# UNDER -FIVE MORTALITY IN MYANMAR: APPLICATION OF ZERO-INFLATED POISSON REGRESSION MODEL

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## Abstract

Despite the reduction in the global under-five child mortality rate, there has been a considerable rate in the death of many children before their fifth birthday in Myanmar. Therefore, the causes of under-five mortality need to be investigated because it is a critical issue for the development of a country like Myanmar. This study attempted to analyze under-five mortality in Myanmar with an application of the zero-inflated Poisson regression model. A sample of 3670 mothers with children aged 0-59 months was collected from the 2015-2016 Myanmar Demographic and Health Survey (MDHS) for the data analysis. The results revealed that mothers' education, household size, childbirth order, and type of fuel for cooking significantly affected the under-five mortality in Myanmar. Among those, childbirth order and mother's education level were the most significant effects on under-five mortality. Therefore, concerned efforts should be made to improve mother's access to education and birth control. Hence, the Myanmar government should plan the respective programs and promote infrastructures, health care services, well-being, and survival of a new generation of Myanmar children.

**Keywords: childbirth order, cooking fuel, household size, maternal education, under-five mortality, zero-inflated Poisson regression.**

## Introduction

Children represent the future of every nation, playing a crucial role in determining the social and economic development of a country as their health and well-being serve as pivotal indicators. The under-five mortality rate, signifying the loss of a child within the initial five years of life, holds profound importance for socioeconomic, health, environmental, and national development, fostering enhanced health equity and access. Under-five mortality serves as a comprehensive indicator of a society's overall health and well-being, encapsulating socio-economic, demographic, healthcare, and environmental factors. Furthermore, aligning with the Sustainable Development Goals (SDGs), a new target has been established to reduce the under-five mortality rate to 25 deaths per 1000 live births in all countries by 2030. To attain these goals, Myanmar must explore the major influencing factors of under-five mortality.

Myanmar is a country located in Southeast Asia, with a population of approximately 51.14 million people (Department of Population, 2020). Like many developing countries, Myanmar has struggled with high rates of under-five mortality. According to the ASEAN statistical yearbooks (2022), the under-five mortality rate in Myanmar was 43.0 in 2013, which

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increased to 66.5 in 2014. Therefore, the various risk factors that influence under-five mortality in Myanmar were explored in this study.

Socioeconomic factors play a significant role in reducing the under-five mortality rate. Poverty, lack of access to healthcare, and inadequate nutrition are major contributors to under-five mortality. The lack of access to healthcare facilities, particularly in rural areas also largely influenced the under-five mortality. Additionally, environmental factors also affect under-five mortality in Myanmar. Poor sanitation, inadequate water supply, and exposure to air pollution can all lead to disease and illness in young children. Many households in Myanmar lack access to clean water, which can lead to waterborne diseases such as diarrhea, which is a leading cause of under-five mortality (WHO, 2019). Therefore, this study intends to analyze the influencing factors of under-five mortality with an application to the zero-inflated Poisson regression model.

## Literature review

Under-five mortality is defined as the occurrence of a child dying between birth and the fifth birthday. This mortality may represent a comprehensive indication of the socioeconomic, demographic, health care, and environmental status of the communities and countries.

Abera and Yohannis (2022) described determinants of under-five mortality in Tach-Armachiho District, North Gondar, Ethiopia. This study identified the determinants of under-five mortality among women in childbearing age group of Tach-Armachiho district using count regression models. So, the zero-inflated Poisson regression model was found to be the best fit for the collected data. Results of the zero-inflated Poisson regression model showed that education of husband, source of water, mother's occupation, Keebler of mother, prenatal care, place of delivery, place of residence, wealth of household, average birth interval, and average breast feeding were found to be statistically significant determinants of under-five mortality. In this study, it was found that the factors like average birth interval and average breast feeding were found to be statistically significant factors in both groups (not always zero category and always zero category) with under-five child death whereas education of husband, source of water, place of delivery, mother occupation and wealth index of the household have significant effect on under-five mortality under not always zero group. Place of residence, kebele of mother and prenatal care have a significant effect on under-five mortality in Tach-Armachiho district on inflated group.

