

Rural-urban differentials in the determinants of under-five mortality in Bhutan

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Abstract

Purpose – The differences in the distribution of factors associated with under-five mortality (UFM) can help explain the rural-urban inequities in UFM. The determinants contributing to UFM in rural and urban areas have not been previously explored in Bhutan. This study examined the factors associated with UFM in rural and urban Bhutan and the role of the factors in explaining UFM disparity.

Design/methodology/approach – The dataset of 6,398 single births (4,999 in rural and 1,399 in urban areas) from the 2012 Bhutan National Health Survey was analyzed. Logistic regression analysis accounting for the complex survey design was performed to investigate the determinants.

Findings – The UFM rate was 2.75 times higher in rural than in urban Bhutan. In rural communities, children of younger mothers, born in households without safe sanitation and electricity, and central and eastern regions had increased UFM odds. Whereas, children born to working mothers and educated fathers, and born in households with non-working household heads had lower UFM odds in urban areas. A higher number of births and smaller household size was associated with an increased UFM odds irrespective of rural-urban residence. Environmental factors were attributable for the largest portion of rural UFM disadvantage.

Originality/value – This study helps to understand the rural-urban differences in the factors influencing UFM in Bhutan. The findings suggest that policies aimed to improve environmental and socioeconomic conditions, women empowerment, and those aimed to enhance health utilization can help reduce the rural-urban child survival disparity and accelerate the achievement of the Sustainable Development Goal target.

Keywords Under-five mortality, Rural-urban disparities, Environmental factors, Bhutan

Paper type Research paper

Introduction

Under-five mortality (UFM) remains a pressing public health issue in developing countries. Globally, 5.6 million children died before reaching the age of 5 years in 2016, of which

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countries in the sub-Saharan and South Asian regions contributed to more than 80% of the deaths [1]. Given its close association with poverty, education, healthcare, nutrition, and the environment, child mortality is not only a good marker of children's health but also reflects a nation's wellbeing [1]. The under-five mortality rate (UFMR) has been considered as an important socioeconomic measure under the Sustainable Development Goals (SDGs) with an ambitious target to reduce it by ≤ 25 deaths per 1,000 live births by 2030 [2]. Despite the significant progress made by many countries in improving child mortality, child survival differentials by place of residence persist [3].

The risk of UFM is generally higher in rural than urban areas in developing nations [4–10]. Higher child deaths in rural areas can indicate an uneven distribution of adequate public resources and services. Some studies attribute low household income and wealth, mother's education, contraceptive use and vaccination to rural disadvantage in infant and child mortality [6–8, 11, 12]. Likewise, poor access to safe drinking water, electricity, health services and poor housing conditions contributed to high child mortality in rural settings [4, 9]. In contrast, better community factors besides socioeconomic and behavioral characteristics were shown to be the reasons for urban advantage in child survival [7]. A study also identified household wealth in addition to the child's gender and maternal obesity in urban areas, and region of residence and mother's marital status in rural areas as risk factors for infant mortality [5]. Rural-urban social and resource inequalities may lead to different behaviors among mothers and families that can potentially contribute to UFM disparities [3]. Differences in the distribution of factors influencing child mortality have been purported to explain the gap in mortality between urban and rural areas [4, 13, 14].

Bhutan is a small, landlocked Himalayan country in South Asia known for measuring its wellbeing and development using the Gross National Happiness Index. In Bhutan, health service is accessible free of cost and is provided by the State through its three-tiered health care system built upon primary health care principles. The UFMR declined from 134 in 1990 to 37 per 1,000 live births in 2012 [15], and further to 32 per 1,000 live births in 2016 [16]. The fertility rate has also declined from 5.6 in 1994 to 2.1 in 2012 [15], and further down to 1.9 in 2017 [17] reflecting the commendable socio-economic and health progress that Bhutan has achieved over the last two decades. However, the current UFMR is higher compared to some other developing countries in the region, such as Indonesia (26 per 1,000), Sri Lanka and Maldives (9 per 1,000 each), and Thailand (12 per 1,000) [16]. Bhutan is currently positioned 66th out of more than 192 countries in terms of global UFMR when ranked from highest to lowest [16]. Targeted interventions to improve child survival may not only help Bhutan achieve a UFMR level beyond that of the SDG target but may also positively impact other related socioeconomic indicators.

