivered water is 0.297 with a 1% significance level. This indicates that households using delivered water such as water bottles for drinking water have a 29.7% higher measles vaccination rate than those using collected rainwater, which is the reference group.

Column 5 in Table 4 adds socioeconomic-related control variables such as whether the household owns agricultural land, the household's wealth index and square, and the household has access to electricity. After implementing the controls, the coefficient of interest, mother's education in years, slightly decreases to 0.0117 ($p < 0.01$), indicating that all else being equal, an additional year of mother's education on average results in a 1.17% increase in total measles vaccination rate of her children. The coefficient for the father's education slightly decreased to 0.00527, and the relationship became insignificant. The socioeconomic-related control variables, such as land ownership, wealth index, and access to electricity, remained insignificant.

<u>Cluster Fixed Effects</u>

To further refine the study, the paper incorporates cluster fixed effects to account for potential biases arising from omitting unobservable variables at the cluster level. By introducing cluster-based fixed effects, the analysis controls for the unobserved local factors to ensure that the coefficients are not biased by characteristics common to all households within the same cluster that may be correlated with the mother's education. The geographic variables such as states and urban/rural status are removed for this analysis as the fixed-effects model automatically controls for these variables.

The first column in Table 5 examines the correlation between a mother's education in years and the child's HAZ with cluster-fixed effects. Similar to the standard linear regression model, the coefficient for the mother's education is not statistically significant, indicating that even after controlling for the within-cluster variation, the mother's education does not seem to have a statistically significant effect on the child's HAZ. The coefficient for the wealth index variable is 0.112, which is significant at the 5% level. This means that, even after controlling for cluster-based variations, a standard deviation increase in the wealth index significantly raises a child's Height for Age Z-score (HAZ) by 0.112. The coefficient for the household's primary source of drinking water as delivery is significant at the 10% level at 0.971, indicating that compared to children whose household drinking water is from collected rainwater, children who get their water delivered tend to be taller in the DHS survey. All the other control variables are insignificant.

The second column in Table 5 examines the relationship between maternal education over the years and the child's WHZ score with clustered fixed effects. The coefficient for a mother's education is 0.00721, but like HAZ, the relationship is insignificant. Additionally, households who get their drinking water from delivered, piped, protected spring water instead of collected water (our omitted category) are statistically significant at the 1% level at 0.438, 0.527, and 0.553, respectively. Moreover, protected wells and unprotected surface water are significant at the 5% level at 0.301 and 0.334, respectively. Public access water and unprotected wells are also significant but only at the 10% level with coefficients of 0.350 and 0.280, respectively. The land-ownership variable is statistically significant at 0.0874 ($p < 0.10$), indicating that children whose households own lands tend to be less undernourished. All the other control variables remain statistically insignificant.

The third column in Table 5 studies the effect of the mother's education and the child's measles vaccination status. Even though the relationship between a mother's education and vaccination status was statistically significant at the 5% level in the standard regression, the relationship is now only significant at the 10% level at 0.00546 after controlling for fixed effects. In other words, introducing cluster-based fixed effects diminishes the apparent impact of a mother's education on a child's measles vaccination status when accounting for local environmental and socio-economic factors shared within clusters. This suggests that factors specific to each cluster, in addition to maternal education, may play a critical role in vaccination rates.

Moreover, the child's age in years (and all of its terms) is significant at the 1% level at -0.0431, indicating that as the child ages, the probability of completing the measles vaccine initially decreases. However, the positive coefficient for the quadratic term at 0.00514 ($p < 0.01$) suggests that this decline slows down and may start to reverse as age increases. The negative coefficient for the cubic term ($p < 0.01$) and the positive coefficient for the quartic term ($p < 0.01$) indicate that the relationship between age and vaccination probability is non-linear and complex. The delivered water source variable coefficient is statistically significant at 0.354 ($p < 0.05$). This indicates that children who live in households that drink delivered water, such as bottled water, are also associated with higher measles vaccination rates.