Argawu and Mekebo (2022) attempted to identify the risk factors for under-five mortality in Ethiopia using the 2019 Ethiopian Mini Demographic and Health Survey data. The best model that fits the data well was selected using selection criterion like AIC, BIC. Zero-inflated Poisson

model was found to fit the data well. The study found that mother's age, marital status of mother, age of mother at first birth, place of delivery, place of residence, time to get drinking water, number of children at home, birth order, type of birth were statistically significant determinants for under-five mortality in Ethiopia.

## Data and Methods

The secondary data including socio-economic, demographic, health care, environmental characteristics of mothers and under-five mortality data were collected from the 2015-2016 Myanmar Demographic and Health Survey (MDHS). In this study, a descriptive analysis was carried out to examine the under-five mortality situation based on mothers' socio-economic, demographic, health care, and environmental status. Then, the zero-inflated Poisson regression model was employed to analyze the influencing factors of under-five mortality in Myanmar.

### Variables Used in this Study

In this study, descriptions, and coding of the dependent and independent variables related to under-five mortality are presented. The dependent variable $(Y_i)$ is the number of deaths of children whose age is 0-59 months (under-five mortality) that each mother has experienced under the study period. Thus, $(Y_i)$ takes on values 0, 1, 2, … where 'i' denotes the individual mother. The socioeconomic variables such as the mother's education level, and wealth index, demographic variables such as state and region, place of residence, household size, marital status, mother's age at birth, and childbirth order, health care variables such as place of delivery and contraceptive use and environmental variables such as access to safe water, access to safe toilets, and types of fuel for cooking are presented in Appendix Table (1).

### Zero-Inflated Poisson Regression Model (ZIP)

The zero-inflated Poisson regression model is used for modeling count data that show over-dispersion and zero counts (excess zeros). The ZIP model, introduced by (Lambert,1992), allows for covariates for both the binary and Poisson parts of the model and it has been commonly used to model count data with excess zeros (Hur et al., 2002). The zero-inflated Poisson regression studies the relationship between dependent and independent variables when there are many zeros value in the dependent variable, where the relationship is the mixture between Poisson model and Logistic model. Specifically, if $Y_i$ is the number of under-five mortality per mothers are independent random variables having a zero-inflated Poisson distribution, the zeros are assumed to arise in two ways corresponding to distinct underlying sources.

The first source occurs with probability $w_i$ and produces only zeros (mothers who are never born), while the second source occurs with probability $1 - w_i$ and leads to a standard Poisson count with mean $\lambda$ and hence a chance of further zeros (mothers who may not be dead her child). In general, the zeros from the first source are called structural zeros (with true zeros) that distributed according to Poisson distribution. The Zero-inflated Poisson regression model is

$$P(Y_i = y_i) = \begin{cases} w_i + (1 - w_i)e^{-\lambda_i} & ; \quad y_i = 0 \\ (1 - w_i)\frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!} & ; \quad y_i = 1,2, \ldots \end{cases} \qquad (3.12)$$

where $Y_i \sim ZIP\ (\lambda_i, w_i)\ and\ \ 0 \leq w_i \leq 1$. The first part of the equation above is the zero parts of the model and the second part is the non-zero count's part of the model. The two components together constitute the zero-inflated model. The parameters $\lambda_i$ and $w_i$ can be obtained by using the link functions,

$\ln(\lambda_i) = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \cdots + \beta_p X_{ip} = \mathbf{X_i'\beta}$ and

$\text{logit}(\pi_i) = \gamma_0 + \gamma_1 Z_{i1} + \gamma_2 Z_{i2} + \gamma_3 Z_{i3} + \cdots + \gamma_q Z_{iq}$

$= \ln\left(\frac{w_i}{1-w_i}\right)$

$= \boldsymbol{Z_i'\gamma} \qquad ; \ i = 1,2, \ldots, n$

where, $\mathbf{X_i'}\ and\ \mathbf{Z_i'}$ are covariate matrices and $\boldsymbol{\beta}, \boldsymbol{\gamma}$ are the (p +1) ×1 and (q +1) ×1 unknown parameter vectors respectively.