Around 65% of the population live in rural Bhutan and most of the population practice sustenance farming [18]. Rural Bhutan is characterized by scattered settlements, rugged terrain, inadequate public services including health and motorable roads, stronger traditional beliefs, and a poor socioeconomic and environmental conditions. These characteristics place rural residents, especially women and children, at a much higher risk of poor health. Socioeconomic transitions have also led to a rising trend of migration and urbanization, lifestyle changes, and health issues. Bhutan's projected urban population growth rate was among the highest in South Asia [19], which is attributable to the rapid rural-urban migration resulting in an increasing underserved migrant population [20]. The growing population can exert pressure on the inadequate services and the environment, which can affect health, especially that of women and children. Seasonal shortages and pressure on the already limited water supply in urban areas are being reported [21]. Although health care is free, stark rural-urban health disparities remain [15, 20, 22, 23]. Studies investigating specific factors influencing health in rural and urban areas are scarce.

Our previous study found mother's age, household size, parity, access to electricity and sanitation, and the region of residence were the predictors of UFM [24]. National surveys show higher rates of UFM in rural than urban Bhutan portraying a significant rural-urban health inequity [15, 25]. The factors contributing to this disparity have not been previously explored. Interventions directed to reduce child mortality in rural areas may yield a greater impact on the overall UFM, given the high UFM in rural settings. Such focused efforts to improve health and narrow disparities by understanding the health needs of the specific population is essential for a resource-constrained country like Bhutan. Therefore, this study examined the determinants of UFM in rural and urban Bhutan using the most current dataset of the Bhutan National Health Survey (BNHS) [15]. The potential factors contributing to the rural-urban differences in UFM were also explored.

Methods

Study data

This study used the datasets of the Bhutan National Health Survey (BNHS) that was conducted jointly by the Ministry of Health and the National Statistical Bureau of Bhutan in 2012 [15]. The survey aimed to generate health indicators and to observe the trend of health status. A two-stage sampling design that defined rural and urban areas in each of the 20 districts as sampling strata was used. The data were collected using five interviewer-administered questionnaire sets, namely the household, individual, women, immunization and domestic violence from November 2012 until February 2013. This survey successfully interviewed 13,256 (97%) households and 45,635 eligible individuals (87%). The response rate was $\geq 90\%$ for both the domestic violence and questionnaires targeting women in the reproductive age range of 10-49 years. The study report of the 2012 BNHS has been previously published [15].

All the data files, such as household, women, birth history, immunization and domestic violence, were merged. In maintaining consistency with the national report, all live births in the last five years or more prior to the survey (November 2002 to October 2007) were extracted. This allowed for the youngest children to attain their first five years at the beginning of the BNHS in November 2012 [15]. For this study, only single births were selected to prevent potential confounding due to multiple pregnancies. After excluding eight observations without mortality information, the final sample used in the present study was 6,389.

Study variables

Under-five death was defined as a death that occurred before the children attained their fifth birthday. To enable logistic regression analysis, under-five death was coded as "1" and those who survived as "0". The selection of explanatory variables was made by reviewing the current literature and considering the availability of variables in the dataset. Mosley and Chen's framework for analyzing UFM determinants in developing countries was used to group the explanatory variables into three categories [26]. Parent's education, wealth index that was created using the principal components analysis [15], household head and mother's working status, household size, and domestic violence were grouped as the socioeconomic determinants. The bio-demographic variables included the current age of mother, age when mother got first married and pregnant, marital status, birth order, birth interval, total births, the household head's sex and the child's sex. The World Health Organization's recommendation of a minimum of 33 months between two consecutive births was used to define birth interval [27]. The birth interval was also assessed as a continuous variable and using other thresholds (≤ 36 and > 36 months, and ≤ 24 and > 24 months). The region of residence, drinking water source, access to safe sanitation, the use of solid fuel for cooking, and the availability of electricity comprised the environmental determinants.

Statistical analysis

Cross-tabulations assessed the distribution of UFM by the explanatory variables. The unadjusted or crude odds ratio (COR) along with the 95% confidence intervals (CIs) were generated using simple logistic regression (SLR) that examined the association of each explanatory variable with the likelihood of UFM.

Determinants of UFM were then identified by using multiple logistic regression (MLR) analysis with a stepwise hierarchical method [28]. Varying significance levels with a backward elimination method were applied to minimize the risk of missing important determinants [29]. Initially, socioeconomic variables with a p -value of ≤ 0.2 in the SLR were included in an MLR model to assess their association with UFM, and variables associated with UFM at a 10% level ($p < 0.1$) were retained for consequent modeling. In the next model, bio-demographic variables with a p -value of ≤ 0.2 in the SLR were included and assessed their association with UFM in the presence of the retained socioeconomic variables. The variables with a p -value of < 0.1 were kept again in the model. The final model combined the socioeconomic and bio-demographic variables retained in the preceding models with the environmental variables having a p -value ≤ 0.2 in SLR. The final model retained only those variables that were significant at 5% ($p < 0.05$). The adjusted odds ratio (AOR) and their 95% CIs were reported.

