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THE CAUSAL EFFECT OF WATER AND SANITATION ON CHILDREN UNDER FIVE-YEAR MORTALITY IN AFGHANISTAN

Afganistan'da su ve sanitasyonun beş yaş altındaki çocuk ölümleri üzerindeki nedensel etkisi

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Abstract

Due to the inaccessibility of households to improved drinking water and safe sanitation, Afghan children die at the early age of childhood. This study provides empirical evidence to examine the causal effect of unsafe drinking water and poor sanitation on children under 5-year mortality in Afghanistan. To testify the relationship between household's sanitation environment and drinking water sources on children under five-year mortality, the children under five-year categorized into the neonatal, infant, and under five-year ages. The binary logistic regression and marginal effect model have been used to discover the impact of water and sanitation on children under-five year mortality. The result revealed that children born in unimproved environments such as unclean drinking water sources and poor sanitation facilities are more likely to die in infancy age. The risk of poor sanitation facilities is significantly higher than unsafe water supply on child mortality at the age of less than 5. In conclusion, an unprotected environment is statistically more likely to increase the risk of children under five-year mortality in Afghanistan. The result recommended to the government to provide a safe water supply, increase the awareness of household members about sanitation, and improve the quality of public healthcare services to decrease the casual effect of water and poor sanitation on children under five-year mortalities.
Keywords: Neonatal mortality, infant mortality, childern under 5-year mortality, sanitation, water.

Özet

Afgan çocukları, hanelerin sağlığa uygun içme suyuna ve güvenli sanitasyona erişimi olmaması nedeniyle erken çocukluk döneminde ölmektedir. Bu çalışma, güvenli olmayan içme suyunun ve yetersiz sanitasyonun Afganistan'daki 5 yaş altı ölümler üzerindeki etkisini incelemek için deneysel kanıtlar sunmaktadır. Beş yaş altı çocuklarda hanenin sanitasyon ortamı ve içme suyu kaynakları arasındaki ilişkiyi test etmek için beş yaşın altındaki çocuklar "yenidoğan", "bebek" ve "beş yaş altı" olarak sınıflandırıldı. Afganistan'da beş yaş altı çocuk ölüm hızı ile su ve sanitasyon etkisini ortaya çıkarabilmek için binary lojistik regresyon ve marjinal etki kullanıldı. Bulgularda, güvenli olmayan içme suyu ve yetersiz sanitasyon gibi iyileştirilmemiş ortamlarda doğan çocukların ölme olasılığının bebeklik döneminde daha yüksek olduğu ortaya koyulmuştur. Beş yaş altı çocuk ölüm hızı için Afganistan'daki yetersiz sanitasyon tesislerinin riski, güvenli olmayan su tedariğinden daha anlamlıdır. Sonuçta, kirli bir çevre Afganistan'da beş yaş altı çocuk ölüm hızını istatistiksel olarak artırmaktadır. Bulgulara göre suyun ve yetersiz sanitasyonun beş yaş altındaki çocuklar üzerindeki etkisini azaltmak için hükümetin güvenli bir su temini sağlaması, hanehalkı bireylerin sanitasyon hakkında farkındalığının artırılması, kırsal alanlarda kamu sağlık hizmetlerinin kalitesini artırması önerilmelidir.
Anahtar kelimeler: Yenidoğan, bebek, 5 yaş altı çocuklar, ölüm, sanitasyon, su.

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Introduction

The life expectancy at birth and children mortality dramatically has been changing globally. The trend of children under five years' age mortality rate declined by 59 percent from 93 deaths per 1000 live births in 1990 to 39 in 2018 (1). Although the global children's death rate is high and we need to prevent the causes of death, the decline rate is not equal in all regions of the world. Sub-Saharan Africa remains the region with the highest under-five mortality rate in the world by the average rate of 78 deaths per 1000 live births in 2017. In southern Asia countries, the average rate of mortality for children under five years' age was 41.8 death per 1000 live birth in 2017, Sri Lanka by 10 deaths from 1000 live birth and Pakistan by 87 death was the lowest and highest rate of mortality for under five years' age in 2017, after Pakistan, Afghanistan by 81 death from 1000 live birth was the second-largest mortality rate in the age of under five years (2). In sustainable development goals (SDGs) of the United Nations aim to reduce the mortality by 2030, and preventable deaths of newborns and children under 5 years of age, with all countries to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortalities to at least as low as 25 per 1000 live births (3). The trend of child under-five years' mortality in Afghanistan has declined in the past five years. Neonatal mortality rate declined by 43.25 deaths per 1000 live birth in 2013 to 37.07, the infant mortality declined from 57.29 in 2013 to 47.86 and the children under five years' age mortality declined from 76.92 in 2013 to 62.27 in 2018 (4).