The likelihood function of ZIP model is

$$L(\boldsymbol{\beta}, \boldsymbol{\gamma}) = \prod_{i=1}^{n} P(Y_i = y_i)$$

$$= \prod_{i=1}^{n}\left[w_i + (1 - w_i)e^{-\lambda_i}\right]\prod_{i=1}^{n}\left[(1 - w_i)\frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!}\right] \qquad (3.13)$$

The log-likelihood function of ZIP model is

$$\ell(\boldsymbol{\beta}, \boldsymbol{\gamma}) = \sum_{y_i=0}^{n} ln\left[w_i + (1 - w_i)e^{-\lambda_i}\right] \sum_{y_i \neq 0}^{n} [\ln(1 - w_i) - \lambda_i + y_i ln\lambda_i - \ln(y_i!)]$$

$$= \sum_{y_i=0}^{n} \ln(exp(\boldsymbol{Z_i'\gamma}) + \exp(-exp(\boldsymbol{X_i'\beta}))) + \sum_{y_i \neq 0}^{n} [y_i \boldsymbol{X_i'\beta} - \exp(\boldsymbol{X_i'\beta})$$

$$- \ln(y!)] - \textstyle\sum_{y_i \neq 0}^{n} \ln(1 + \exp(\boldsymbol{Z_i'\gamma})) \qquad (3.14)$$

The parameters of this model can be estimated using maximum likelihood estimation.

The mean and variance of ZIP are given by

$$E(Y_i) = (1 - w_i)\lambda_i$$

and

$$V(Y_i) = E(Y_i)(1 + w_i\lambda_i).$$

Indicating that the marginal distribution of $y_i$ exhibits over-dispersion, if $w_i > 0$. It is clear that this reduces to the standard Poisson model when $w_i = 0$.

## Data analysis

In order to examine the overall picture of the data, the distribution of the number of under-five mortality per mother and the cross tabulation by explanatory variables are displayed in this section. After that, there is also a test for association between under-five mortality and its related factors. Additionally, the fitted zero-inflated Poisson regression model for estimating under-five mortality has been presented.

**Number of Mothers by Factor of Under-Five Mortality**

Table (4.1) shows the distribution of under-five mortality per mother in Myanmar based on information from 3670 ever married women surveyed in the MDHS. It is observed that among the 3670 ever married women, a total of 187 (5.1%) experienced the under-five mortality (their children died at 0-59 months) whereas 3483 (94.9%) of women have never experienced under-five mortality of their children. It is also found that 102 (2.78%) of women experiencing under-five mortality lost only one child, 56 (1.53%) lost two children, 22 (0.6%) lost three children, 2 (0.05%) lost four children, 3 (0.08%) lost five children, 1 (0.03%) lost six children, no women lost seven children and there was only one woman (0.03%) who lost eight children which is the highest number of all.

**Table (4.1) Distribution of Under-Five Mortality**

| Number of Under-five Deaths Per Mother | Mothers | |
|---|---|---|
| | Number | Percent |
| 0 | 3483 | 94.9046 |
| 1 | 102 | 2.7794 |
| 2 | 56 | 1.5259 |
| 3 | 22 | 0.5995 |
| 4 | 2 | 0.0545 |
| 5 | 3 | 0.0817 |
| 6 | 1 | 0.0272 |
| 7 | 0 | 0.0000 |
| 8 | 1 | 0.0272 |
| Total | 3670 | 100 |

Source: Myanmar Demographic and Health Survey (2015-2016)

Further screening in Figure (4.1) shows that the distribution of the number of under-five mortality has a rapidly decreasing and highly skewed to the right. This is an indication that the data could be fitted better by count data models which take into account excess zeros.

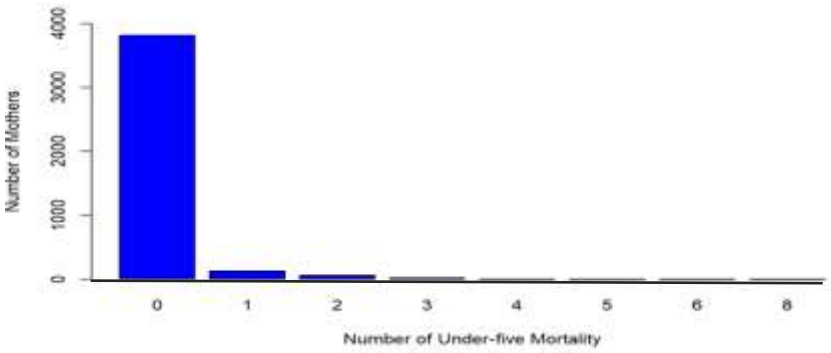


**Figure (4.1)** Bar Chart of the Number of Under-five Mortality

Source: Myanmar Demographic and Health Survey (2015-2016)