The above analyses were conducted separately for rural and urban areas. Some variables that are found to significantly predict child mortality in the literature, such as age and education of mother, sex of the child, wealth index, and use of solid fuel, were again included in the final model to reexamine their influence. Furthermore, using the full sample, separate models that adjusted for each group of variables were also fitted to assess their role in explaining the effect of place of residence (rural-urban areas) on UFM. For this, only those variables found significant in the bivariate analysis in each group were considered. The complex-sample analysis was performed in the data analysis to take into account the sampling weight and clustering effects emanating from the multistage sampling. All analyses were conducted using the STATA version 14 package [30].

Ethical approval

This study obtained ethical approval from the Bhutan Research Ethics Board of Health (Approval number: REBH/Approval/2016/031).

Results

The total number of single births in the five-year period (November 2002 to October 2007) was 1,399 in urban and 4,990 in rural areas. Table 1 presents the distribution of UFM by determinants. The overall weighted UFMR was 37 per 1,000 live births, and the weighted UFMR in rural and urban areas was 44 per 1,000 and 16 per 1,000 live births, respectively. In urban areas, the UFMR was higher among boys, second child, among children born with a birth interval of ≥ 33 months, born to mothers aged 29–34 years, who married before 18 years of age, who were married, who experienced domestic violence and had > 2 children. The prevalence was also higher among children born in male-headed households, born to uneducated parents and unemployed mothers, born in households with < 5 members, and uneducated and employed household heads. The UFMR was also greater among children born in central Bhutan, and in households with access to safe drinking water, sanitation, electricity, and that used solid fuel.

The rates of UFM in rural areas was similar to urban areas for most of the reported characteristics. In contrast, the prevalence of UFM in rural areas was higher among third or higher-order children, children born to mothers who got pregnant before 20 years old and did not experience violence, and among children born with a birth interval of < 33 months. The UFMR was greater among children born in households with educated and unemployed

Variables	Urban (N = 1399, 27 died)			Rural (N = 4990, 231 died)		
	N	n ¹ (% ¹)	UFMR	n	n ¹ (% ¹)	UFMR
<i>(a) Bio-demographic determinants</i>						
<i>Mother's age</i>						
≤28 years	393	417 (28.0)	9	1202	1215 (25.7)	46
29–34 years	608	653 (43.8)	23	1760	1621 (34.3)	44
>34 years	398	420 (28.2)	11	2028	1884 (39.9)	42
<i>Mother's age when first married</i>						
<18 years	445	484 (32.5)	20	1755	1728 (32.5)	52
≥18 years	936	982 (65.9)	14	2899	2713 (65.9)	40
Not reported/missing	18	24 (1.6)	0	336	279 (5.9)	31
<i>Mothers age when first pregnant</i>						
<20 years	563	603 (40.5)	17	2318	2231 (47.3)	47
≥20 years	747	790 (53.0)	16	2478	2286 (48.4)	38
Not reported/missing	89	97 (6.5)	7	194	202 (4.3)	73
<i>Mother's marital status</i>						
Married	1324	1408 (94.6)	16	4418	4270 (90.5)	45
Not married	75	81 (5.4)	0	572	450 (9.5)	31
<i>Sex of the child</i>						
Girl	685	715 (48.0)	10	2507	2365 (50.1)	38
Boy	714	774 (52.0)	21	2483	2354 (49.9)	50
<i>Total births</i>						
≤2 births	664	794 (53.3)	6	1408	1317 (27.9)	15
>2 births	735	695 (46.7)	27	3581	3402 (48.03)	55
Not reported/missing				1	1	0
<i>Sex of the household head</i>						
Female	369	403 (27.0)	4	2191	1811 (38.4)	43
Male	1030	1086 (73.0)	20	2799	2909 (61.6)	44
<i>Birth order</i>						
First	572	658 (44.2)	9	1396	1348 (28.6)	39
Second	413	420 (28.2)	22	1271	2088 (24.7)	38
≥Third	414	411 (27.6)	19	2323	1284 (46.7)	50
<i>Birth interval</i>						
<33 months	1010	1,001 (67.2)	16	3928	3659 (77.5)	45
≥33 months	36	50 (3.4)	39	99	111 (2.4)	19
Not reported/missing	353	438 (29.4)	12	963	949 (20.1)	40
<i>(b) Socioeconomic determinants</i>						
<i>Mother's education</i>						
No education	583	610 (40.9)	30	3223	3052 (64.6)	45
With education	814	876 (58.8)	6	1751	1660 (35.2)	41
Not reported/missing	2	4 (0.3)	0	16	8 (0.2)	37
<i>Education of the husband</i>						
No education	363	382 (25.7)	37	2387	2322 (49.2)	47
With education	1,013	1077 (72.3)	9	2266	2122 (45.0)	43
Not reported/missing	23	30 (2.0)	0	337	276 (5.8)	22
<i>Education of the household head</i>						
No education	434	452 (30.4)	31	3251	3015 (63.9)	42
With education	961	1036 (69.5)	9	1726	1698 (36.0)	47
Not reported/missing	4	1 (0.1)	0	13	7 (0.1)	41