Additional Analyses

To further explore the impact of maternal education on a child's health outcomes, I also used the highest level of education completed as a set of categorical education variables. They are: no education; primary level education; secondary level; and tertiary level. Parents with no formal education serve as the omitted category. As depicted in Table 7 for HAZ, mothers who completed secondary education had taller kids than mothers without formal education ($p < 0.1$). Interestingly, the coefficients for tertiary education were not significant. I believe it could be attributed to a significantly lower sample size as only around five percent of mothers and fathers had education at the tertiary level. This makes all estimates for higher education very imprecise, which is evident in their large standard errors. For WHZ, none of the education levels for mothers showed any significance. However, the education levels of fathers were significant, with those who completed tertiary school having a significant effect at the 5% level and secondary and elementary at 10%. Similarly, for the measles vaccination rate, the coefficients for mothers who completed secondary education were significant at 5%, and those who finished elementary school were significant at 10%. This suggests that, in general, compared to parents without formal education, better-educated parents tend to have children with higher HAZ, WHZ, and measles vaccination rates.

To capture the potential non-linear effect of the mother's and father's education on child health outcomes, I also looked at the squared and logged terms of the parents' education levels. However, as they were all insignificant, they were removed from the analysis. I also tested the relationship between the mother's education and the binary variables indicating whether the child is stunted (children with a HAZ score of -2 or below) or whether the child is wasted (children with a WHZ score of -2 or below). However, as the relationships were insignificant, they were also excluded from the study.

Discussion and Conclusion

This research examines the relationship between maternal education and the indicators of childhood health outcomes, height-for-age Z-score (HAZ), weight-for-height Z-score (WHZ), and measles vaccination status. This research builds on the work of Soe et al. (2019), who looked at the relationship between maternal education and childhood mortality in 2015 in Myanmar. The finding of an effect of maternal education on vaccination status, even after introducing cluster-based fixed effects, is consistent with Abuya et al. (2011), albeit at the 10% significance level, who stated that educated mothers are more likely to act on preventative health measures for their children.

However, my findings deviate from those of Soe et al. (2019) regarding child health status (Soe et al. looked at child mortality rate while I looked at HAZ and WHZ). Soe et al. found that a mother's education had a significant effect on under-5 and neo-mortality rates; this study, after accounting for cluster-based fixed effects, did not find a significant effect of the mother's education on child's health status variables, such as HAZ and WHZ. The child's WHZ, which indicates short-term nutritional status, is not statistically significant in any regression table. The child's HAZ, which measures the child's long-term health status, on the other hand, was statistically significant with the mother's year of education. However, the effect was significantly mediated by introducing socioeconomic variables such as land ownership and household wealth index. This finding is also supported by Desai and Alva (1998), who looked at the relationship between maternal education and child health across 22 developing countries and found that the effect of maternal education on a child's health significantly diminishes after controlling for socioeconomic factors. Additionally, Frost, Forste, and Haas (1998), who studied pathways through which maternal education influences child nutritional status in Bolivia, also concluded that socioeconomic factors such as wealth status significantly weaken the effect of maternal education on the child's health outcomes.

However, even though the relationship between maternal education and HAZ might not be direct, it does not mean that maternal education does not affect a child's health status, as the effect of a mother's education can work through wealth. As a mother's education and the household wealth index are highly correlated, and in turn, the child's HAZ and household wealth status are also correlated, highly educated mothers might contribute to household wealth. As shown in Table 6, this household wealth index positively correlates with the children's long-term health status, such as HAZ ($p < 0.01$). Additionally, as shown in Table 7, compared to parents with no formal education, the children of more educated parents tend to have higher HAZ, WHZ, and measles vaccination rates.

