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Factors Associated with Under-five Mortality in Cambodia: Data Analysis of the Cambodia Demographic and Health Survey

Samnang Um[1], Heng Sopheab[1]

[1] School of Public Health, National Institute of Public Health

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ABSTRACT

Introduction

The under-five mortality rate (U5M) is reflected in socioeconomic development and health. Globally, 5.3 million children died in 2018, in which more than half of deaths were due to diseases that are preventable and treatable through simple, affordable interventions. In Cambodia, U5M is a major public health problem with a rate of 28 deaths per 1,000 live births (2018). This study aimed to examine the socio-demographic and behavioral factors associated with U5M.

Methods

This study analyzed data from the 2014 Cambodia Demographic Health Survey (CDHS). A total of 611 clusters (urban vs. rural) from 15,825 households with 17,578 women aged 15-49 years old were selected for the interview. We used weighted analysis and restricted 5,880 eligible children to the latest births aged 0-59 months. Multivariable logistic regression was performed using STATA V14.2 to assess the significant factors associated with U5Ms.

Results

Factors associated with increased odds of U5M included children born from older mothers aged 35-49 years with adjusted odds ratios (AOR=9.63, 95% CI: 1.48-32.61), low birth weight children (AOR=4.43, 95% CI: 2.32-7.35), and mothers living in rural residences (AOR=2.76, 95% CI: 1.25-6.10). However, children born from mothers' reports of contraceptive use were a protective factor of U5M, with AOR= 0.30 (95% CI: 0.18-0.52).

Conclusions

Older mothers, children with low birth weight and children born to mothers living in rural areas had a higher risk of U5M. Mothers reported using contraceptives had a reduced risk of child mortality. Therefore, Cambodia should consider these socio-demographic and behavioral factors when designing maternal and child health program interventions aimed at further reducing the U5M in Cambodia.

* Corresponding author: Um S. umsamnang56@gmail.com

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Introduction

The under-five mortality rate (U5M) is defined as the probability of a child dying before reaching the exact age of five years per 1,000 live births. It has been used to reflect the socioeconomic development, health status, and environmental condition of children [1]. Globally, 5.3 million children died in 2018, of whom Sub-Saharan Africa and Central and Southeast Asia accounted for more than 80% [2]. More than half of U5M have been mainly caused by diseases that are preventable and treatable through simple, affordable interventions in developing countries and especially among the most vulnerable populations, including poor households living in remote areas [1].

In Cambodia, U5M was 28 deaths per 1,000 live births in 2018, which was still higher than that in Vietnam, with 12 deaths per 1,000 live births, and in Thailand, with 20 deaths per 1,000 live births [3]. Furthermore, the prevalence of U5M varied geographically; commonly, it was still higher in rural areas than in urban areas, with 52 deaths vs. 18 deaths per 1,000 live births, respectively [4]. Previous literature indicated that factors that significantly predicted U5M included mothers' educational level and mother's marital status [5-7], while birth order and birth interval were significantly associated with increased U5 M [8-10]. Furthermore, maternal age, mother's working status, child's sex and age were significantly associated with an increased risk of U5M [5, 7, 11-13]. Low birth weight (LBW), household size, household access to electricity, sanitation and parity were the key factors associated with increased U5 M [9, 12]. Other studies found that breastfeeding and contraceptive use significantly decreased the risk of U5Ms [6-9]. However, antenatal care (ANC) and tetanus toxoid immunization were protective against U5Ms [14, 15]. Despite this, in Cambodia, there have been few papers assessing socio-demographic and behavioral factors associated with U5Ms. Therefore, this study aimed to explore these associated factors.