Table 1. Characteristics and distribution of under-five mortality rate in urban and rural Bhutan

(continued)

Variables	Urban (N = 1399, 27 died)			Rural (N = 4990, 231 died)		
	N	n ¹ (% ¹)	UFMR	n	n ¹ (% ¹)	UFMR
<i>Household size</i>						
≤4	583	691 (46.4)	20	1182	1189 (25.2)	61
>4	816	798 (53.6)	11	3808	3531 (74.8)	38
<i>Mother's working status</i>						
Working	438	488 (32.8)	5	1468	1422 (30.1)	34
Not working	947	992 (66.6)	21	3470	3267 (69.2)	48
Not reported/missing	14	9 (0.6)	0	52	30 (0.6)	37
<i>Household head's working status</i>						
Working	1196	1276 (85.7)	17	3115	3168 (67.1)	43
Not working	200	211 (14.2)	4	1858	1537 (32.6)	46
Not reported/missing	3	2 (0.2)	0	17	14 (0.3)	0
<i>Wealth index</i>						
Poor/second/middle	192	194 (13.0)	14	3934	3712 (78.6)	50
Fourth/richest	1207	1295 (87.0)	16	1056	1008 (21.4)	20
<i>Domestic violence</i>						
Yes	142	124 (8.3)	23	729	646 (13.7)	36
No	1257	1365 (91.7)	15	4259	4073 (86.3)	45
Not reported/missing				2	1 (0.03)	0
<i>(c) Environmental determinants</i>						
<i>Region of residence</i>						
Western	635	1037 (69.6)	13	1278	1563 (33.1)	23
Central	488	226 (15.2)	25	1897	1364 (28.9)	45
Eastern	276	227 (15.2)	18	1815	1792 (38.0)	61
<i>Place of residence</i>						
Urban	1399	1489 (24.0)	16			
Rural				4990	4720 (76.0)	44
<i>Safe drinking water</i>						
Yes	1394	1482 (99.5)	16	4840	4561 (96.6)	44
No	5	7 (0.5)	0	144	151 (3.2)	27
Not reported/missing				6	9 (0.2)	220
<i>Safe sanitation facilities</i>						
Yes	1279	1386 (93.1)	16	2858	2681 (56.8)	32
No	116	100 (6.7)	14	2126	2035 (43.1)	59
Not reported/missing	4	3 (0.2)	0	6	4 (0.1)	0
<i>Solid fuel use</i>						
Yes	16	20 (1.3)	44	1784	1807 (38.3)	56
No	1383	1469 (98.7)	15	3205	2913 (61.7)	36
Not reported/missing				1	1 (0.01)	0
<i>Electricity availability</i>						
Yes	1394	1485 (99.7)	16	4208	4034 (85.5)	38
No	4	4 (0.3)	0	778	677 (14.3)	78
Not reported/missing	1	1 (0.01)	0	4	9 (0.2)	0

Note(s): UFMR: weighted estimates of under-five mortality rate as deaths per 1000 live births; *n*: sample size; *n*¹: weighted sample size; %¹: weighted percentage

Table 1.

household heads and born in poor to middle-income households. The UFM was also higher among those born in the eastern region, and born in households with safe drinking water, without safe sanitation and electricity, and that utilized solid fuel.

Table 2 provides the unadjusted odds ratio for rural and urban areas. Under-five children born to mothers with >2 children had a higher likelihood of UFM regardless of the residential area. Specifically, in urban areas, children born to educated mothers and fathers, working mothers, born in households headed by females, with educated and non-working household heads had significantly reduced odds of mortality. In rural areas, under-five children born in wealthier households had reduced odds while children living in eastern and central regions, born in households without safe sanitation and electricity, and that used solid fuels for cooking had a significantly greater likelihood of UFM.