Summary statistics of the independent variables that directly influence the risk of under-five mortality were presented in Appendix Table (2). According to the Appendix Table (2) notable discrepancy was observed in under-five mortality between women with and without education. Women with some education showed a lower mean number of under-five mortality compared to those with no education. The mean number of under-five mortality per mother was 0.2133, 0.0779, 0.0439, and 0.0534 for no education, primary, secondary, and higher education levels, respectively. The maximum standard deviation, at 0.7224, was recorded for the no education category.

Among the women included in the study, it is revealed that the mean number of under-five mortality for women's living in households with poor and middle wealth index were (0.1233), and (0.0675), higher as compared with a women's living in rich household wealth index (0.0422). Because a women's living in household with rich and middle wealth index experienced to have less mean number of under-five mortality as compared with women is living in household with poor wealth index.

Tanintharyi Region, Chin State and Shan State had the highest mean number of under-five mortality per mother, and they were (0.2129), (0.1702), and (0.1673) respectively. Generally, the average number (0.0973) of under-five mortality occurred in rural areas with the standard deviation of (0.4674) while the average number (0.0525) of mortality happened in urban areas and the standard deviation is (0.3284). Of the total number of under-five mortality per women, a smaller number of under-five deaths occurred in urban areas compared to rural under-five mortality.

It is also observed that the mean number of under-five mortality was higher number of household size of 2 and 3 (0.1457) and the smallest mean number of under-five mortality occurred for household with more than 5 member (0.0761). Moreover, mother's age at birth was observed that young mothers (below 20 years) had the lowest mean number of under-five mortality (0.0518) and the mother's age at birth (30-45 years) had the highest mean number of under-five mortality (0.1293).

The results in Appendix Table (2) also show that married mothers have a higher mean number of under-five mortality (0.0869) as compared to other mothers such as widowed, divorced and separated (0.0765). Besides, the highest mean number of under-five mortality was observed for children of birth order of four and above (0.2747) while the lowest mean number of under-five mortality was observed of first birth order (0.0377). Among the women included in the study, the mean number of under-five deaths for children who were delivered at home (0.1140) is higher than that for those delivered at public and private hospitals (0.0490 and 0.0264 respectively). In the same way, the mean number of under-five deaths concerning contraceptive use was (0.1196), of which (0.1196) mothers did not use any type of contraceptive method, and the remaining (0.0646) used one of the contraceptive methods.

It is also found that the highest mean number of under-five mortality occurred with families who used unimproved water (0.1299) as compared with families who used improved water (0.0745). Similarly, the mean number of under-five mortality (0.1092) occurred in household unimproved toilet facility and the mean number of under-five mortality (0.1092) happened in improved toilet facility user households. With regards to type of fuels for cooking, the higher mean number of under-five mortality occurred, the mothers who used clean fuels (0.0731) and wood and cool (0.0892) and as compared to mothers who use others fuel such as straw/shrub/ grass, agricultural crops and animal dung (0.0936).

**Association between Under-Five Mortality and Related Factors**

Table (4.2) shows the association of selected variables with under-five mortality using Chi-square test.

**Table (4.2) Association between Under-Five Mortality and Related Factors**

| Variables | Chi-square | P- value |
|---|---|---|
| **Socioeconomic Factors** | | |
| Mother's Education Level | 56.262*** | 0.000 |
| Wealth Index | 25.176*** | 0.000 |
| **Demographic Factors** | | |
| Place of Residence | 11.678*** | 0.009 |

| Variables | Chi-square | P- value |
|---|---|---|
| Household Size | 8.277** | 0.041 |
| Mother's Age at Birth | 18.467*** | 0.000 |
| Childbirth Order | 135.76*** | 0.000 |
| **Health Care Factors** | | |
| Place of Delivery | 13.083*** | 0.004 |
| Contraceptive Use | 23.572*** | 0.000 |
| **Environmental Factors** | | |
| Access to Safe Water | 15.077*** | 0.002 |
| Access to Safe Toilet | 15.173*** | 0.002 |
| Type of Fuel for Cooking | 10.022** | 0.018 |