Methods

1. Data Source

This study combined three datasets consisting of child data, women data and household data of the CDHS 2014 into a single dataset. Then, we limited our analysis to children born in the last five years prior to the interview of the mother whose first birth was aged 15-49 years since it could be directly linked to the mother's information. This process resulted in a final sample size of 5,880 children. The CDHS was a nationally representative household survey using two-stage stratified cluster sampling to collect the samples from all 19 sampling domains. They were further divided into 38 sampling strata between urban and rural areas. In the first stage, 611 enumeration areas (EAs), the number of households residing in the EAs or clusters (188 urban EAs and 423 rural EAs) were selected from 4,245 urban EAs and 24,210 rural EAs, respectively, using probability proportional to EA size. In the second stage, a fixed number of households were selected from each cluster (24 urban and 28 rural) through systematic sampling [4].

2. Measurements

Dependent Variable: This study used children born in the last 5 years prior to the interview, or children data file, with the variable child was alive (B5) that CDHS collected [10] to calculating all boys and girls born 5 years preceding the survey as under-five deaths and survival in which deaths were coded as 1 and survivals were coded as 0, respectively.

Independent Variable: Women's age group (15-24 years old, 25-34 years old and 35-49 years old), mother's marital status, child sex, birth order (1-2 children, > 3 children), mother's education level, mother's employment, household wealth quantile (poor, middle, and rich), residence areas (urban vs rural), source of drinking water, sanitation facility, tetanus toxoid immunization, mothers who used contraceptives, delivery facility and ANC visits (at least 4 visits or less than 4 visits).

3. Statistical Analysis

Analyses were performed in STATA V14.2 (Stata Corp 2015, College Station, TX) taking into account population sampling weights and urban rural stratification to adjust for the complex sampling design. Socioeconomic, household and demographic characteristic variables were described as counted frequencies and percentages. We used binary logistic regression analysis to assess the magnitude of association between independent variables and U5M. A significant level of any covariates at a p value <0.10 was included in the multivariable logistic regression model [16]. However, background variables such as mother's age group and residence were included automatically regardless of their significance level. Multivariable logistic regression using a backward elimination approach was used to predict the independent factors associated with U5Ms after adjusting for potential confounding factors in the model. Adjusted odds ratios (ORs) with 95%

confidence intervals and p-values < 0.05 were considered statistically significant. .

Results

Household and Children's Characteristics

Overall, 85.3% of the children were born in rural areas. Slightly more than 43.0% of households were poor based on wealth index quintiles. Close to 51.0% of households had improved drinking water, and half of them had improved or not shared sanitation facilities. Children's average weight at birth was 3,658 grams (SD=1928 grams), in which 12.0% of children were classified as low birth weight (**Table 1**).

Table 1: Household and Children's Characteristics, CDHS 2014

Variables	(N = 5,958) *	
	Freq.	%
Place of residence		
Urban	874	14.7
Rural	5084	85.3
Wealth Index		
Poor	2565	43.0
Middle	1132	19.0
Rich	2262	38.0
Source of drinking water in wet season		
Improved**	3026	50.8
Unimproved	2932	49.2
Sanitation facilities		
Improved, not shared*	3001	50.4
Non-improved or shared	2957	49.6
Child birth weight (grams)		
≥2500	5217	87.6
<2500	742	12.4
Sex of the child		
Boy	2993	50.2
Girl	2966	49.8
Birth order		
1–2	3945	66.2
≥3	2013	33.8
Child with single birth	5895	98.9

**Weighted count frequency; **Improved drinking water was included piped into dwelling, piped into yard/plot, public tap/standpipe, tube/piped wells or boreholes, protected wells, protected spring; ***Improved sanitation was included flush toilet connected to sewage or septic tank and improved*

Mothers' Characteristics

The mean age of the mother at giving birth was 29 years old (SD=6.2 years). More than half completed the primary education, with 13.4% of the mothers having no schooling. A total of 34.7% of the mothers were in agricultural jobs and self-employed, and nearly one-fourth of the mothers had no job/not working. Ninety-five percent of the mothers were currently married, and 63.5% of them received at least two doses of tetanus toxoid vaccinations. Furthermore, 60.7% reported currently using contraceptive methods. Most mothers had at least 4 ANC visits during pregnancy, and approximately 85% of them reported delivering children at health facilities. About 40% of mothers currently breastfed (**Table 2**).