The adjusted odds ratio estimated in the final model is presented in Figures 1 and 2 for urban and rural areas, respectively. Compared to bivariate analysis in Table 2, mother's education, and household head's sex, education, and working status in urban areas, and wealth index and solid fuel use in rural areas turned out to be not statistically significant in the multivariate analysis. However, the mother's age in rural areas and household size in urban areas emerged significant. Regardless of rural-urban residence, under-five children in households with >4 members had significantly reduced odds of UFM (by 91% in urban and 65% in rural areas), while those born to mothers who have >2 children had higher UFM odds. Independently, in urban areas, the likelihood of mortality among children of educated fathers was lower by 70% (AOR = 0.30, $p = 0.043$) than their counterparts. Under-five children of working mothers also had decreased odds of dying by 79% (AOR = 0.21, $p = 0.016$). Whereas, children in households with non-working household heads had lower odds of dying (AOR = 0.20, $p = 0.032$). The pseudo- R^2 of the final urban model was 0.20.

Specifically, in rural areas (Figure 2), children born to mothers who were 29–34 (AOR = 0.77, $p = 0.092$) and >34 (AOR = 0.60, $p = 0.002$) years old had reduced odds of UFM. Compared to children born in the western region, the odds of UFM was 2.19 ($p = 0.001$) and 1.60 ($p = 0.097$) times higher among children born in the eastern and central regions, respectively. Children living in households without electricity (AOR = 1.72, $p = 0.046$) and unsafe sanitation (AOR = 1.50, $p = 0.049$) also had a higher likelihood of dying. The pseudo- R^2 for the final rural model was 0.08.

The results showed that environmental factors were attributable to 46% of the effect of place of residence on UFM (Table 3). The effect of rural residence attenuated but remained statistically robust when adjusted for socioeconomic and bio-demographic factors. Although the association was not statistically strong in the models that adjusted for all groups of variables, the effect size was >1, suggesting the role of other factors not examined in this study. The associations between other birth interval measures and UFM were not significant (the results are not presented).

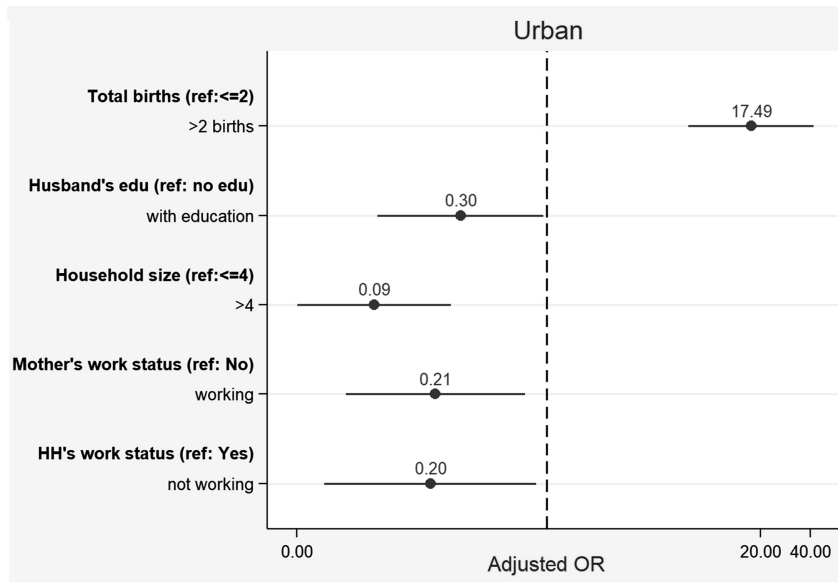
Discussion

To our knowledge, this is the first study that examined the UFM determinants by rural-urban residence using a nationally representative dataset. Our study found that the weighted UFM in rural Bhutan was 2.75 times higher than in urban Bhutan. Parity and household size were the common factors influencing UFM, indicating higher parity and smaller household size were associated with greater odds of mortality in both rural and urban areas. The findings suggest that environmental factors (electricity availability, the region of residence and safe sanitation) are important in influencing child health in rural areas. Whereas, some socioeconomic factors (employment status and education level) could play a stronger role in affecting children's health in urban Bhutan. The largest part of rural-urban disparities in UFM was attributable to the environmental factors, followed by socioeconomic factors.

