Women's education and the impacts of Under-5 Child mortality in Vietnam:
Evidence from the UNICEF's Multiple Indicators Cluster Survey 2014

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Abstract

This paper used data from Multiple Indicator Cluster Survey (MICS) 2014 from the Unicef to study the role of education in determining women's risk of under-5 child mortality. The sample included 7101 women aged 15-49 who had ever given birth before the time of the survey. Using logistic regression to deal with a binary dependent variable - the probability of experiencing child mortality - this research found that there is a statistically significant impact of a woman's years of completed general education, the ethnicity of her household's head, whether she lives in rural areas. Education matters; however, its impacts fade away right after primary school. Findings also show the importance of contraception usage, HIV knowledge, as well as wealth in lowering the exposure to under-5 offspring death. Even though Vietnam is a country with low child mortality, the odds varied greatly across sub-groups of women based on regions compared to Red River Delta.

Introduction

According to the United Nations (UN), reducing child mortality is one of the eight goals in the Millennium Development Goals (MDGs) that 191 members of the UN agreed to work towards, from the year 1990 to 2015. As a member of the UN since 1977, Vietnam is also committed to the MDGs and has implemented different policies to improve the health care system, especially child and neonatal health care. Vietnam's under-5 child mortality rate, on estimation, is around 10.5 child per 1000 live births, which is slightly higher than 6.6 per 1000 live births in developed countries but is only one-fifth of the average rate in developing countries (Lee et al., 2016). Previous empirical research about Vietnam shows evidence of inequalities across groups of women in terms of offspring mortality, due to different education level attainment, regions, ethnicities, and other socio-economical status. In this honor thesis, my major question is how the difference in women's education determined their risk of under-five child mortality in Vietnam using the data set called Vietnam MICS5 from Unicef. This dataset is the latest MICS of Vietnam in 2013-2014. From the previous literature, my thesis statement is parents' education level, especially mothers', as well as their literacy status, determined the chance of having a child born alive and later died before the age of five.

Literature Review

Child mortality in developing countries

Child mortality has always been one of the top concerns for policy makers of developing countries as well as international human rights organizations. Researchers and scholars worldwide have also been investigating this topic for decades. Current research on child mortality focused on two aspects. One group of scholarship answered questions about the causes of the deaths of the children who were born alive (Black et al, 2010, Bassani et al, 2010). The other group of scholarship explored what factors determined child mortality using regression methods.

Black et al (2010) applied the methods from Inter-agency Group for Child Mortality Estimation (IGME), a group of representatives from major organizations such as WHO, UNICEF, UN Population, World Bank, and academic institutions to estimate the under-5 child mortality rates to the

population of these age groups. This paper included data from 167 countries from 1990 to 2008. There were almost 9 millions deaths of children younger than five.Infectious diseases are the major causes for 68% of the cases, with the largest proportion caused by pneumonia, diarrhoea and malaria. Almost half of the death happened during neonates. In addition, India, Nigeria, Democratic Republic of the Congo, Pakistan, and China accounted for 49% of the total child deaths. One limitation to this research is that there is inadequacy and discontinuity in data collection in countries with high child mortality, such as sub Saharan countries which affect the validity of the estimation of overall death rates in this region. Bassani et al (2010) conducted some analysis on child mortality in India using data collected in 2001-2003 from all households and individuals in 6671 clusters out of 1 million areas in India. Surveyors interviewed each family and wrote down in the native language the causes of neonatal deaths and deaths in children from 1 month and 4 years old. In this research, there are roughly 23 thousands deaths in both neonates and children. Similar to the findings in Black et al (2010), pneumonia and diarrhea are the major direct causes of under 59 month children's deaths. Girls in central areas also have much higher death rates due to these two infectious diseases than boys in the south and the west regions. This conclusion implied that in some society, baby girls are more vulnerable than baby boys. Both Black et al(2010) and Bassani et al (2010) emphasized the improvement in health care services with these curable diseases as a method to deal with child mortality, but the indirect causes of child mortality is more complicated that requires more systematic changes outside of healthcare for mothers and children.

Research that determined factors affecting child mortality showed mixed results across regions and time periods. In the 1990s, the United Nation's Millenium Development Goals called for the improvement of mother and children's healthcare. Countries all around the world have since then spent more effort in improving child mortality. Most developing countries have seen drastic decreases in child mortality. However, countries in regions like sub Sahara showed only minor changes, and even slightly increase in child mortality (Rutstein, 2005). Using the cross-country data from the Demographics and Health Surveys (DHS) of 56 countries, Rutstein (2005) found that West Africa, Asia, North Africa and Latin America all showed decreases in the number of deaths in millions of live births, but East and

Southern Africa had increasing death rates. Using ordinary least squares regression of changes in child mortality rates on 27 independent variables, Rutstein (2005) found that higher birth order significantly decreased the mortality rates of the child in any age group. Vaccination and an improved healthcare system also lowered the mortality rates that a country may experience. Having flush toilet paper in the household only decreased under-5 child mortality and having pipewaters only reduced toddler mortality. The higher the proportion of mothers with primary education or more is, the lower the mortality rates of post-neonates, infants, children aged 2-4 and under the age of 5 children are. This research also pointed out that the proportion of females with at least primary education in these 17 countries varied greatly from only 4% to 99.6% with the mean of 44%.

Many scholars have confirmed the importance of mother's education as one of the main determinants for child mortality (Basu & Stephenson, 2004, Chowdhury et al., 2010, Mondal et al., 2009). Basu and Stephenson (2004) used data from the 1992/93 Indian National Family Health Survey and found the correlation between mother's education and some popular causes of child mortality, such as infectious diseases like fever, diarrhea, the lack of proper medical care and vaccination, the use of traditional or modern contraception. Running bivariate regressions of 22 variables on mother's education, Basu and Stephenson (2004) argued that mother's education had a negative linear relationship with the death probability of the early post-neonatal, and latepost-neonatal and toddler groups in India. However, this research also pointed out that a little education, such as mothers with incomplete primary education, does not help lowering the neonatal child mortality, compared to illiterate mothers. Basu and Stephenson (2004) also suggested that with some education, mothers are able to recognize the symptoms of diarrhea or measles and report it, thus there is a higher odds of their children having these diseases than illiterate mothers. One limitation of this research is that authors chose only bivariate regressions, which failed to take into accounts some variables besides education that could lead to child mortality and some causes of child mortality.