Source: Myanmar Demographic and Health Survey (2015-2016)

Note: ***, **, * Significant at 1 %, 5% and 10% level respectively

According to Table (4.2), it is found that association between under-five mortality and all socioeconomic factors are significant at 1% level. Likewise, the association between under-five mortality and all demographic factors are significant at 1% level. However, household size is significant at 5% level. Moreover, the association between under-five mortality and all health care factors are significant at 1% level. Furthermore, the association between under-five mortality and all environmental factors are significant at 1% level. However, association between under-five mortality and the type of fuel for cooking is significant at 5% level.

The results of the Chi-square test show that the association between under-five mortality and State and Region and the association between under-five mortality and marital status are not significant. Therefore, these two variables are not considered in modeling the zero-inflated Poisson regression model in this study.

**Parameter Estimation of Zero-Inflated Poisson Regression Model**

The parameter estimates along with their corresponding standard errors, are displayed in Table (4.3).

**Table (4.3) Estimated Coefficient of Zero-Inflated Poisson Regression Model**

| Positive count | Estimate | Exp(b) | S. E | Z value | Pr (> \|z\| ) |
|---|---|---|---|---|---|
| **Intercept** | -0.2484 | 0.7801 | 0.3840 | -0.6470 | 0.5178 |
| **Household Size (2-5, Ref:)**<br>More than 5 | -0.4169** | 0.6591 | 0.1956 | -2.1320 | 0.0330 |
| **Childbirth Order (1st Birth, Ref:)**<br>Second and Third<br>Fourth and above | 0.5985*<br>1.5037*** | 1.8193<br>4.4983 | 0.3616<br>0.3325 | 1.6550<br>1.5220 | 0.0979<br>0.0000 |

| **Positive count** | **Estimate** | **Exp(b)** | **S. E** | **Z value** | **Pr (> \|z\| )** |
|---|---|---|---|---|---|
| **Types of Fuel for Cooking (Clean Fuels, Ref:)** Solid Fuels | -0.6494*** | 0.5224 | 0.1975 | -3.2890 | 0.0010 |
| **Zero count** | **Estimate** | **Exp (b)** | **S. E** | **Z value** | **Pr (> \|z\| )** |
| **Intercept** | 1.3393*** | 3.8163 | 0.3802 | 3.5220 | 0.0000 |
| **Mother's Education Level (No Education, Ref:)** Primary<br>Secondary and above | 0.7162***<br>1.0500*** | 2.0466<br>2.8577 | 0.2005<br>0.2446 | 3.5720<br>4.2930 | 0.0004<br>0.0000 |
| **Household Size (2-5, Ref:)** More than 5 | 0.6400*** | 1.8966 | 0.2279 | 2.8090 | 0.0050 |
| **Childbirth Order (1st Birth, Ref:** Second and Third<br>Fourth and above | 0.1843<br>-0.6393* | 1.2024<br>0.5277 | 0.3746<br>0.3756 | 0.4920<br>-1.7020 | 0.6227<br>0.0887 |

Source: Myanmar Demographic and Health Survey (2015-2016)

Note: ***, **, * Significant at 1 %, 5% and 10% level respectively. Ref: Reference category of the variables

The fitted zero-inflated Poisson regression model as follows

$\ln(\lambda)$ = - 0.7801 – 0.6591 (household size = more than 5) + 1.8193 (childbirth order = second and third) + 4.4983 (child birth order = fourth and above) – 0.5224 (types of fuel for cooking = solid fuels)

logit(w) = 3.8163 + 2.0466 (mother's education level = primary) + 2.8577 (mother's education level = secondary and above) + 1.8966 (household size = more than 5) + 1.2024 (child birth order = second and third) + 0.5277 (child birth order = fourth and above)

The results in Table (4.3) shows that estimated zero-inflated Poisson regression model fits the results of incidence counts, and the coefficients can be interpreted as follow: for a one-unit change in the predictor variable, the log of the response variable is expected to change by the value of the regression. In zero-inflated Poisson regression model, for every one unit increase in a unit of the significant predictors, the log number of under-five mortality is expected to increase or decrease by approximately the corresponding coefficient in the column of coefficient.