Afghanistan under the SDGs and the unfinished business of the millennium development goals (MDGs) have been considered in formulating the goals, targets, and strategies of the six national health strategies to improve the quality of health services, the National Health Policy 2015–2020, macroeconomic policies and economic growth, and the socioeconomic status of the country (5). Insufficient public health services significantly affect public health. Only 8.2% of GDP of Afghanistan was allocated to health expenditures in 2014 and 3.9% of GDP for education expenditure in 2017 (6). Education of household members and the quality of public health services strongly affect the rate of mortality.

Low-income countries are still facing many social challenges. Children are dying because of many diseases. Observing sanitation will reduce the rate of children's death, a study shows that washing the hands with soap and keeping hands clean reduces diarrhea by (42-47) percent (7). Almost 43.42 percent of Afghan civilians use at least basic sanitation services, 4.84 percent of household income expended on household health expenditure (8). In 2013 national sanitation in Afghanistan was estimated 63% improved in rural areas (9). In 2017 from all populations 67.06% used at least basic drinking water services, 70% drank improved water, and 53% used improved sanitation facilities (10).

Household life conditions directly affect the health of household members, especially children under five years' age who are more sensitive to household sanitation and drinking water. Shortage of clean drinking water in rural, uneducated parents, lack of knowledge, weak and disqualify public health services, insufficient clinics, inaccessibility of people to medicines, unreachable of people to clinics in rural and awareness level of people are the biggest reasons that the mortality rate of children under five years' age still in high in Afghanistan. Most of Afghan households do not observe good health and cleanliness such as frequent hand washing with soap, using the protected and safe toilet, and drinking clean water. Many diseases can happen when the household uses unclean water and unprotected toilets.

To recognize the sensitivity of children's death from household's sanitation and water, this study was conducted to find the effect of sanitation and water on three stages of childhood under five years'

age mortality. We aimed to find the neonatal mortality, infant mortality, and children under five age mortality caused by household sanitation and using water. In order to recognize the sensitivity of children's death from household's sanitation and drinking water conditions, this study was conducted to find the effects of sanitation and water on three stages of childhood under five years' mortality. We aimed to find neonatal mortality, infant mortality, and children under five age mortality caused by household hygiene.

Literature review

The scarcity of water resources and unequal accessibility of people to clean and improved water is rapidly increasing all around the world. Around 2.1 billion people lack access to safely managed drinking water services and 4.5 billion people lack safely managed sanitation services (11). 340,000 children under five die every year from diarrheal diseases (12). Unimproved water and poor sanitation are affecting child life and causing child mortality. Inadequate sanitation and poor hygiene practices are estimated to cause 1.5 million child deaths every year, mostly in developing countries (13). 12% of health care facilities had no water services and in Least Developed Countries, only 55% of health care facilities had basic water services in 2016 (9).

According to scholars' findings, observing households on sanitation and hygiene directly improved the sanitation and hygiene status of households and rescued the children's lives. Improved water and sanitation significantly reduced the death of neonatal, post-natal, and children under 5 years by 31%, 41%, and 47% respectively in Nigeria (14). Water and sanitation facilities are one of the measurements of human development and have different effects on urban life vs rural. Urbanization and re-settlements leave impacts on residents. According to (15), lack of safe water and poor sanitation cause diarrhea risk, and by improving the quality of water and handwashing with soap the risk of children mortality is strongly reduced (16).

Do neighborhood and religious sanitation affect infant mortality? In India, the result of research presents that Muslim children are substantially more likely than Hindu children to survive to their first birthday and poor sanitation are a channel linking the religious composition of neighborhoods to infant mortality (17), Muslims children survival rates are higher than Hindu because of socioeconomic status (18). Village sanitation affects the average child's height (19). The household environment affects the children's growth. Children from clean households had higher height, lower lactulose, and lower immunoglobulin than children from contaminated households (20).