Table 2: Mother's and Health Related Characteristics, CDHS 2014

Variables	(N = 5,958)*	
	Freq.	%
Mother's mean age at giving birth, in years (SD)	29 (6.17)	
15-24	1649	27.7
25–34	3337	56.0
35-49	973	16.3
Mother's education		
No education	799	13.4
Primary (Grade 1-6)	3093	51.9
≥ Secondary (Grade ≥ 7)	2067	34.7
Mother's working status (n = 5,957)		
Agricultural jobs and self-employed	2069	34.7
No job/not working	1431	24.0
Professional, technical and sales jobs	1364	22.9
Others (manual labor and unskilled jobs)	1093	18.4
Mother currently married	5642	94.7
Maternal tetanus toxoid immunization		
Not received	979	16.4
Received one dose	1193	20.0
Received ≥ two doses	3786	63.5
Current report of ever contraceptive use	3616	60.7
Institutional delivery (n = 5,971)	5043	84.6
Skilled delivery	5391	90.5
Child received all vaccination	3747	62.9
Vaccination card available	4296	72.1
Current breastfeeding practices	2369	39.8
Number of ANC visits		
< 4	1446	24.3
≥ 4	4512	75.7
Health insurance coverage	1051	17.6
Perceived problems accessing health service ≥ 1 barrier γ	4455	74.8
ANC with nutrition counselling (n = 5,703)	4983	87.5
Mother reported smoking cigarettes	151	**2.5**

**Weighted count frequency; *Institutional delivery (i.e., public hospital, health center, private hospital/clinic, and NGO)*
γ: Barrier is defined as distance, money, waiting time

Association between household, child, mother and health characteristics with U5M

In binary logistic regression analysis, the following factors were significantly associated with U5 M (**Table 3**): Rural residence with odds ratio (OR) = 4.2, (95% CI: 2.15-8.08). Households with access to improved toilet facilities (OR=0.47, 95% CI: 0.27-0.82) and higher wealth index households (OR=0.39, 95% CI: 0.22-0.71). Children with low birth weight (OR=4.43, 95% CI: 2.58-7.63). Additionally, at least the third birth order of the children was significantly associated with U5 M (OR=2.37 95% CI: 1.44-3.90).

Related to maternal factors, older mothers at given birth (35-49 years old) OR=4.34 (95% CI: 2.31-8.14), mothers who received one dose of tetanus toxoid (OR=0.43, 95% CI: 0.23-0.81), and mothers who received two doses of tetanus toxoid vaccination (OR=0.51, 95% CI: 0.30-0.90) reported contraceptive use (OR=0.26, 95% CI: 0.16-0.43). Additionally, at least four ANCs during pregnancy for their last birth (OR=0.39, 95% CI: 0.23-0.65) and skilled delivery were associated with U5M. We found no association between U5M and child sex, improved source of drinking water, birth interval of the child, mother's education, mother's employment, or place of delivery.

Factors associated with U5M in the multivariable logistic regression model

As shown in **Table 4**, the following factors were independently associated with U5Ms: mothers giving birth at an older age (35-49) with AOR=9.63 (95% CI: 1.48-32.61), contraceptive use (AOR=0.30, 95% CI: 0.18-0.52), low birth weight less than 2500 grams (AOR=4.43, 95% CI: 2.32-7.35), and rural residence (AOR=2.76, 95% CI: 1.25-6.10). However, other factors, such as household wealth index, access to sanitation facilities, ANC visits, birth order, and maternal cigarette smoking, were no longer significantly associated with U5M after controlling for other covariates in the model.

Discussion

This study found several main predictors of U5M in the study, including mother's age (35-49 years old), contraceptive use, children with low birth weight, and rural residence. Older mothers commonly have biological and physical disadvantages during gestation and childbearing due to their premedical condition once the women get older, which could lead to an increased risk of child mortality [17-19].