In this study, household size and type of fuels for cooking are found to be negatively associated with under-five mortality in the positive counts. However, childbirth order is positively associated with under-five mortality. It is observed that household size is a significant influence on the number of under-five mortality. The expected under-five mortality for mothers with more than five people in the household is 0.66 times lower compared to those with a household size of two to five people. It is found that childbirth order is a significant variable on the number of under-five mortality. As birth order rises, the number of under-five deaths also

increases. The expected number of under-five mortality in second and third childbirth order is 1.82 times greater as compared to that for first birth childbirth order while holding all other variables in the model constant. Moreover, the expected number of under-five mortality in fourth and above childbirth order is 4.50 times greater as compared to that for first birth childbirth order.

The finding shows that the estimated coefficient of type of fuels for cooking is statistically significant for the number of under-five mortality. The expected number of under-five mortality for mothers who used type of fuels for cooking with solid fuels is 0.52 time less than mothers who were used clean fuels controlling for other variables in the model.

The second part of Table (4.3) provides estimated odd ratio for the factor change in the odds of being in zero count group (binomial with logit link) model (no under-five death). Mother's education level and household size are significantly associated with the probability of being in zero count group.

It can be seen that mother's education level has a significant impact on the probability of being in the zero count groups. The odds of no occurrence of under-five mortality for mothers with primary education is 2.05 times greater as compared to no education level controlling other variables. In addition, the odds of no occurrence of under-five mortality for mothers with secondary and above is 2.86 times greater than as compared to no education level.

It is also observed that household size has a significant effect on the probability of being an excess zero. In addition, the odds of no occurrence of under-five mortality are 1.90 times lower for more than five household members as compared to two to five household members. It can be seen that childbirth order has a significant impact on the probability of being in the zero count. The odds of no occurrence of under-five mortality are 1.20 times greater for mothers with two to three birth orders compared to the first child. Likewise, the odds of no occurrence of under-five mortality are 0.53 times greater for mothers with two to three birth orders compared to the first child.

## Conclusion

This study intended to examine the socio-economic, demographic, health care, and environmental factors which have an influence on the under-five mortality in Myanmar based on the 2015-2016 MDHS data by applying the zero-inflated Poisson regression model.

## Findings and Discussions

This study showed that (94.90%) of the ever-married women had never experienced under-five mortality and (5.10%) of them had experienced under-five mortality due to different factors. Hence, it was obvious that there was an excess zero and high variability in the non-zero values in this study. It was found that there was association between under-five mortality and all socioeconomic, demographic, health care, and environmental factors.

The findings of the study identified several significant factors influencing under-five mortality. These factors include mother's education level, household size, childbirth order, and types of fuels used for cooking, all of which had statistically significant effects on under-five mortality. It was also observed that there was a negative relationship between under-five mortality and size of household. It means that households with a large family member can reduce the number of deaths for under-five children compared with those with a small family member. This could be because a family with more members are able to look after and take care of their child. Perhaps mothers with more children are better experienced in childbearing and possess more knowledge of childbearing practices.

In addition, it was found that the childbirth order was one of another important determinant factors of under-five mortality in this study. The children with later birth order have more chance to die compared to those with earlier birth order. A possible reason might be that the later birth orders decrease the care given to the child by mother, that is, the reason of having more children. Furthermore, the intra-familiar competition for foods and other limited resources essential for child's needs will increase. Some of these results are similar to those results by Abera and Yohannis (2022) and Argawu and Mekebo (2022).

### Recommendations

Based on the findings of this study, some recommendations were made. The study underscores the imperative for targeted education programs on contraceptive use, the enhancement of maternal education levels, and the urgent need for comprehensive healthcare infrastructure improvements to effectively combat under-five mortality rates in Myanmar.

### Needs for Further Research

Further research is essential to address the gaps in understanding under-five mortality in Myanmar, including exploring additional variables such as birth complications, diseases, cooking fuel types and locations, mother-related factors, and the impact of the post-COVID landscape, ultimately guiding the development of more effective public health policies to improve child health outcomes.