Chowdhury et al.(2010) and Mondal et al. (2009) both conducted research about child mortality in Bangladesh with two different data sets. The former one used data collected from Natore sadar upazila

in Natore district, and the latter one was from Rajshahi district. Using a logistic regression model, Mondal et al. (2009) concluded that some variables such as both parents' education attainment, sanitary facility, access to media like TV, birth order, mother's ages. However, contrary to the findings of Black et al. (2010), higher birth order is associated with higher odds of mortality according to Mondal et al. (2009). Chowdhury et al (2010) used Chi-square tests and logistic models to confirm the findings of Mondal et al (2009) that parents' education and literacy, hygienic toilets, electricity are important factors in reducing child mortality.

Factors such as sanitary, mother's ages, preceding birth intervals were all significant determinants of infant mortality and under-5 child mortality, but whether the impact from parents' education, especially mothers' education, is significant remains debatable (Kembo & Van Ginneken, 2009, Akmatov et al., 2008). According to research by Kembo and Van Ginneken (2009) about Zimbabwe using the Proportional Hazard Model, mother's education did not have significant causal impacts on the change of child mortality, despite the correlation. Researchers suggested some possible explanations why the variable of mother's education did not weigh as expected. Kembo & Van Ginneken (2009) explained that in Zimbabwe, the proportion of women with no education was dramatically high and that made the impact of education on women limited to only a small portion of the population. Meanwhile, in Central Asian countries, there are nearly no women with no or only primary education in the sample and the difference in terms of the knowledge that women learned at schools, whether it is secondary or higher education may not be enough to influence childhood mortality (Akmatov et al., 2008).

In summary, research that focused on determining what factors affected child mortality have tried to include many variables, such as Birth record, Mother's education, Parent's education, Other socio-economic factors: Parents' work, Income (household, comparing mother and her husband), Wealth, Child and mother health, After birth treatment, Residence area: Regions, Rural vs Urban, Sanitary: Source of water and flush toilet. These are important indicators but their impacts of child mortality is across countries in different timeframes. Most research also investigated the developing countries with high death rates, with the dependent variable being the live/dead status of a particular birth. This paper

contributes an in-depth case study about a country with relatively low child mortality rate-Vietnam, including their regional differences, to the current literature.

2. Child mortality in Vietnam

Lozano et al. (2010) conducted an analysis on maternal and child mortality to see the progress of countries all around the world in meeting the Millenium Development Goals by 2015. They concluded that most countries have made great progress, however, it may take years after 2015 for many developing countries to meet the goals. From Lozano et al. (2010)'s data, Vietnam has been doing really well in reducing child mortality compared to countries in its geographic area, South East Asia, as well as most of the developing countries. Vietnam's data showed 10.5 deaths of under 5 children in every 1000 live births on average, with an annualized rate of decline being much higher than the world target of 4.4%. Vietnam's accomplishment in this area is worth investigating as it offers a possible solution to other developing countries in dealing with child mortality and mother-child health care issues.

Most research about Vietnam's child mortality used data collected during the 1990s or early 2000s. A lot of previous research mainly used data about child mortality from two main surveys; one is Vietnam Demographic and Health Survey (VNDHS) and the other is Unicef's Multiple Indicator Cluster Survey (MICS). To study the changes after Doimoi Reform in 1986, Lee et al. (2016) used data from Vietnam MICS in 2000, 2006 and 2011. The results included evidence of the decrease in child mortality across all ethnic groups, and boys having higher probability of mortality than girls. This research showed that there still remains a great gap between women living in urban and rural, in terms of rural women having much lower odds of experiencing child mortality. One possible explanation from the authors was that urban poverty emerged along with the high rate of urbanization, hence poor people in big cities have limited access to health care. This requires further investigation for future research. Hoa et al. (1997) surveyed households in Hoa Binh province in the Red Delta River and found that Acute respiratory infection (ARI) was most common among under 5 children, and the majority used antibiotics without medical consultation. There is no connection between ARI and child death. Pham et al. (2013) studied the data from VNDHS 1997 and 2002. In this research, they found evidence of death clusters in many

households with boys having higher death probability than girls, similar to the conclusion of Lee et al. (2016).

There is a widespread belief in education, especially mother's education, as a way to improve child mortality. Findings from Pham et al.(2013) and Lee et al. (2016) confirmed this belief. These studies concluded that the higher mothers or parents' education level is, the lower the risk of child deaths is. However, Hoa et al.(1997) said that there was no connection between a mother's education level and the risks of infant death. In addition, Pham et al. (2013) suggested that "a low education level of the mother increases mortality risk, but the effect is significant for boys only"; "a low education level of the father increases mortality risk as well, but the effect is significant for girls only" (p.317). These arguments pave a way for future research to further investigate how education from both parents, especially mothers, could affect the probability of a child being born alive but died within their first five years, with a focus on how homogenous the researched population is.

This research aims to determine the factors that affected Vietnamese women's child mortality rate with the main focus on women's education. Previous research in both Vietnam and other developing worlds seems to show a lack of consistency in whether women's education could help reduce child mortality. This paper aims to contribute to current literature of Vietnam's child mortality in some aspects. Firstly, I used two different ways to measure education, one is the continuous variable of total completed schooling and the dummy variable for the school level attended by an individual. Secondly, three variables that I added to my logistic regression that were not in previous papers are the use of contraception and how much a woman knows about HIV, and the women's ages at their first birth. Lastly, instead of looking only at a specific birth a woman has, I measure impacts of education on the odds of experiencing child mortality in her birth history, since Vietnam has a really low child mortality rate.

Methods

Dataset

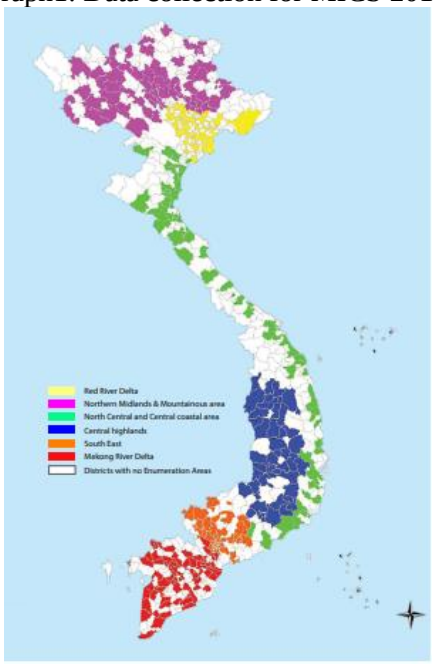
This study uses data collected by the Unicef in the Multiple Indicator Cluster Survey (MICS) 2013-2014 to study under-five child mortality. MICS is an international survey that was first conducted in

1995 for 60 countries and then the Unicef expanded its reach to hundreds of countries all around the world. MICS 2013-2014 was the fifth round of this survey in Vietnam since the first one in 2000. There are some reasons that I decided to use this data set. Firstly, this is the latest dataset to be published publicly on the Unicef's online database, even though there is another MICS6 that was conducted in 2016 but not yet ready for public use. Another dataset that was used a lot by other researchers, besides MICS, is Demographics and Health Survey (DHS), because of its large coverage of total population. I decided not to use DHS because the latest one was collected in 2005, meaning 15 years ago, and its public dataset did not show the birth history of women, which is at the center of this research.