Variables	Urban			Rural		
	COR	95% CI	p-value	COR	95% CI	p-value
<i>(a) Bio-demographic determinants</i>						
<i>Mother's age</i> (Ref: ≤28 years)			0.246			0.844
29–34 years	2.63	0.53–13.16	0.234	0.97	0.67–1.40	0.864
>34 years	1.22	0.30–4.93	0.774	0.91	0.63–1.29	0.564
<i>Mother's age when first married</i> (Ref: <18 years)			0.469			0.066
≥18 years	0.70	0.26–1.87	0.469	0.76	0.57–1.02	0.066
<i>Mothers age when first pregnant</i> (Ref: <20 years)			0.917			0.148
≥20 years	0.95	0.39–2.36	0.917	0.81	0.60–1.08	0.148
<i>Mother's marital status</i> (Ref: Married)						0.103
Not married	NA	–	–	0.69	0.44–1.09	0.103
<i>Sex of the child</i> (Ref: Girl)			0.132			0.109
Boy	2.11	0.79–5.64	0.132	1.34	0.93–1.93	0.109
<i>Total births</i> (Ref: ≤2 births)			<0.001			0.001
>2 births	4.93	2.30–10.56	<0.001	3.71	1.87–7.35	0.001
<i>Sex of the household head</i> (Ref: Female)			0.017			0.755
Male	5.44	1.37–21.59	0.017	1.04	0.80–1.36	0.755
<i>Birth order</i> (Ref: First)			0.355			0.255
Second	2.37	0.70–7.99	0.160	0.99	0.58–1.67	0.961
≥Third	2.09	0.51–8.53	0.298	1.30	0.83–2.05	0.238
<i>Birth interval</i> (Ref: <33 months)			0.415			0.262
≥33 months	2.54	0.26–24.71	0.415	0.40	0.08–2.12	0.262
<i>(b) Socioeconomic determinants</i>						
<i>Mother's education</i> (Ref: No education)			0.035			0.623
With education	0.19	0.04–0.88	0.035	0.90	0.57–1.42	0.623
<i>Education of the husband</i> (Ref: No education)			0.027			0.594
With education	0.23	0.06–0.84	0.027	0.92	0.67–1.27	0.592
<i>Education of the household head</i> (Ref: No education)			0.048			0.559
With education	0.27	0.08–0.99	0.048	1.12	0.76–1.65	0.559
<i>Household size</i> (Ref: ≤4)			0.273			0.022
>4	0.55	0.19–1.61	0.273	0.60	0.40–0.92	0.022
<i>Mother's working status</i> (Ref: Not working)			0.040			0.071
Working	0.25	0.07–0.93	0.040	0.71	0.48–1.03	0.071
<i>Household head's working status</i> (Ref: Working)			0.015			0.732
Not working	0.24	0.08–0.75	0.015	1.09	0.64–1.86	0.732
<i>Wealth index</i> (Ref: Poorest/Second/Middle)			0.815			<0.001
Fourth/Richest	1.16	0.32–4.26	0.815	0.38	0.24–0.61	<0.001
<i>Domestic violence</i> (Ref: No)			0.594			0.364
Yes	1.59	0.34–7.37	0.594	0.79	0.46–1.35	0.364
<i>(c) Environmental determinants</i>						
<i>Region of residence</i> (Ref: Western)			0.312			0.002
Central	1.96	0.82–4.72	0.128	2.04	1.13–3.68	0.021
Eastern	1.44	0.38–5.55	0.588	2.79	1.70–4.58	<0.001
<i>Safe drinking water</i> (Ref: Yes)						0.555
No	NA	–	–	0.60	0.10–3.61	0.555
<i>Safe sanitation facilities</i> (Ref: Yes)			0.856			0.002
No	0.91	0.34–2.46	0.856	1.86	1.29–2.67	0.002
<i>Solid fuel use</i> (Ref: No)			0.235			0.008
Yes	2.99	0.48–18.69	0.235	1.56	1.14–2.13	0.008
<i>Electricity availability</i> (Ref: Yes)						0.011
No	NA	–	–	2.12	1.21–3.73	0.011

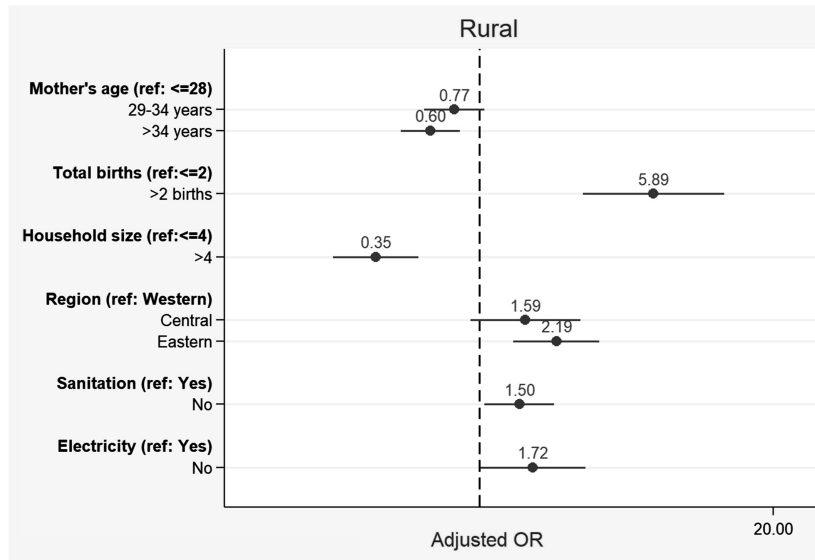
Table 2.
Unadjusted association
between under-five
mortality and
determinants in urban
and rural Bhutan