One of the paper's biggest limitations is its use of cross-sectional data that restricts the pathways to show the causal impact of a mother's education on the child's health status. I tried to look for an instrumental variable (IV) that has predictive power for the mother's education but has no direct effect on the child's health, but finding the proper instrument was very difficult due to the limitations of the data. Moreover, the study only examines the mother's education in years up until high school. It is restrictive as it does not explain the effects of higher educational attainment, such as having a college degree or more. Additionally, as the study was conducted at a unique time in Myanmar's history - a couple of years after the country opened its doors to foreign investors and right before a democratic landslide victory of the civilian government after decades of military oppression, the results of the study might not be generalizable not only to foreign countries but also to the present-day Myanmar. Because of the COVID-19 pandemic as well as the 2021 coup, followed by the civil disobedience movement (where a huge population of doctors and nurses went on strike) and intensifying civil conflict, Myanmar today is unfortunately in a very different state compared to the promising years of 2015/2016. Therefore, recent data and research are needed to understand a more contemporary relationship between a mother's education and a child’s health status, as Myanmar during 2015/2016 is very different from Myanmar in 2024.

Appendix

Table 2: OLS Regression of Mother's Education and Child's HAZ

VARIABLES	(1)	(2)	(3)	(4)	(5)
Mother's Education	0.0475***	0.0244**	0.0224**	0.0186**	0.00871
	(0.00740)	(0.00981)	(0.00990)	(0.00925)	(0.00950)
Father's Education		0.0189**	0.0187**	0.0136	0.00724
		(0.00906)	(0.00913)	(0.00846)	(0.00865)
Kayah		-0.0586	-0.0553	-0.124	-0.118
		(0.119)	(0.123)	(0.126)	(0.124)
Kayin		0.470***	0.443***	0.316**	0.282**
		(0.127)	(0.125)	(0.128)	(0.126)
Chin		0.0183	-0.00197	-0.0559	-0.0328
		(0.114)	(0.127)	(0.132)	(0.136)
Sagaing		0.266**	0.269**	0.240*	0.211*
		(0.121)	(0.119)	(0.127)	(0.127)
Taninthayi		0.381***	0.310***	0.274**	0.295***
		(0.109)	(0.109)	(0.114)	(0.113)
Bago		0.276**	0.261**	0.237**	0.224**
		(0.109)	(0.105)	(0.111)	(0.111)
Magway		0.251*	0.241*	0.168	0.154
		(0.132)	(0.129)	(0.127)	(0.128)
Mandalay		0.240*	0.224*	0.158	0.111
		(0.124)	(0.119)	(0.122)	(0.122)
Mon		0.377***	0.342**	0.220	0.213
		(0.142)	(0.138)	(0.137)	(0.136)
Rakhine		0.115	0.0870	0.0302	0.0540
		(0.162)	(0.159)	(0.156)	(0.157)
Yangon		0.608***	0.560***	0.518***	0.501***
		(0.148)	(0.147)	(0.136)	(0.134)
Shan		0.124	0.115	0.0570	0.0251
		(0.130)	(0.128)	(0.136)	(0.133)
Ayeyarwaddy		-0.0221	-0.0186	-0.0272	0.0149
		(0.118)	(0.116)	(0.121)	(0.121)
Naypyitaw		0.334***	0.318***	0.318**	0.298**
		(0.121)	(0.118)	(0.127)	(0.127)
Urban/Rural		-0.150**	-0.110	-0.0988	-0.00971
		(0.0735)	(0.0795)	(0.0745)	(0.0764)
Collected Water			0.0502	0.0503	0.0846
			(0.195)	(0.173)	(0.160)
Delivered Water			0.843**	0.830*	0.986**
			(0.336)	(0.457)	(0.434)
Other Water Source			0.0621	0.0525	0.182
			(0.203)	(0.182)	(0.177)
Protected Spring Water			-0.155	-0.187	-0.0141