Overall, MICS5 is by far the most suitable dataset for its large and diverse coverage of 1700 households, meaning 10,200 individuals, that were carefully selected from clusters and strata to make sure that the sample best represented the whole country's population geographically. In addition, the process of data collection was done carefully under the supervision from the Unicef with detailed questionnaires about the women's background, birth history, socio-economic backgrounds, their access to news, as well as their understanding of contraception and HIV.

Study Population

Graph1: Data collection for MICS 2014



(source: Viet Nam Multiple Indicator Cluster Survey 2014 Final Report)

According to the Unicef, Vietnam's MICS 2014 used for the selection of sample clusters based on a 15 percent sample of enumeration areas. The data collectors allocated equal numbers of households, approximately 1700 to each of 6 regions as can be seen in the graph 1. Depending on the population of each region, with regards to the rural and urban areas, which could vary greatly, they used different sampling fractions. Since the sample is clearly not self-weighting, later in my regression analysis, I also included the women's individual weights, which were also calculated by the Unicef in the original dataset. It is important to acknowledge the differences of these six regions in graph 1 because they could vary in many aspects, such as weather, geographic characteristics, their levels of economic development, gender distribution, composition of ethnicities.

In this paper, the main variable of interest is the odds of a woman experiencing child mortality in her life. With access to the women's birth history, out of 10190 women in the age of 15 to 49 years old, I created a subset of 7101 whoever gave birth as my sample for further analysis. However, there is some limitation with the data collection that makes my sample less representative. Out of 10190 women who were selected as the country representatives in this survey, 9827 completed their surveys, while 282 women were not at home during the time of the survey, 12 women refused, and 69 women were severely disabled who cannot answer. Therefore, this is a potential of selection bias, especially when women with severe disability are not included.

Empirical Methodology

In this research, I focus on determining what factors affect the chance of women aged 15-19 years old experiencing under-five child mortality at least once in their life. There are different ways of viewing and measuring child mortality, previous research has used neonatal mortality (within 27 days after a live birth), post neonatal mortality (27 to 84 days after a live birth), infant mortality (under 1 year after birth) and under-5 child mortality (under 5 years after birth). However, in Vietnam's case, the child mortality is relatively low, compared to both developed and developing countries. According to Lozano et al (2011), Vietnam's neonatal, post neonatal and infant mortality is relatively low, only under 3.5% of 1000 live births but for under five child mortality, the figure is cumulatively 10.5%. The longer period after birth is

suitable for this research, since this increases the number of women who ever experienced child mortality within 7101 women in my sample, which enables more variance among independent variables.

My dependent variable in this research is the dummy for experiencing child mortality. I created a unique ID for each woman from a combination of their cluster number, their strata number and their line number as can be found in their household's survey. This helps me match data from women's individual surveys with data from their birth history data set. After that, I looked up the birth history of women from the age 15-19 who ever gave births and filtered out women who delivered at least one live birth that later died within 5 years after birth. I created a dummy variable for child mortality, women who ever experienced it will be assigned value 1, otherwise, 0. To see what factors affect probability of experiencing under-5 child death, I run logistic regression of this variable on variables that indicates mother's basic characteristics, namely education, marital status, region of living, rural vs urban, age at the interview time; household's characteristics, such as the gender, the ethnicity, and the religion of the head of household; sanitary conditions, such as piped water and flushed toilet; mother's access to news and sex education, such as contraception and HIV; mother's birth history, including their ages at first birth and the total live births they have delivered.

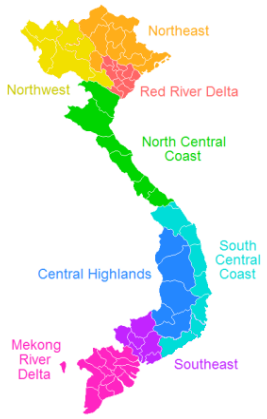
$$\text{logit}(p) = log\left(\frac{p\,(u5death = 1)}{1 - p\,(u5death = 1)}\right)$$

$$= \beta_0 + \beta_1 mother's\ basic\ characteristics + \beta_2 household's\ characteristics + \beta_3 sanitary\ conditions + \beta_4 access\ to\ news\ \&\ sex\ ed + \beta_5 birth\ history$$

There are many ways to deal with a dependent variable being a dummy variable but I choose logistic regression because it is a good tool to transform a dummy variable from having only the value of 0 and 1 into having more variance. When running regression, I also include the weight for each individual, as calculated from the survey by the Unicef, which will make each woman in this data set become more representative to the women in the whole population.

Descriptive statistics

Graph 2: Vietnam's regions



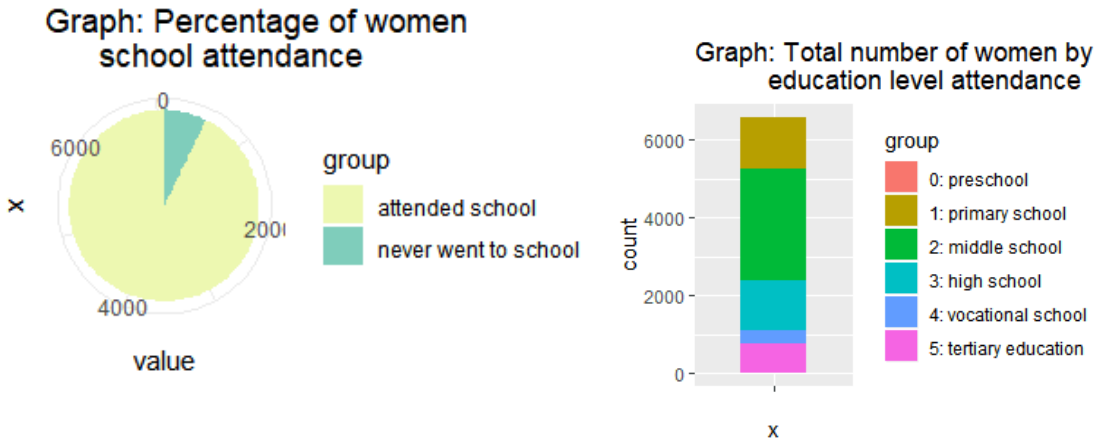
Source: Wikipedia

Table1 : Distribution of Women by region	
Region	**Number of women**
Red River Delta	1085
Northern Midlands and Mountain area	1272
North Central and Central Coastal area	1093
Central Highlands	1275
South East	1213
Mekong River Delta	1163