Table 3: Binary Logistic Analysis: Association between Household, Children and Mother's Characteristics and U5M

Variables	(N = 5,958)* (Death =108) n (%)	p-value	OR	95% CI
Place of residence				
Urban	4 (0.50)	< 0.001	Ref	-
Rural	104 (2.04)		**4.17**	**2.15 - 8.08**
Wealth index				
Poor	69 (2.69)		Ref	-
Middle	15 (1.31)	0.005	**0.48**	**0.21 - 1.07**
Rich	24 (1.08)		**0.39**	**0.22 - 0.71**
Sanitation facilities				
Unimproved	73 (2.46)	0.007	Ref	-
Improved*	35 (1.18)		**0.47**	**0.27 - 0.82**
Child birth weight (grams)				
≥ 2500	67 (1.29)	< 0.001	Ref	-
< 2500	41 (5.49)		**4.43**	**2.58 - 7.63**
Sex of the child				
Boy	66 (2.22)	0.084	Ref	-
Girl	42 (1.41)		0.63	0.37 - 1.07
Birth order				
1–2	49 (1.25)	< 0.001	Ref	-
≥ 3	59 (2.92)		**2.37**	**1.44 - 3.90**
Mother's age at giving birth				
15-24	27 (1.65)		Ref	-
25–34	45 (1.34)	< 0.001	0.81	0.46 - 1.43
35-49	37 (3.76)		**2.33**	**1.23 - 4.44**
Mother's education				
No education	19 (2.35)		Ref	-
Primary	54 (1.75)	0.660	0.74	0.36 - 1.53
Secondary and higher	35 (1.71)		0.72	0.33 - 1.58
Maternal tetanus toxoid vaccination				
Not received	31 (3.12)		Ref	-
One dose	16 (1.35)	0.019	**0.43**	**0.23 - 0.81**
≥ Two doses	62 (1.63)		**0.51**	**0.30 - 0.90**
Contraceptive use				
No	77 (3.28)		Ref	-
Yes	31 (0.87)	<0.001	**0.26**	**0.16 - 0.43**
Place of delivery				
Institutional*	86 (1.71)		Ref	-
Noninstitutional (home, others)	22 (2.41)	0.224	1.42	0.80 - 2.50
Number of ANC visits				
< 4	48 (3.35)		Ref	-
≥ 4	60 (1.32)	**<0.001**	**0.39**	**0.23 - 0.65**
Cigarette smoking				
No	101 (1.74)		Ref	-
Yes	7 (4.71)	0.044	**2.79**	**1.00 - 7.90**

**Weighted count frequency, OR=Unadjusted odds ratio, *Improved sanitation included flush toilet connected to sewage or septic tank and improved, *Not married included divorced, single, widowed, separated), *Institutional delivery included hospital, health center, private hospital/clinic and NGO*

Table 4: Factors associated with U5M in the Multivariable Logistic Regression Model

Variables	(N = 5,957)*	
	AOR	**95% CI**
Maternal age at the time of giving birth		
15-24	Ref	-
25–34	2.24	0.65 - 7.75
35-49	**9.63**	**1.48 – 32.61**
Contraceptive use		
No	Ref	-
Yes	**0.30**	**0.18 - 0.52**
Number of ANC visits		
< 4	Ref	-
≥ 4	0.65	0.38 - 1.10
Cigarette smoking		
No	Ref	-
Yes	1.29	0.43 - 3.84
Child birth weight (grams)		
≥ 2500	Ref	-
< 2500	**4.13**	**2.32 - 7.35**
Sex of the child		
Boy	Ref	-
Girl	0.61	0.36 - 1.04
Birth order		
1-2	Ref	-
≥ 3	1.74	0.90 - 3.33
Place of residence		
Urban	Ref	-
Rural	**2.76**	**1.25 - 6.10**
Wealth index		
Poor	Ref	-
Middle	0.60	0.27 - 1.32
Rich	0.77	0.40 - 1.49
Sanitation facilities		
Unimproved	Ref	-
Improved	0.83	0.42-1.65

** Weighted count frequency, AOR=Adjusted Odds Ratio*

Consequently, health providers always do not recommend women's pregnancy and childbearing at older ages. For example, babies born to older mothers could be exposed to a higher risk of having Down syndrome, miscarriage, or stillbirth [17-19]. Our study findings are consistent with studies conducted in Bangladesh, India, and the USA [11, 20, 21].