			(0.199)	(0.187)	(0.182)
Protected Well			-0.0457	-0.0714	0.0791
			(0.175)	(0.155)	(0.145)
Public Access Water			-0.196	-0.218	-0.0492
			(0.198)	(0.188)	(0.185)
Surface Water			-0.155	-0.175	-0.00294
			(0.184)	(0.166)	(0.157)
Unprotected Well			0.0134	-0.0409	0.131
			(0.196)	(0.173)	(0.163)
Kid's Age in Months				-0.0459*	-0.0423
				(0.0278)	(0.0279)
Kid Age Squared				-0.00346*	-0.00366**
				(0.00185)	(0.00186)
Kid Age Cubed				0.000146***	0.000150***
				(4.58e-05)	(4.60e-05)
Kid Age Fourth Term				-1.39e-06***	-1.42e-06***
				(3.74e-07)	(3.76e-07)
Mother's Age				-0.000596	-0.00232
				(0.0295)	(0.0293)
Mother's Age Square				6.51e-05	6.85e-05
				(0.000451)	(0.000446)
Land Ownership					-0.0627
					(0.0565)
Wealth Index					0.153***
					(0.0398)
Wealth Index Square					0.0159
					(0.0222)
Electricity					-0.0396
					(0.0578)
Constant	-1.563***	-1.670***	-1.639***	-0.326	-0.647
	(0.0494)	(0.124)	(0.211)	(0.525)	(0.518)
Observations	4,162	4,085	4,085	4,085	4,085
R-squared	0.019	0.049	0.052	0.194	0.199

Notes: Table 2 presents an OLS regression analysis of the relationship between maternal education and children's height-for-age Z-scores (HAZ). The table includes five columns, each representing a different model specification with progressively added control variables: father's education, state of residence, urban/rural status (urban as the omitted category), household water source (with collected water as a reference source), the child's age in months (with polynomial terms), the mother's age (with its square term), and household socioeconomic status indicators such as land ownership, wealth index (and its square), and access to electricity. Significance levels are as follows: ***p < 0.01, **p < 0.05, and *p < 0.1. The number of observations and the R-squared values for each model are provided at the bottom of the table.

Table 3: OLS Regression of Mother's Education and Child's WHZ

VARIABLES	(1)	(2)	(3)	(4)	(5)
Mother's Education	0.00325	0.00143	0.00332	0.00187	0.00269
	(0.00658)	(0.00788)	(0.00811)	(0.00813)	(0.00907)
Father's Education		0.0103	0.0104	0.00960	0.0101
		(0.00740)	(0.00731)	(0.00743)	(0.00753)
Kayah		0.0514	0.0389	0.0298	0.00899
		(0.160)	(0.156)	(0.153)	(0.151)
Kayin		-0.177	-0.163	-0.186	-0.184
		(0.163)	(0.156)	(0.153)	(0.152)
Chin		0.0606	0.0109	0.00248	0.0125
		(0.170)	(0.171)	(0.167)	(0.169)
Sagaing		-0.322**	-0.327**	-0.328**	-0.318**
		(0.160)	(0.152)	(0.149)	(0.150)
Taninthayi		-0.512***	-0.493***	-0.506***	-0.514***
		(0.171)	(0.163)	(0.160)	(0.158)
Bago		-0.519***	-0.497***	-0.498***	-0.498***
		(0.161)	(0.153)	(0.151)	(0.149)
Magway		-0.377**	-0.381**	-0.384**	-0.380**
		(0.165)	(0.157)	(0.153)	(0.154)
Mandalay		-0.310*	-0.301*	-0.315*	-0.304*
		(0.179)	(0.167)	(0.165)	(0.168)
Mon		-0.399**	-0.373**	-0.386**	-0.398**
		(0.170)	(0.165)	(0.162)	(0.159)
Rakhine		-0.642***	-0.615***	-0.628***	-0.653***
		(0.178)	(0.173)	(0.170)	(0.167)
Yangon		-0.465***	-0.446***	-0.455***	-0.448***
		(0.172)	(0.165)	(0.163)	(0.161)
Shan		-9.34e-05	-0.0372	-0.0490	-0.0542
		(0.165)	(0.157)	(0.154)	(0.153)
Ayeyarwaddy		-0.412**	-0.404**	-0.413***	-0.419***
		(0.166)	(0.157)	(0.154)	(0.152)
Naypyitaw		-0.433***	-0.409***	-0.413***	-0.417***
		(0.163)	(0.156)	(0.153)	(0.152)
Urban/Rural		0.0527	0.0502	0.0521	0.0332
		(0.0662)	(0.0698)	(0.0689)	(0.0772)
Collected Water			0.116	0.119	0.120
			(0.144)	(0.147)	(0.146)
Delivered Water			-0.306	-0.323	-0.331
			(0.690)	(0.684)	(0.681)
Other Water Sources			0.163	0.167	0.160
			(0.162)	(0.164)	(0.164)
Protected Spring Water			0.549***	0.558***	0.556***
			(0.204)	(0.207)	(0.205)
Protected Well			0.0951	0.0982	0.0998
			(0.138)	(0.140)	(0.139)