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## APPENDIX

**Table (1) Description and Coding of Socio-Economic, Demographic, Health Care and Environmental Factors**

| No. | Description of Variables | Coding |
|---|---|---|
| 1 | Mother's Education Level | 1 = No education<br>2 = Primary<br>3 = Secondary<br>4 = Higher |
| 2 | Wealth Index | 1 = Poor<br>2 = Middle<br>3 = Rich |
| 3 | State and Region | 1 = Kachin 9 = Mandalay<br>2 = Kayah 10 = Mon<br>3 = Kayin 11 = Rakhine<br>4 = Chin 12 = Yangon<br>5 = Sagaing 13 = Shan<br>6 =Taninthayi 14 = Ayeyarwaddy<br>7 = Bago 15 = Nay Pyi Taw<br>8 = Magway |
| 4 | Place of Residence | 1 = Urban<br>2 = Rural |
| 5 | Marital Status | 1 = Married<br>2 = Others (Widowed, Divorced, Separated/No Longer Living Together) |
| 6 | Mother's Age at Birth | 1 = Below 20<br>2 = 20-29<br>3 = 30-45 |
| 7 | Childbirth Order | 1 = First birth<br>2 = Second and third<br>3 = Fourth and above |
| 8 | Place of Delivery | 1 = Private institution<br>2 = Public institution |
| 9 | Contraceptive Use | 1 = No<br>2 = Yes |
| 10 | Access to Improved Source of Water | 1 = Improved<br>2 = Unimproved |
| 11 | Access to Improved Sanitation Facilities | 1 = Improved<br>2 = Unimproved |
| 12 | Types of Cooking Fuels | 1 = Clean Fuels<br>2 = Wood and Coal<br>3 = Others |

Source: Myanmar Demographic and Health Survey (2015-2016)