Many studies conducted in Nigeria, Bhutan, Ghana, and Asian countries confirmed that children with low weight were a main predictor of U5M [22, 23]. Low birth weight infants are at increased risk of infectious diseases such as diarrhea, early growth retardation, delay in physical and mental development and finally death during infancy and childhood (WHO). Therefore, nutritional counseling for pregnant women, regular ANC checkups at least 4 visits, and breastfeeding with their mother's milk could be recommended to mothers to keep children healthy and maintain their healthy weight, contributing to the reduction in U5M [24].

In this study, mothers reported using contraceptives were independently associated with a reduced risk of U5Ms. The main reason is that contraceptive use or family planning could allow women to space and limit their childbearing at high-risk maternal ages (i.e., too young or too old) with births too close to one another or shorter birth intervals and to avoid unwanted pregnancy [8, 25]. Consequently, it could contribute to the decreased risk of U5M among mothers who have been exposed to family planning or contraceptive use. Our results are consistent with findings of previous studies conducted in Bangladesh, and Angola reported that contraceptive use was one of the important significant predictors in reducing under-five mortality [35]. Currently, maternal health guidelines have recommended spaced pregnancy at least 18-24 months between pregnancy by using any form of contraceptive to prevent mothers from premature birth, low birth weight or anemia that could lead to U5M [24, 26].

Furthermore, children born to mothers in rural areas had a significantly higher risk of U5M than those born to mothers in urban areas. Similarly, previous literature in Cambodia and Kenya confirmed that rural residence was a risk factor for U5Ms [9]. This can be explained partly by the high poverty level in rural remote areas, undernutrition, poor sanitation, lower health knowledge, and limited access to health care in the rural setting [27, 28]. Therefore, maternal and child health programs should be addressed by targeting more rural remote areas and focusing on social health determinants with the aim of improving maternal and child health. As a result, it may further contribute to some extent to the reduction of the U5M in the country.

This study has some limitations. First, we could not make any causal inferences, such as the cross-sectional and retrospective data used in this study. Second, it is also possible that the number of deaths may have been underreported because only surviving mothers gave information about their child's birth and death during the survey. Hence, the mortality estimates reported in this study may have been underestimated. Third, information on the medical history of the child, mother and the cause of child death was unknown, as verbal autopsy was not conducted in CDHS. Despite these limitations, this study has several strengths. First, the data used in this study were nationally representative with a large sample size and a high response rate (> 95%). The use of valid survey methods with data analysis taking sampling weight into account in the survey led to the study's credibility. Therefore, the findings from this

study could be generalizable to the Cambodian population.

In conclusion, under-five mortality is still a main public health concern in Cambodia since it is one of the main indicators reflecting socioeconomic development, health status, and environmental conditions. Intensified efforts are still required to address these factors, such as older age mothers, rural residence, and low birth weight children, with targeted interventions to achieve the SDGs by 2030. Additionally, there is a need for community-based family planning interventions, such as the promotion of contraceptives to all women with easy access and safety. Although Cambodia has made a significant improvement in U5M in the past 20 years, further interventions to reduce the prevalence of U5M should be continued.

Ethical Approval

The CDHS 2014 was approved by the Cambodia National Ethics Committee for Health Research (Ref: # 056 NECHR) and the Institutional Review Board (IRB) of ICF in Rockville, Maryland, USA. The CDHS data are publicly accessible and were made available to the researchers upon request to the DHS Program, ICF.

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