Note(s): COR: crude/unadjusted odds ratio; CI: confidence interval; Ref: reference group; NA: not available



Note(s): F -statistic (p -value) = 25.57 (< 0.001); pseudo- R_2 = 0.20

Figure 1.
Adjusted association
between under-five
mortality and the
determinants in
urban Bhutan



Note(s): F -statistic (p -value) = 29.63 (< 0.001); pseudo- R_2 = 0.08

Figure 2.
Adjusted association
between under-five
mortality and the
determinants in
rural Bhutan

Our findings point to the need for targeted policies to reduce rural-urban health inequities in Bhutan that can also help accelerate the achievement of the SDG target.

The higher UFMR in rural areas in this study is consistent with findings in previous national surveys [15, 25] and other studies that showed higher mortality risk among rural

children [4–6, 8]. This can be attributable to poor public service and health infrastructure, greater distance to health centers, poor socioeconomic and living conditions, inadequate sanitation, and safe drinking water in rural Bhutan [15, 25, 31, 32]. The results also show a greater risk of mortality among children born in households of rural communities with no safe sanitation and no access to electricity. The coverage of improved sanitation in 2012 was still low in rural (58%) compared to urban areas (93%) [15]. The high occurrence of diarrhea, malnutrition, and respiratory infection in rural Bhutan depicts the direct effect of poor sanitation and hygiene [15, 17, 25]. Studies have also demonstrated that access to electricity is associated with reduced odds of child mortality [33, 34] in rural areas [4]. Access to electricity can be crucial in improving hygiene, reducing indoor pollution from solid fuel use, enhancing health knowledge through access to radio and television [35], and may potentially increase income contributing towards child health.

Defying expectations, the impact of socioeconomic factors such as wealth index, parent's education, and working status was not evident in the adjusted analysis, especially in rural areas. Studies suggest that improved community-based health care services may buffer the adverse impact of socioeconomic factors [36, 37]. This can be particularly true in the Bhutanese context where access to health care has improved substantially, as reflected in high immunization (~95%) and antenatal care coverage [15]. However, some environmental factors such as electricity, sanitation and solid fuel use were associated with UFM in rural areas suggesting the role of individual components used to construct the wealth index that may be useful for channeling interventions. This finding supports that environmental factors were responsible for the large part of the observed rural-urban UFM gap. Wealth index also emerged to be a significant UFM predictor in the unadjusted model.

Furthermore, the findings that children born to non-working mothers and uneducated fathers were more likely to experience UFM may indicate poor socioeconomic status to be an important factor contributing to health disparities in urban Bhutan. This is plausible given the rapid rural-urban migration leading to significant growth of the urban population in Bhutan, leaving a migrant population that may be socioeconomically disadvantaged. Poor urban areas were also found to experience higher UFM rates and stunting than in rural areas [11]. Addressing the health of urban residents, therefore, becomes equally important. More studies are needed to understand the health disparities in urban Bhutan. The results also show that urban under-five children of educated fathers had reduced odds of dying. While the benefit of the mother's education on their children's health is well documented [38], father's education can also be important in determining the child's health [39] through improving household economic conditions [40], care for children, and health utilization.

Place of residence (ref: Urban)	OR	OR for rural		Proportion change in OR
		95% CI	<i>p</i> -value	
Model 1 (unadjusted model)	2.89	1.74–4.81	<0.001	
Model 2	2.21	1.32–3.69	0.003	–24%
Model 3	1.71	1.01–2.89	0.044	–41%
Model 4	1.56	0.90–2.71	0.111	–46%
Model 5	1.17	0.68–2.03	0.547	–60%

Note(s): OR: Odds ratio; Model 2: Adjusted for significant bio-demographic variables from bivariate analysis (mother's age when first married, total births, birth order); Model 3: Adjusted for significant socioeconomic variables from bivariate analysis (husband's education, mother's working status, wealth index); Model 4: Adjusted for significant environmental variables from bivariate analysis (region, safe sanitation facilities, solid fuel use, electricity availability); Model 5: Adjusted for only for significant bio-demographic, socioeconomic, and environmental determinants