Vietnam's geographic shape is an important thing to be in consideration because of its long S shape that expands in the North-South direction, but does not expand in the East-West direction. Indeed, the Northern Central coast of Vietnam is quite narrow but long with regards to its longitudinal spread. The region classification of Vietnam usually follows graph 2, with 8 regions, namely the Northeast, the Northwest, Red river delta, North central coast, South central coast, Central Highlands, Southeast, and Mekong river delta. However, when conducting MICS surveys in Vietnam, the Unicef uses a slightly different way of classifying regions. Comparing graph 1 with graph 2, it is clear that the Unicef only classified Vietnam into 6 regions, by keeping 4 regions the same, but clustering the Northeast and Northwest into Northern Midlands and Mountain area, and North central coast and South central coast into North Central and Central Coastal area. This way of reclassifying regions does not affect much with the sampling process and the validity of this dataset because these combined regions themselves are close to each other, and usually do not differ from each other significantly in most aspects, such as weather, human development, ethnicity, or political regime. According to Jones and Gu (2012), a report on Vietnam Briefing, there are three main economic zones in Vietnam, including the Northern key economic region, located in most of the Red River Delta and a small part of the Northern Midlands and Mountain area, Central key economic zone, located in the middle of North Central and Central Coastal area, and

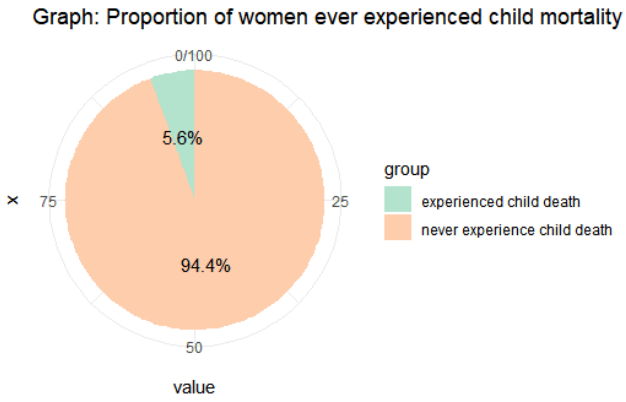
Southern key economic zone, located entirely in the Southeast region and a small part of Mekong River Delta. The centralization of these three economic zones in some particular area of the country is important for the development of Vietnam but also implies the inequality in many aspects with other regions. According to Liu (2001), expenditure levels varied significantly among regions in Vietnam, especially The Northern Midlands and Mountain area and the Central Highlands are the poorest regions and the Southwest, followed by Mekong River Delta and the Central Coast are the wealthiest.

Table 1 shows the distribution of women within the 15-49 age groups who ever gave birth in their lives that were surveyed. The number of women is quite even across regions, of around 1000 to 1200 people. The fact that there seems to be a small evidence of women oversampling in the Northern Midlands and Mountain area, the Central Highlands and the South east remains in acceptable levels because the two former ones are the poorest and the later one is the richest in the country that balance out with this way of sampling.

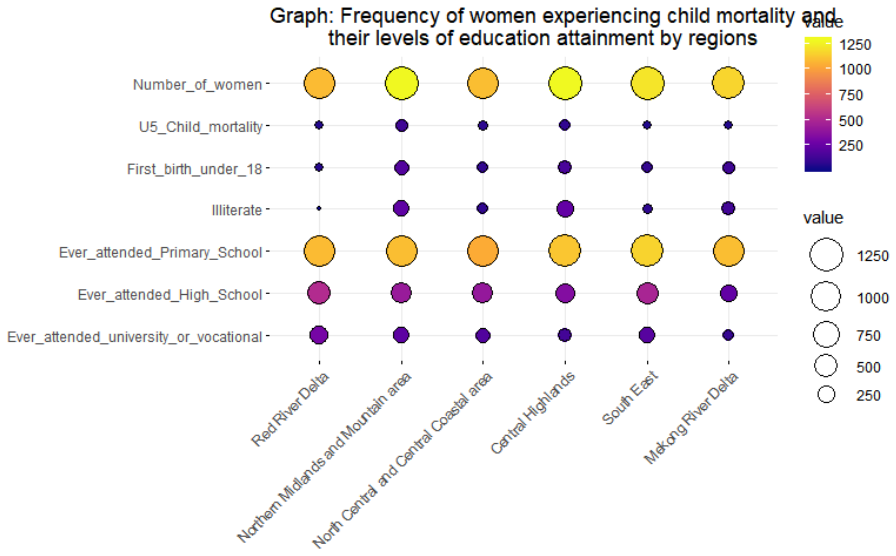


My main variables of interest in this research include child mortality and women's education levels. Overall, most of Vietnamese women in this research who ever gave birth attended schools at least for some periods in their lives. Given the fact that only 7% of the 7101 women never went to school, it is surprising that 11% of the women are illiterate, who could barely read or could not read at all when being asked to read a sentence by the survey conductors. The clustered bar graph shows the number of women by the level of education attendance, from the question asking about the highest level of education a

woman ever attended, among women who ever went to school. One noticeable thing is that many women who ever went to school seemed to attend middle schools to some grade levels and then dropped out. This is interesting because Vietnam's compulsory level of education is primary, meaning that many women only completed the compulsory level of education, entered the next level, which is middle schools and then they could not continue. Future research should look more into the reason for the tendency of Vietnamese women dropping out in middle school. Proportionally, more women went to college/university than professional/vocational schools after their high schools.



Overall, out of 7101 women in the 15-49 age group who ever gave birth, only 5.6% ever experienced child mortality in their lives, which is relatively low compared to many developing countries. This graph represents the data on the dummy dependent variable, that classifies women based on their birth history, meaning 1 stands for ever experiencing at least one child death under the age of five, or 0 otherwise.