**Table (2) Summary Statistics of Some Important Variables Related to Under-five Mortality**

| Variables with Category | | Number of Child Death | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **8** | **Total Death** | **Mean** | **Std.De** |
| Mother's Education Level | No Education | 513 | 19 | 26 | 10 | 0 | 3 | 1 | 0 | 59 | 0.2133 | 0.7224 |
| | Primary | 1560 | 52 | 23 | 6 | 1 | 0 | 0 | 1 | 83 | 0.0779 | 0.4040 |
| | Secondary | 1103 | 28 | 6 | 2 | 1 | 0 | 0 | 0 | 37 | 0.0439 | 0.2713 |
| | Higher | 307 | 3 | 1 | 4 | 0 | 0 | 0 | 0 | 8 | 0.0534 | 0.3661 |
| Household Wealth Index | Poor | 1676 | 62 | 41 | 15 | 1 | 3 | 1 | 1 | 124 | 0.1233 | 0.5400 |
| | Middle | 606 | 22 | 6 | 3 | 0 | 0 | 0 | 0 | 31 | 0.0675 | 0.3320 |
| | Rich | 1201 | 18 | 9 | 4 | 1 | 0 | 0 | 0 | 32 | 0.0422 | 0.2903 |
| State and Region | Kayah | 26 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.0370 | 0.1925 |
| | Kachin | 137 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 6 | 0.0699 | 0.4051 |
| | Kayin | 111 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 6 | 0.0855 | 0.4270 |
| | Chin | 41 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 6 | 0.1702 | 0.4809 |
| | Sagaing | 394 | 9 | 4 | 4 | 0 | 0 | 0 | 0 | 17 | 0.0706 | 0.3792 |
| | Taninthayi | 100 | 3 | 3 | 0 | 0 | 0 | 1 | 1 | 8 | 0.2129 | 1.0142 |
| | Bago | 307 | 8 | 6 | 0 | 0 | 0 | 0 | 0 | 14 | 0.0623 | 0.3100 |
| | Magway | 248 | 6 | 4 | 1 | 0 | 0 | 0 | 0 | 11 | 0.0656 | 0.3403 |
| | Manda;ay | 368 | 11 | 5 | 5 | 0 | 0 | 0 | 0 | 21 | 0.0925 | 0.4327 |
| | Mon | 121 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 0.0400 | 0.2342 |
| | Rakhine | 244 | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 10 | 0.0630 | 0.3499 |
| | Yangon | 388 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 12 | 0.0450 | 0.2705 |
| | Shan | 477 | 15 | 18 | 7 | 0 | 3 | 0 | 0 | 43 | 0.1673 | 0.6368 |
| | Ayeyarwaddy | 445 | 19 | 4 | 1 | 1 | 0 | 0 | 0 | 25 | 0.0723 | 0.3503 |
| | Nay Pyi Taw | 76 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.0379 | 0.1924 |
| Place of Residence | Rural | 2616 | 84 | 51 | 17 | 1 | 3 | 1 | 1 | 158 | 0.0973 | 0.4674 |
| | Urban | 867 | 18 | 5 | 5 | 1 | 0 | 0 | 0 | 29 | 0.0525 | 0.3284 |
| Household Size | 2-3 | 405 | 22 | 14 | 5 | 0 | 0 | 0 | 0 | 41 | 0.1457 | 0.2374 |
| | 4-5 | 1459 | 38 | 27 | 10 | 1 | 0 | 0 | 0 | 76 | 0.0821 | 0.3822 |
| | More than 5 | 1585 | 42 | 15 | 7 | 1 | 3 | 1 | 1 | 70 | 0.0761 | 0.4576 |
| Marital Status | Married | 3325 | 91 | 55 | 22 | 2 | 3 | 1 | 1 | 175 | 0.0869 | 0.4439 |
| | Others (W, D, S) | 158 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 12 | 0.0765 | 0.2879 |
| Mothers' age at Birth | Below 20 | 370 | 12 | 4 | 0 | 0 | 0 | 0 | 0 | 16 | 0.0518 | 0.2646 |
| | 20-29 | 1908 | 47 | 28 | 9 | 0 | 0 | 0 | 0 | 84 | 0.0653 | 0.4409 |
| | 30-45 | 1205 | 43 | 24 | 13 | 2 | 3 | 1 | 1 | 87 | 0.1293 | 0.5847 |
| Childbirth Order | First | 1439 | 38 | 6 | 2 | 0 | 0 | 0 | 0 | 46 | 0.0377 | 0.2291 |
| | 2-3 | 1530 | 42 | 23 | 4 | 0 | 0 | 0 | 0 | 69 | 0.0625 | 0.3201 |
| | 4 and above | 514 | 22 | 27 | 16 | 2 | 3 | 1 | 1 | 72 | 0.2747 | 0.8641 |
| Place of Delivery | Home | 2057 | 77 | 43 | 17 | 2 | 3 | 1 | 1 | 144 | 0.1140 | 0.5136 |
| | Public | 1165 | 23 | 12 | 4 | 0 | 0 | 0 | 0 | 39 | 0.0490 | 0.2942 |
| | Private | 261 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 4 | 0.0264 | 0.2369 |
| Contraceptive Use | No | 1358 | 52 | 28 | 11 | 1 | 3 | 1 | 1 | 97 | 0.1196 | 0.5458 |
| | Yes | 2125 | 50 | 28 | 11 | 1 | 0 | 0 | 0 | 90 | 0.0646 | 0.3478 |
| Access to Safe Water | Improved | 2751 | 75 | 43 | 14 | 1 | 0 | 0 | 1 | 134 | 0.0745 | 0.3893 |
| | Unimproved | 731 | 27 | 13 | 8 | 1 | 3 | 1 | 0 | 53 | 0.1299 | 0.5811 |
| Access to Safe Toilet | Improved | 1826 | 55 | 21 | 8 | 1 | 0 | 0 | 0 | 85 | 0.0654 | 0.3385 |
| | Unimproved | 1657 | 47 | 35 | 14 | 1 | 3 | 1 | 1 | 102 | 0.1092 | 0.5242 |
| Types of Fuels for Cooking | Clean Fuels | 658 | 13 | 3 | 9 | 1 | 0 | 0 | 0 | 26 | 0.0731 | 0.2027 |
| | Wood and Coals | 2663 | 86 | 48 | 12 | 1 | 3 | 1 | 1 | 152 | 0.0892 | 0.8389 |
| | Others | 162 | 3 | 5 | 1 | 0 | 0 | 0 | 0 | 9 | 0.0936 | 0.1967 |
| **Total** | | **3483** | **102** | **56** | **22** | **2** | **3** | **1** | **1** | **187** | **3670** | |