Public Access Water			0.117	0.118	0.115
			(0.193)	(0.193)	(0.194)
Surface Water			0.241	0.238	0.223
			(0.153)	(0.155)	(0.152)
Unprotected Well			0.0927	0.0918	0.0822
			(0.163)	(0.164)	(0.161)
Kid's Age in Months				-0.00887	-0.0107
				(0.0315)	(0.0315)
Kid Age Squared				0.000604	0.000707
				(0.00198)	(0.00198)
Kid Age Cubed				-1.54e-05	-1.77e-05
				(4.73e-05)	(4.74e-05)
Kid Age Fourth Term				1.12e-07	1.30e-07
				(3.80e-07)	(3.81e-07)
Mother's Age				0.0143	0.0142
				(0.0237)	(0.0236)
Mother's Age Square				-0.000227	-0.000222
				(0.000361)	(0.000360)
Land Ownership					0.0639
					(0.0462)
Wealth Index					-0.0365
					(0.0372)
Wealth Index Square					0.0218
					(0.0221)
Electricity					0.0489
					(0.0538)
Constant	-0.564***	-0.309*	-0.449**	-0.567	-0.556
	(0.0416)	(0.165)	(0.214)	(0.452)	(0.457)
Observations	4,162	4,085	4,085	4,085	4,085
R-squared	0.000	0.031	0.037	0.040	0.041

Notes: Table 3 presents an OLS regression analysis of the relationship between maternal education and children's weight-for-height Z-scores (WHZ). The table includes five columns, each representing a different model specification with progressively added control variables: father's education, state of residence, urban/rural status (urban as a reference source), household water source (with collected water as a reference source), the child's age in months (with polynomial terms), the mother's age (with its square term), and household socioeconomic status indicators such as land ownership, wealth index (and its square), and access to electricity. Significance levels are as follows: ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$. The number of observations and the R-squared values for each model are provided at the bottom of the table.

Table 4: Linear Probability Model of Mother's Education and Measles Vaccination Status