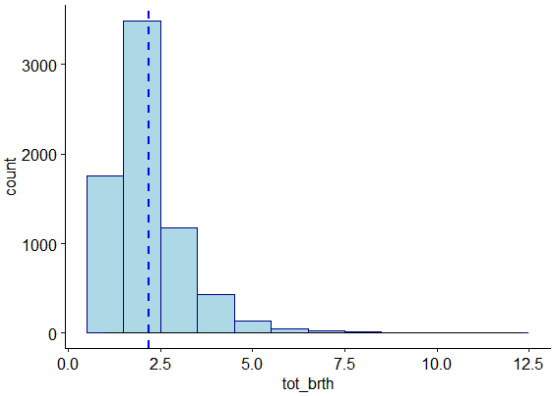
This balloon plot shows the frequency of women ever experienced child mortality, their ages at first birth and levels of education by regions. The first column shows the total number of women by six regions for the sake of reference. From this plot, in terms of women experiencing child mortality, the data for each region seem relatively low, from 44 to 120, meaning less than 10% for each region. However, the two poorest regions, Northern Midlands and Mountain Areas, and Central Highlands, still do fairly worse than the rest of the country, for having more women ever experiencing child mortality, more women having their first birth under 18, and especially more illiterate women.

Red River Delta seems to perform the best compared to other regions with only 53 women delivering the first birth under 18 and 11 being illiterate. This is possibly due to the fact that this region is located in one big economic zone and Hanoi, the capital of Vietnam is also there. Since Vietnam has a centralized education system under the supervision of the Ministry of Education and Training (MOET), there seems to be a correlation between the level of basic education among the population and the proximity to the centrally-governed cities. There are five of them in Vietnam, with 2 located in the Red River Delta, namely Hanoi and Hai Phong.

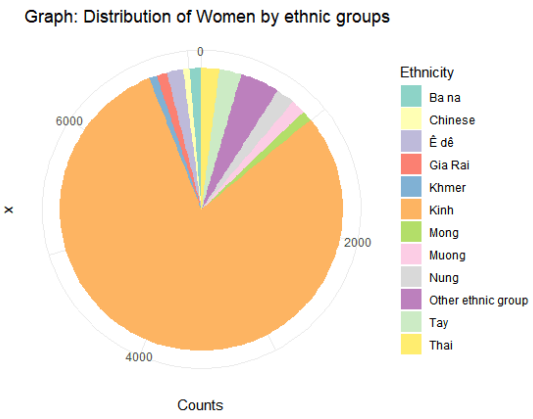
The common trend for all 6 regions is that while the majority of women have attended primary schools in their lives, fewer women attended high schools and also even fewer went through post-secondary education and training. Red River Delta has 27% of the women in this sample ever attended

post-secondary education, while Mekong River Delta has only 8%. This area also has the lowest number of women ever attended high schools. This trend really needs to be examined clearly from the education policy makers to provide regions and improve the attainment level by regions.

Graph: Total birth for each women

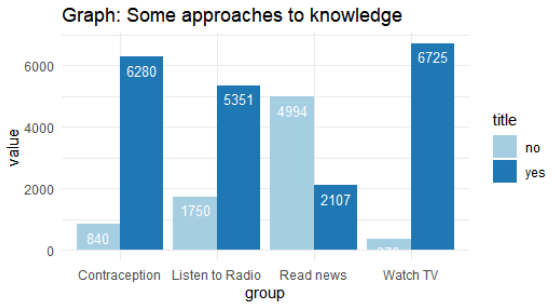


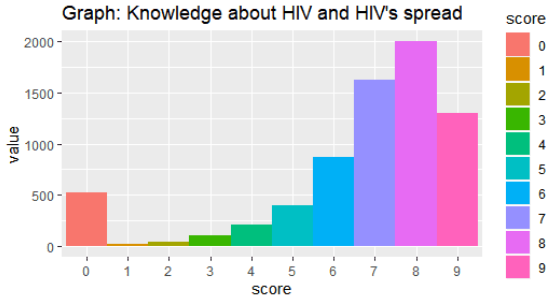
This graph presents the distribution of women by the total number of births they ever gave in their life. Since this dataset only has women who ever gave birth, the minimum birth is 1 and the maximum birth is 12. On average, each woman has given birth to 2.18 children, while 49.06% of this sample gives birth to 2 children. This indicates the direct impact of the two child policy in Vietnam that was recommended in 1981 and made law in 1988 (Ngo, 2020).



This pie chart represents the data on the ethnicity of the head of the household for each woman, not necessarily her own ethnicity. In this sample, the majority are Kinh people, at approximately 79.9%. Tay is the second largest group in this dataset at 2.5% followed by Nung people at 2.12% and Thai People at 2.03%. This dataset's ethnic composition closely resembles that of the Vietnam 2009 Census dataset, in

the way Kinh People being the majority. I could not find the data of the proportion of women within this age group but have ever given birth in the total population so it is hard to compare. I thus focus more on comparing the major group, Kinh people, with the rest being non-Kinh people.



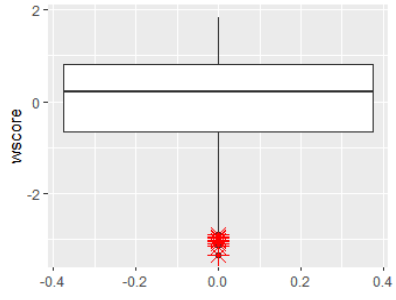


To measure what factors affect a mother's odds of child mortality, I also used proxy variables that potentially indicate the general knowledge of women, and what they know about HIV and contraception. In general, 88.17% of the sample have used or used contraception in their life. One fourth of the women who have never used contraception live in Central highlands.

In the MICS5's questionnaires, there is a question on how often they read newspaper/watch TV/listen to radio. These are three main ways one could use to access news in Vietnam. The answer could be Almost every day, At least once a week, Less than once a week, Not at all. I created a dummy binary variable for these questions. If the women's answers are either almost every day or at least once a week, they will be given value 1, meaning having good access and prefer newspaper/ TV/ radio, or else, 0. In this dataset, most women have access and prefer watching TV. More women who listen to radio than who do not listen much. Interestingly, significantly fewer women who read newspapers than women who did not do that as much.

To measure the women's understanding of HIV, I create a continuous variable to measure how much a woman knows about HIV from their answer to a list of yes/know questions in the MICS5 's questionnaire. Women who did not know about HIV or answered all questions wrong are given the score of 0. Women who answered one question correctly are given the score of 1, likewise. The higher the score of the women, the more she knows about HIV. The graph shows that most women had higher scores, like

7,8, or 9, than women who scored low. However, there are still 524 women who did not know about HIV or had zero correct answers. Almost 60% of women who did not know anything about HIV are illiterate.