Table 3. Change in effect of place of residence (rural-urban) after adjusting for other groups of independent variables

This study found that under-five children born in households with >4 members had decreased odds of dying independent of rural-urban residence. This is in accordance with findings from previous research [35, 41]. Larger family size may have more members to take care of children [42] and higher household income. In Bhutan, the practice of extended family living is still prevalent [42], and one in five people (20%) surveyed were found to live in an extended family [31]. Another finding in this study was that children in households with non-working household heads had reduced mortality risk. The household head is usually a male [15] and the oldest person in the house and may not be economically active; instead, he/she may be engaged in looking after the children at home while the parents of the child are away working. This situation is plausible, particularly in urban Bhutan, where the rising living costs may compel both the couples to work. Besides, older parents might also support the family financially. The actual mechanism of the effect of household size and economic activity of household heads requires further investigation.

Similar to the findings in other studies [43, 44], higher parity was correlated with a higher propensity of UFM both in rural and urban areas. The decline in the mother's health status and possible competition for attention and restricted resources among siblings may be some explanations for this. The multivariable analysis also showed that children from older mothers had reduced odds of dying in rural areas. Some previous work also found similar findings [8, 35, 41]. Better economic status and the ability to cope with pregnancy and related situations among older mothers can explain this attenuated risk. In agreement with the findings of a national survey [25], this study found that under-five children from rural areas of central and eastern regions had an increased probability of dying. Comparatively, western Bhutan is more developed with better public infrastructure and services. Malnutrition and stunting in children, inadequate access to safe sanitation, high prevalence of anemia in pregnant women, poor health literacy and poverty in rural communities of these regions are some plausible reasons for the higher UFM risk [17, 25, 31, 32].

Strengths and limitations

The use of complex samples analysis to prevent biased estimation arising from sampling strategy adopted in the 2012 BNHS and the stepwise regression informed by a widely used conceptual framework are some of the strengths of this study. However, there are some limitations. First, since this was a cross-sectional study, the directionality of the associations identified cannot be made. Owing to the huge missing observation for health-related factors and the non-availability of information on birth weight, these factors were not examined. The influence of health-related variables, including breastfeeding on UFM is indisputable [5, 9, 33, 43], and can be more important than socioeconomic and other distal factors with improvement in socioeconomic conditions. The effect of these factors needs to be investigated in future studies. The possible underestimation of UFM from interviewing only those mothers who were alive and bias arising from recalling birth and mortality inherent to demographic and health surveys cannot be ruled out. Furthermore, to cover all possible under-five deaths of children being studied, all births from November 2002 to October 2007 were extracted, which allowed for five full calendar years of life (exposure). However, socioeconomic and other characteristics were only collected in 2012. Given the time elapsed between birth extraction and socioeconomic variables collection periods, the associations identified in this study could be imprecise and need to be interpreted with an understanding of the changes in socioeconomic conditions in Bhutan over time. Future studies with matched measurement periods are warranted. Finally, the small number of under-five deaths for some categories of the variables examined in urban areas could have potentially influenced the results.

Conclusion

The data of BNHS 2012 suggests that UFM was higher in rural than urban Bhutan, and the determinants influencing UFM varied by rural and urban areas. Older mother's age, living in the western region, and access to safe sanitation and electricity were significantly associated with lower odds of UFM among rural children. Whereas in urban areas, children of unemployed mothers and uneducated fathers had higher UFM odds, while those born in households with unemployed household heads had lower odds of dying. Lower parity and larger household size were associated with reduced UFM risk regardless of rural-urban residence. Similar studies with better designs, including those that investigate infant mortality and urban health disparities, are required to inform focused policies.

Focused policy interventions are needed to reduce the rural-urban disparities in UFM that can further help Bhutan hasten the attainment of the SDG target. Specifically, increasing health access and utilization, enhancing health knowledge, programs to improve access to electricity and sanitation and hygiene, and empowering women through education can potentially help improve child survival in rural areas. Targeting socioeconomically disadvantaged urban populations with health and socioeconomic improvement programs, and women empowerment through education can be cost-effective in urban areas. Additionally, equitable regional socioeconomic development policies are essential to reduce rural-urban health inequities. These may be undertaken in collaboration with relevant stakeholders such as the education sector, urban municipalities, primary health centers and the local governments and non-government organizations working at the grass-root level, including the community. These cross-sectoral interventions can not only help accelerate the reduction of UFM beyond that of the SDG target but may also improve other socioeconomic and health indicators that in turn can positively impact development.

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