VARIABLES	(1)	(2)	(3)	(4)	(5)
Mother's Education	0.0121***	0.00784**	0.00759**	0.0129***	0.0117***
	(0.00275)	(0.00350)	(0.00346)	(0.00286)	(0.00294)
Father's Education		0.00182	0.00214	0.00610**	0.00527
		(0.00334)	(0.00341)	(0.00306)	(0.00323)
Kayah		0.0241	0.0273	0.0818**	0.0821**
		(0.0424)	(0.0422)	(0.0363)	(0.0362)
Kayin		-0.170***	-0.163***	-0.0730*	-0.0727*
		(0.0486)	(0.0467)	(0.0426)	(0.0424)
Chin		-0.0629	-0.0600	-0.0384	-0.0329
		(0.0469)	(0.0491)	(0.0436)	(0.0441)
Sagaing		-0.00412	-0.00280	0.0114	0.00759
		(0.0493)	(0.0470)	(0.0431)	(0.0441)
Taninthayi		-0.0943	-0.102*	-0.0746	-0.0692
		(0.0580)	(0.0569)	(0.0558)	(0.0548)
Bago		0.00598	-2.79e-05	0.0151	0.0173
		(0.0503)	(0.0496)	(0.0428)	(0.0429)
Magway		-0.0241	-0.0307	0.000411	0.00279
		(0.0461)	(0.0451)	(0.0403)	(0.0408)
Mandalay		-0.0568	-0.0601	-0.0164	-0.0195
		(0.0445)	(0.0444)	(0.0360)	(0.0377)
Mon		-0.0494	-0.0537	0.0121	0.0151
		(0.0492)	(0.0484)	(0.0430)	(0.0422)
Rakhine		-0.127***	-0.127***	-0.0720*	-0.0621
		(0.0455)	(0.0453)	(0.0387)	(0.0395)
Yangon		-0.0145	-0.0125	0.0311	0.0306
		(0.0533)	(0.0548)	(0.0432)	(0.0434)
Shan		-0.102**	-0.0894*	-0.0179	-0.0200
		(0.0516)	(0.0510)	(0.0437)	(0.0439)
Ayeyarwaddy		-0.133***	-0.127***	-0.0948**	-0.0845*
		(0.0466)	(0.0462)	(0.0444)	(0.0451)
Naypyitaw		-0.102*	-0.109**	-0.102**	-0.0984**
		(0.0524)	(0.0509)	(0.0483)	(0.0487)
Urban/Rural		0.00831	0.0137	0.00156	0.00929
		(0.0269)	(0.0293)	(0.0262)	(0.0277)
Collected Water			0.0607	0.0421	0.0504
			(0.0764)	(0.0701)	(0.0733)
Delivered Water			0.271*	0.297***	0.316***
			(0.144)	(0.0930)	(0.0945)
Other Water Sources			0.0832	0.0877	0.0998
			(0.0768)	(0.0710)	(0.0747)
Protected Spring Water			0.0270	0.0147	0.0327
			(0.0846)	(0.0849)	(0.0894)
Protected Well			0.0782	0.0871	0.101
			(0.0684)	(0.0645)	(0.0702)

Public Access Water			0.0478	0.0490	0.0663
			(0.0902)	(0.0833)	(0.0888)
Surface Water			0.00623	0.0215	0.0408
			(0.0786)	(0.0727)	(0.0779)
Unprotected Well			0.0284	0.0610	0.0787
			(0.0774)	(0.0721)	(0.0773)
Kid's Age in Months				-0.0475***	-0.0471***
				(0.00604)	(0.00603)
Kid Age Squared				0.00545***	0.00544***
				(0.000485)	(0.000485)
Kid Age Cubed				-0.000142***	-0.000142***
				(1.34e-05)	(1.34e-05)
Kid Age Fourth Term				1.14e-06***	1.14e-06***
				(1.17e-07)	(1.17e-07)
Mother's Age				0.00818	0.00796
				(0.0101)	(0.0101)
Mother's Age Square				-5.30e-05	-5.31e-05
				(0.000160)	(0.000160)
Land Ownership					-0.00538
					(0.0189)
Wealth Index					0.0185
					(0.0144)
Wealth Index Square					-0.00606
					(0.00688)
Electricity					-0.00354
					(0.0203)
Constant	0.390***	0.458***	0.390***	-0.262	-0.292
	(0.0188)	(0.0480)	(0.0855)	(0.173)	(0.179)
Observations	4,162	4,085	4,085	4,085	4,085
R-squared	0.008	0.019	0.022	0.360	0.361

Note: Table 4 presents the results of a Linear Probability Model (LPM) examining the relationship between maternal education and whether a child has received the two doses of the measles vaccine. The table includes five columns, each representing a different model specification with progressively added control variables: father's education, state of residence, urban/rural status (urban as a reference category), household water source (collected water as a reference category), the child's age in months (with polynomial terms), the mother's age (with its square term), and household socioeconomic status indicators such as land ownership, wealth index (and its square), and access to electricity. Significance levels are denoted as follows: ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$. The number of observations and the R-squared values for each model are provided at the bottom of the table.