This graph shows the distribution of wealth score among women in my dataset. The wealth score is a continuous variable that was calculated by the Unicef when they processed the data. The higher the score, the wealthier the woman and her household. There are more poor people than rich people in this dataset. There are some outliers in this dataset; however, I cannot apply log because this variable has negative values.

Regression Analysis

After descriptively analyzing the data by each variable, I ran a logistic regression of the probability of experiencing child mortality on women's education, together with some controlled variables.

Table A: Results for under five child mortality

	Dependent variable:					
	Probability of Experiencing Under-5 Child mortality (y=1,n=0)					
	model 1 (1)	model 2 (2)	model 3 (3)	model 4 (4)	model 5 (5)	model 6 (6)
Women's general characteristics						
Highest general education grades completed	-0.135*** (0.013)	-0.130*** (0.014)	-0.111*** (0.016)	-0.110*** (0.016)	-0.086*** (0.018)	-0.039** (0.020)
Regions (Ref. group: Red River Delta)						
Northern Midlands and Mountain area		0.396** (0.168)	0.096 (0.199)	0.107 (0.199)	0.143 (0.199)	0.092 (0.202)
North Central and Central Coastal area		0.030 (0.166)	-0.041 (0.170)	-0.036 (0.170)	-0.121 (0.172)	-0.142 (0.175)
Central Highlands		-0.120 (0.236)	-0.305 (0.254)	-0.282 (0.254)	-0.267 (0.256)	-0.230 (0.260)
South East		-0.542*** (0.209)	-0.521** (0.213)	-0.509** (0.213)	-0.467** (0.215)	-0.401* (0.219)
Mekong River Delta		-0.753*** (0.195)	-0.718*** (0.202)	-0.695*** (0.203)	-0.709*** (0.203)	-0.718*** (0.208)
Rural (y=1,n=0)		0.414*** (0.141)	0.356** (0.149)	0.403** (0.161)	0.381** (0.162)	0.294* (0.165)
Marriage (Ref. group: Being married)						
Living with a man		0.697*** (0.230)	0.615*** (0.232)	0.613*** (0.233)	0.613*** (0.234)	0.487** (0.238)
Used to married		0.144 (0.215)	0.171 (0.215)	0.166 (0.216)	0.108 (0.224)	-0.262 (0.231)
Used to live with a man		-1.881 (1.391)	-1.978 (1.392)	-1.981 (1.392)	-2.131 (1.396)	-2.048 (1.408)
Never married/lived with a man		-0.436 (0.829)	-0.356 (0.830)	-0.342 (0.831)	-0.536 (0.844)	-0.444 (0.868)
Household's characteristics						
Kinh (y=1,n=0)			-0.368** (0.175)	-0.352** (0.176)	-0.332* (0.178)	-0.365** (0.184)
Religious (y=1,n=0)			-0.102 (0.146)	-0.118 (0.147)	-0.145 (0.148)	-0.149 (0.151)
Wealth score			-0.072 (0.081)	-0.129 (0.097)	-0.055 (0.103)	-0.249** (0.108)
Sanitary conditions						
Piped water (y=1,n=0)				0.130 (0.151)	0.112 (0.151)	0.142 (0.153)
Flushed toilet (y=1,n=0)				0.129 (0.160)	0.139 (0.161)	0.146 (0.164)
Access to news and health related knowledge						
Read newspaper (y=1,n=0)					-0.381** (0.173)	-0.063 (0.176)
Watch TV (y=1,n=0)					0.217 (0.214)	0.107 (0.221)
Listen to Radio (y=1,n=0)					0.238* (0.125)	0.208 (0.127)
Used/Have used Contraception (y=1,n=0)					-0.200 (0.162)	-0.409** (0.168)
HIV knowledge					-0.085*** (0.022)	-0.070*** (0.023)
Women's age related factors						
Age at first birth						-0.126*** (0.018)
Age at interview time						0.087*** (0.008)
Constant	-1.910*** (0.092)	-2.165*** (0.219)	-1.875*** (0.254)	-2.053*** (0.296)	-1.666*** (0.387)	-2.323*** (0.594)
Observations	7,101	7,101	7,101	7,101	7,100	7,099

Log Likelihood	-1,426.068	-1,390.047	-1,385.484	-1,384.650	-1,372.670	-1,291.402
Akaike Inf. Crit.	2,856.136	2,804.094	2,800.967	2,803.299	2,789.341	2,630.804
Adj Pseudo R^2	0.065	0.082	0.083	0.0825	0.087	0.139

Note: *p<0.1; **p<0.05; ***p<0.01

Table A shows the results of logistic regression models of the probability of experiencing child mortality on highest general education grades a women completed in her life before the interview. However, different from the Ordinary Least Squares, the coefficient of Logistic regression is harder to interpret straightforward. In linear regression, the estimated coefficients of independent variables have marginal effects and also there is a variance in the dependent variable itself. For logistic regression, as can be seen for the model on page ??? we focus on measuring the likelihood of an event to happen. In order to do this, I use R to produce the average marginal effects of each independent and control variables on dependent variable.

Table B: Average marginal effect from model 6
Dependent variable: Probability of Experiencing Under-5 Child mortality

	AME	SE	Z
Highest general education grades completed	-0.0019	0.0009	-2.0077
Southeast	-0.0195	0.0105	-1.8616
Mekong River Delta	-0.0311	0.0093	-3.3606
Rural	0.0142	0.0079	1.8074
Living with a man	0.0285	0.0162	1.7570
Kinh	-0.0176	0.0089	-1.9882
Wealth score	-0.0120	0.0052	-2.3087
Used/Have used contraception	-0.0198	0.0082	-2.4236
HIV knowledge	-0.0034	0.0011	-3.0987
Age at first birth	-0.0061	0.0009	-6.6818
Age at the interview	0.0042	0.0004	10.5338

Note: This table only includes AME of variables that were significant in model 6

Table B includes the AME of variables of model 6 but only the ones that are statistically significant. From table B, the highest general education grade a woman completed before she took this interview is a statistically significant variable with an AME of -0.0019, meaning that a year increases in general education for a woman leads to a 0.19% decrease in the probability of experiencing child mortality, given other factors constant.