Table 5: Cluster Fixed Effect Regression of HAZ, WHZ, and Vaccination Status

VARIABLES	(1) HAZ	(2) WHZ	(3) Measles
Mother's Education	0.00411	0.00721	0.00568*
	(0.00987)	(0.0106)	(0.00323)
Father's Education	0.0135	0.00814	0.00175
	(0.0101)	(0.00852)	(0.00364)
Collected Water	-0.0528	0.438***	0.0865
	(0.275)	(0.132)	(0.0994)
Delivered Water	0.971*	-0.113	0.354***
	(0.538)	(0.706)	(0.108)
Other Water Sources	0.0844	0.527***	0.0854
	(0.294)	(0.155)	(0.102)
Protected Spring Water	0.00778	0.553***	0.0219
	(0.314)	(0.192)	(0.121)
Protected Well	0.0797	0.301**	0.0819
	(0.268)	(0.126)	(0.0931)
Public Access Water	-0.0665	0.350*	0.0602
	(0.312)	(0.179)	(0.118)
Surface Water	-0.0115	0.334**	0.00270
	(0.276)	(0.153)	(0.105)
Unprotected Well	0.0983	0.280*	0.0312
	(0.280)	(0.153)	(0.0970)
Kid's Age in Months	-0.0459	-0.0179	-0.0431***
	(0.0302)	(0.0332)	(0.00759)
Kid Age Squared	-0.00326	0.00131	0.00514***
	(0.00204)	(0.00214)	(0.000574)
Kid Age Cubed	0.000137***	-3.53e-05	-0.000134***
	(5.10e-05)	(5.19e-05)	(1.54e-05)
Kid Age Fourth Term	-1.29e-06***	2.86e-07	1.06e-06***
	(4.21e-07)	(4.19e-07)	(1.33e-07)
Mother's Age	-0.00111	0.0140	-0.000174
	(0.0300)	(0.0261)	(0.0110)
Mother's Age Square	8.53e-05	-0.000214	4.69e-05
	(0.000454)	(0.000399)	(0.000174)
Land Ownership	-0.0394	0.0861	-0.00540
	(0.0667)	(0.0567)	(0.0214)
Wealth Index	0.112**	-0.0479	0.0266
	(0.0454)	(0.0483)	(0.0178)
Wealth Index Square	0.0185	0.0269	-0.00498
	(0.0276)	(0.0235)	(0.00903)
Electricity	-0.00484	-0.00272	0.00730
	(0.0724)	(0.0734)	(0.0243)
Constant	-0.481	-1.035**	-0.125
	(0.551)	(0.460)	(0.198)
Observations	4,085	4,085	4,085
R-squared	0.327	0.189	0.473

Note: Table 5 presents the results of a regression analysis incorporating cluster fixed effects to account for potential biases from cluster-level unobservables. By introducing cluster-based fixed effects, the analysis controls for unobserved local factors to ensure that the coefficients are not biased by characteristics common to all households within the same cluster that may be correlated with the mother's education. Geographic variables such as states and urban/rural status are removed from this analysis as the fixed-effects model automatically controls for these variables. The omitted category for the water source variable is collected water. The table includes three columns, each representing a different outcome: Height-for-Age Z-score (HAZ), Weight-for-Height Z-score (WHZ), and measles vaccination status. Significance levels are denoted as follows: ***p < 0.01, **p < 0.05, and *p < 0.1. The number of observations and the R-squared values for each model are provided at the bottom of the table.

Table 6: Cluster Fixed Effect Regression of Wealth Index and Parental Education

VARIABLES	(1) Wealth Index
Mom Education	0.0689***
	(0.00575)
Dad Education	0.0497***
	(0.00546)
Constant	1.161***
	(0.0320)
Observations	4,085
R-squared	0.722

Note: Table 6 presents a cluster fixed-effect regression analysis examining the relationship between maternal education and the wealth index after controlling for the father's education in years. The table includes a single column showing the effect of the mother's and father's education on the household's wealth index. Significance levels are as follows: ***p < 0.01, **p < 0.05, and *p < 0.1. The number of observations and the R-squared value are provided at the bottom of the table.