With regards to other individual's characteristics, women in two regions, Southwest and Mekong River Delta both have lower child mortality odds than the reference group in Red River Delta. On average, women whose live in Southwest and Mekong River Delta is exposed to 1.95% and 3.11% lower odds of child mortality than women in Red River Delta. This is possible due to the fact that these regions

are economically richer than Red River Delta. Surprisingly, women in Northern Midlands and Mountain area, considerably the poorest region in the country, has higher probability of under-5 child death than in Red River Delta but this coefficient is not statistically significant. Indeed, it was only significant in model 2 when there are not many control variables were added to the model. Women living in rural area had 1.4% higher probability of experiencing child mortality than women living in urban area. Out of 4 marital statuses that were compared with currently married women, only currently living with a man, not in an official marriage is statistically significant. From table A, this variable remains highly significant throughout 6 models, despite the small decrease in the last model. Women who was living with a man not in a marriage at the time of their interview had a higher probability of experiencing child mortality, 2.8%, than women who was in a marriage with a man, when holding other factor constant.

Among households' indicators, women whose live in the households whose heads are Kinh people had 1.76% lower probability of having their child died before the age of 5. On the other hand, richer women had a lower odds of experiencing child mortality than poor women. From wealth score, the variable created by the Unicef's data processors as a proxy for a household wealth, an one-point increase in wealth score leads to a 1.2% decrease in the odds of experiencing under-5 child mortality.

The continuous variable that measures the knowledge of a women about HIV is highly significant and negatively correlated with the odds of experiencing child mortality. An additional correct answer could lead to a 0.34% decrease in women's likelihood of exposure to child mortality.

Age factors are very important when determining under-5 child mortality odds. The coefficient of the age of the women at their first births is negative, meaning that the younger the women, the higher the odds of child mortality, and vice versa. The logistic regression in model 6 shows that an one-year delay delivering the first child could lower the odds of experiencing child mortality for a woman by 0.61%. The result also confirmed this paper's hypothesis that the older the woman at the time of their interviews, meaning their wider windows of fertility, leads to the higher chance that they experienced child mortality.

Rural and urban comparison

The dummy variable for living in rural area was statistically significant through six models in Table A. This indicates that the area where a woman lives could strongly affect whether the woman would experience under-5 child mortality in her life. I decided to break down the dataset into two groups, a group of women living in rural area and a group of woman living in urban area, to see how education levels affect woman in different regions differently. My hypothesis is education would matter in terms of reducing child mortality for woman living in rural, but the impact is unclear for woman in urban area.

Table C : Results for under five child mortality

	Dependent variable:	
	Probability of Experiencing Under-5 Child mortality	
	Rural	Urban
	(1.1)	(1.2)
Women's general characteristics		
Highest general education grades completed	-0.046** (0.022)	-0.020 (0.045)
Regions (Ref. group: Red River Delta)		
Northern Midlands and Mountain area	-0.103 (0.227)	0.934* (0.490)
North Central and Central Coastal area	-0.360* (0.195)	0.856** (0.433)
Central Highlands	-0.307 (0.289)	0.077 (0.643)
South East	-0.320 (0.252)	-0.287 (0.495)
Mekong River Delta	-0.940*** (0.231)	0.079 (0.520)
Marriage (Ref. group: Being married)		
Living with a man	0.384 (0.265)	0.661 (0.559)
Used to married	-0.313 (0.265)	-0.152 (0.482)
Used to live with a man	-1.409 (1.415)	-
Never married/lived with a man	-0.247 (0.889)	-
Household's characteristics		
Kinh (y=1,n=0)	-0.316 (0.206)	-0.636 (0.412)
Religious (y=1,n=0)	-0.240 (0.174)	0.087 (0.314)
Wealth score	-0.349*** (0.119)	0.182 (0.281)
Sanitary conditions		
Piped water (y=1,n=0)	0.120 (0.163)	0.011 (0.510)
Flushed toilet (y=1,n=0)	0.365* (0.197)	-0.263 (0.284)
Access to news and health related knowledge		
Read newspaper (y=1,n=0)	-0.001 (0.211)	-0.218 (0.326)
Watch TV (y=1,n=0)	0.197 (0.238)	-0.345 (0.608)
Listen to Radio (y=1,n=0)	0.301** (0.143)	-0.127 (0.298)
Used/Have used Contraception (y=1,n=0)	-0.406** (0.188)	-0.474 (0.391)
HIV knowledge	-0.066*** (0.025)	-0.085 (0.057)
Women's age related factors		
Age at first birth	-0.122*** (0.021)	-0.148*** (0.041)
Age at interview time	0.093*** (0.009)	0.063*** (0.018)
Constant	-2.398*** (0.638)	-0.567 (1.427)
Observations	4,231	2,868
Log Likelihood	-1,000.691	-279.482
Akaike Inf. Crit.	2,047.382	604.964
Adj Pseudo R^2	0.072	
Note:		*p**p***p<0.01

Table C demonstrates the results when I applied model 6 for rural on rural and urban subgroups. Most variables remain the same, however, for the urban female group, 41 out of 2909 observations was excluded. This happened due to the fact that among these 31 women who used to live with a man, not in a

marriage and 10 women who never married/lived with a man, no one ever experienced child mortality. I used STATA to run this regression and found out that STATA excluded those observations due to perfect failure issue. This indicates a limitation in this dataset about random sampling, however, since this variable is not my main variable of interest, which is mother's education, excluding 1.9% of the sample seems most likely not affect the biasedness of other coefficient estimates.

Table D: Average marginal effect from model 1.1 and 1.2
Dependent variable: Probability of Experiencing Under-5 Child mortality

	Rural (model 1.1)		Urban (model 1.2)	
	AME	se	AME	se
Highest general education grades completed	-0.0028	0.0013		
Northern Midlands and Mountain area			0.0346	0.0199
North Central and Central Coastal area	-0.0241	0.0134	0.0306	0.0148
Mekong River Delta	-0.0514	0.0132		
Wealth score	-0.0210	0.0072		
Flushed Toilet	0.0072	0.0098		
Listen to Radio	0.0181	0.0086		
Used/Have used contraception	-0.0244	0.0113		
HIV knowledge	-0.0040	0.0015		
Age at first birth	-0.0073	0.0013	-0.0047	0.0014
Age at the interview	0.0056	0.0005	0.0020	0.0006

Note: This table only includes AME of variables that were significant in Table C

Table D shows the average marginal effects of some variables from model 1.1 and 1.2. There are more factors that were significant for the group of rural woman than the urban woman. Notably, the highest level of education a woman completed is only significant in model 1.1, which confirms my hypothesis that education matters more to women in the rural areas than women in urban areas. On average, an one-year increase of schooling that a woman completed lowered her chance of experiencing child mortality by 0.28%. Women who lived in the rural area of the North Central and Central Coastal area, and the Mekong River Delta have 2% and 5% lower odds of having at least one died child under the age of five than women in the Red River Delta. Wealth scores also mattered in rural area, meaning that an one-point increase in wealth scores leads to a 2% decrease in the odds of child mortality for a woman. Mothers who used or have used contraception in their life had 2.44% lower odds. For every additional correct answer about HIV a woman gave, their odds of experiencing child mortality lowered by 0.4%. If a rural female delayed her first birth by one year, she would have her odds of experiencing child mortality

decrease by 0.7%. On the other hand, the older the woman in rural area at the time this survey was conducted, the higher chance that she ever experienced child mortality in her life.