Table 7: Cluster Fixed Effects Regression for HAZ, WHZ, and Vaccination Status by Parental Education Levels

VARIABLES	(1) HAZ	(2) WHZ	(3) Measles
Mom Primary Edu	-0.0258	0.0617	0.0538*
	(0.0770)	(0.0660)	(0.0282)
Mom Secondary Edu	0.151*	0.102	0.0671**
	(0.0914)	(0.0796)	(0.0330)
Mom Tertiary Edu	-0.0288	-0.00471	0.0618
	(0.131)	(0.132)	(0.0444)
Dad Primary Edu	0.0786	0.122*	0.0308
	(0.0791)	(0.0630)	(0.0281)
Dad Secondary Edu	0.148*	0.123*	0.0500
	(0.0874)	(0.0741)	(0.0305)
Dad Tertiary Edu	0.0271	0.295**	0.0291
	(0.147)	(0.141)	(0.0469)
Dad Edu DK	0.385**	0.220	-0.0256
	(0.189)	(0.156)	(0.0672)
Dad Edu Missing	1.003***	-1.491**	-0.931***
	(0.301)	(0.742)	(0.127)
Collected Water	-0.0541	0.425***	0.0824
	(0.220)	(0.154)	(0.0900)
Delivered Water	1.046*	-0.112	0.363**
	(0.567)	(0.578)	(0.149)
Other Water Sources	0.0880	0.516***	0.0809
	(0.238)	(0.173)	(0.0939)
Protected Spring Water	0.0153	0.542***	0.0260
	(0.264)	(0.198)	(0.107)
Protected Well	0.0841	0.297**	0.0835
	(0.210)	(0.146)	(0.0856)
Public Access Water	-0.0232	0.332*	0.0601
	(0.247)	(0.191)	(0.103)
Surface Water	0.0470	0.298*	-0.00116
	(0.232)	(0.166)	(0.0932)
Unprotected Well	0.109	0.264*	0.0328
	(0.227)	(0.160)	(0.0912)
Kid's Age in Months	-0.0444*	-0.0208	-0.0442***
	(0.0266)	(0.0287)	(0.00762)
Kid Age Squared	-0.00337*	0.00143	0.00519***
	(0.00180)	(0.00185)	(0.000565)
Kid Age Cubed	0.000140***	-3.75e-05	-0.000135***
	(4.49e-05)	(4.52e-05)	(1.49e-05)
Kid Age Fourth Term	-1.32e-06***	3.04e-07	1.07e-06***
	(3.71e-07)	(3.68e-07)	(1.28e-07)
Mother's Age	0.00983	0.0154	0.00161
	(0.0292)	(0.0258)	(0.00993)
Mother's Age Square	-5.51e-05	-0.000232	1.95e-05
	(0.000450)	(0.000397)	(0.000157)

Land Ownership	-0.0482	0.0926*	-0.00834
	(0.0570)	(0.0489)	(0.0205)
Wealth Index	0.121***	-0.0499	0.0298*
	(0.0429)	(0.0412)	(0.0161)
Wealth Index Square	0.0283	0.0335	-0.00230
	(0.0260)	(0.0233)	(0.00863)
Electricity	-0.00106	0.00694	0.00591
	(0.0639)	(0.0631)	(0.0245)
Constant	-0.738	-1.127**	-0.196
	(0.533)	(0.458)	(0.181)
Observations	4,162	4,162	4,162
R-squared	0.328	0.190	0.472

Note: Table 7 presents the results of a cluster fixed effect regression analysis examining the impact of maternal education on child health outcomes using categorical education variables: no education, primary level education, secondary level education, and tertiary level education, with parents without formal education as the omitted category. The table includes three columns, each representing a different outcome: Height-for-Age Z-score (HAZ), Weight-for-Height Z-score (WHZ), and measles vaccination status. Significance levels are denoted as follows: ***p < 0.01, **p < 0.05, and *p < 0.1. The number of observations and the R-squared values for each model are provided at the bottom of the table.

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