In the logistic regression for rural women, flushed toilet and listen to radio are statistically significant but behave contradictorily to my hypotheses. Women whose household had flushed toiled had 0.07% higher probability of experiencing child mortality than the rest. Women who listened to the radio more had 1.8% higher probability of experiencing child mortality than women who rarely or did not listen at all.

Among women in urban areas who ever gave birth the impacts of ages remained significant statistically but with lower estimates. A trend that stood out is that women in the Northern Midlands and Mountain area, and the North Central and Central Coastal area had higher odds than woman living in the urban area of Red River Delta. The estimate for the Northern Midlands and Mountain area variable for rural woman was insignificantly negative, and for the whole sample was also insignificant but positive. This implies that the gap between Northern Midlands and Mountain area, and Red River Delta exists but is much clearer in the urban area than rural area. Red River Delta, even though is not the richest region in Vietnam, but compared to the Northern Midlands and Mountain area, was far more economically better. Women in the Northern Midlands and Mountain area, on average, have 3.46% higher probability of having child mortality that the women in reference group, considering that they both live in urban regions while other factors were held constant.

Kinh people and non-Kinh people comparison

Model 6 table A shows that household's ethnicity is an important indicator for under five child mortality. I also divided my dataset into subgroups of Kinh and non Kinh people. The regression results showed that the higher the grade level a woman completed, a lower odds of experiencing child mortality she would have. However, this set of regression is susceptible to some kinds of biasedness among the coefficients' estimates. In addition to the fact that Kinh women clearly outnumbered their non-Kinh counterparts in this dataset and also in reality, some regions also show a really small numbers of non-

Kinh people. Since some control variables, such as regions and marital status are both categorical or factor variables, having very imbalance set of Kinh and non Kinh people resulted in multi-collinearity and perfect failure issues in the logistic regression model for non Kinh women. Even though, there is an evidence that education only impacts the odds of experiencing child mortality of women in rural area, I would not report the result in details in this paper. Future research about the ethnic differences in Vietnam should pay close attention to the ratio of Kinh and non Kinh people in the sample to avoid this biasedness.

Comparing women with different education attendance

Since this paper focuses on determining the impacts of general education on child mortality, I ran logistic regression of the probability of experiencing under-5 child mortality with five other independent variable as a proxy for education, instead of the continuous variable of years of education like in model 6. Other control variables remain the same.

Table E: Regressions on binary education variables
Dependent variable: Probability of Experiencing Under-5 Child mortality

	β_1 (se)	z value	AME (se)
Never went to school (y=1,n=0)	0.396	10.6603	0.0191
	(0.1888)		(0.0091)
Attended primary school (y=1,n=0)	-0.367	-1.951	-0.0177
	(0.1883)		(0.0091)
Attended middle school (y=1, n=0)	0.052	0.358	0.0025
	(0.144)		(0.0070)
Attended high school (y=1, n=0)	-0.1553	-0.888	-0.0075
	(0.1748)		(0.0085)
Attended post-secondary schools (y=1, n=0)	0.0755	0.299	0.0037
	(0.2527)		(0.0122)

Note: This table reports the regression results with different depedent variable but the same control variables as Model 6

The independent variable here is a binary variable for different education levels. If the woman ever attended primary schools (including the women who attended, then dropped out right in primary schools, as well as whoever completed higher grade levels than primary), she will be assigned value 1 for Attended primary school, otherwise 0.

Table E shows the results of the five regression models using five different binary independent variables. Holding other factors constant, a woman who never went to school had 1.91% higher probability of experiencing child mortality that woman who ever attended schools, regardless of grade

levels. At 10% level of significance, women who ever attended primary schools have 1.77% lower odds of under-five offspring death than women who never attended primary schools in their life. Other independent variables of interest, such as attended middle school (y=1, n=0), attended high school (y=1, n=0), and attended post-secondary schools (y=1, n=0) did not show any significant results with $z < 2$ when controlling for other variables.

Discussion and Limitations

This papers aims to investigate the impacts of women's education on their probability of experiencing child mortality among women aged 15-19 who have ever given birth in their life before the interview date in 2014. Using logistic regression to deal with binary variable for experiencing offspring mortality, when controlling for some socio economic factors of each woman and her household, her sexual transmitted knowledge and access to news, and birth related factors, this paper finds that an additional increase in completed years at schools led to a decrease in the mother's odds. When trying logistic regression on dummies for the attended school level, a proxy for education, I found that there is only a statistically significant difference between women who never went to school and women who ever attended any grade level, and between women who ever attended primary school in their life and women who did not. This implies that a small level of education matters a lot in terms of helping a woman avoid under five child mortality. In addition, this also means that under 5 child mortality in Vietnam is also under the influence of many other factors, such as the age at first birth of a woman, the region she lives in Vietnam, the rural or urban areas, and the wealth of the households. This paper also contributes to current research two new important variables that significantly determine the odds of offspring death among women, namely the use of contraception and the knowledge about HIV virus. The impacts of general education on child mortality were not statistically significant probably due to the lack of training for women on sexually transmitted diseases, HIV and contraception. More knowledge on HIV and higher uses of contraception should be encouraged to every woman, especially woman in rural areas.

Findings of this research also include the inequality between rural-urban areas, ethnic groups and across six regions of Vietnam. Future research should focus on what factors contribute to the better

performance of Southern regions over Northern regions in the probability of women experiencing child mortality. From this paper, it is still not clear whether it is the economic advantage or any regional differences that contribute to the Red River Delta women having higher odds than the Mekong River Delta and the Southeast regions. Rural and urban Vietnam seems to be starkly different from each other, with education being an important determinants of child mortality in rural but not in urban areas.

This research still has some unsolved issues that contributes to its limitation. Firstly, the exclusion of an important possible determinant, total live birth a woman had had. It is difficult to see whether the total births lead to the higher odds of child death or the other ways, so in order to avoid endogeneity, I decided to exclude it from my regression. Secondly, questions about birth history and also child death is extremely sensitive, meaning the woman may have some reasonable incentive to not report most truthfully. Lastly, there are variables I could not directly control in this paper, besides total birth, including women's health condition, disabilities and employment.

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