Nutrition is important in maintaining health and preventing disease. Safe nutrition protects the children against disease, inadequate nutrition in causing anemia disease. By sanitation, the children of Nepal between 2006-2011 developed higher hemoglobin levels and prevented anemia (21). Government sanitation program effect on childhood life expectation. India's Total Sanitation Campaign (TSC) affected the life of six-year-old kids and open defecation was an important threat to human capital (22). Psychological derivatives of the household such as hygiene and sanitation knowledge do not affect the sanitation preferences (23). Average birth size, maternal age, and birth interval had a positive association, antenatal care by a skilled provider, facility delivery, paternal higher education, and central-eastern region had a negative association on early neonatal mortality in Afghanistan (24).

Drinking water and sanitation leave different effects on child mortality. Accessibility to drinking water affects mortality, sanitation has more effect than water on child mortality (25). Sanitation and drinking water leave different effects on post-natal and neonatal mortality. The researchers illustrated that water supply and toilet facilities statistically have large significance on post-neonatal and child period but insignificant and small effect on the neonatal period (26), Provision of piped water reduced the infant mortality rate

significantly (27). Water resources and sanitation significantly affect child mortality, piped water and the main sewer put the lowest effect and lake waters put the highest effect on the child health of Kenya (28).

Most researchers arrived that the improved and clean water significantly prevented the rate of children dying, poor sanitation of household causes different diseases and increased the children mortality rate at three-stage of children live period. Provision of clean drinking water, qualified water, water resources, improving water supply and accessibility to all residents especially in rural areas significantly improved the quality of life in households and decreased the rate of child mortality. In conclusion, most researchers reached that point that the improved and clean water significantly prevented the rate of children dying, poor sanitation of household causes different diseases and increased the children mortality rate at three stages of children's life period. Provision of clean drinking water, qualified water, water resources, improving water supply and accessibility to all residents especially in rural areas significantly improved the quality of life in households and decreased the rate of child mortality.

Research methodology

Data information: To examine the effect of household sanitation and hygiene status on child mortality in Afghanistan the cross-sectional data based on the 2015 AfDHS (the birth history records) dataset by the permission of the DHS program were extracted and used. The 2015 Afghanistan Demographic and Health Survey (2015 AfDHS) was implemented by the Central Statistical Organization (CSO) and the Ministry of Public Health (MoPH) of Afghanistan. The 2015 AfDHS project was funded by the United States Agency for International Development (USAID). The company provided technical assistance through the DHS Program, the survey implemented from June 15, 2015, to February 23, 2016 (29).

The stratified two-stage sampling method was implemented in the survey of the AfDHS 2015 project. In a birth history record survey, from 34 provinces 125,715 ever-married women were selected, using a stratified sampling method 27% of participants selected from urban areas and 63% from rural, all married women aged 15-49 years living in households have participated in this survey. The main purpose of the 2015 AfDHS survey project was to collect data on housing characteristics and household population, characteristics of represents, marriage and sexual activities, fertility, fertility preferences, family planning, infant and child mortality, maternal healthcare, child health care, nutritional status of children and women, malaria, HIV/AIDS-related knowledge, adult and maternal mortality, women's empowerment, domestic violence and fistula (30).

Variables of study: According to the AFBR70DT (Afghanistan History Birth Records) dataset of the 2015 Afghanistan Demographic and Health Survey (AfDHS) project in the last 5 years before the 2015 survey 10,149 live births have died. Out of 10,149 live births 3,687 children died before reaching the first month, 4,390 children died before reaching one-year age, 1,496 children died before reaching fifth birth and 576 children died after 5-years' age. The outcome variable of this study was child mortality under five years of age and separated into neonatal mortality, infant mortality, and children under 5-year age mortality variables, the response variables were recorded as a binary variable as child died=0 and child living=1. Neonatal mortality is the probability of death before reaching 28 days of age, Infant mortality is the probability of death before reaching 1 year of age, and children under 5-year mortality is the probability of death before reaching 5 years of age. In this research, the neonatal, infant, and under-five mortality rates were extracted directly from the birth history record of the child's age at death.

Table 1 illustrates the variables of this study. The explanatory variables of this research are categorized into the household, mother's and father's characteristics, housing

sanitation, maternal habits, and child status. Table 1 presents the paternal and maternal education/occupation coded as No education/No occupation =0 and has education/occupation =1. The household wealth index is coded as 0= poor include (poor and poorest) and 1= rich include (middle, richer and richest). The four major ethnicities included in this research were coded as follows: Pashtun=1, Tajik=2, Uzbek=3, and Hazara=4. Type of drinking water from response categorized into two parts such as clean water and non-clean (contaminated) water, toilet sanitation defined as improved toilet and traditional toilet. The clean water coded=1 and non-clean water coded=0, the improved toilet coded=1 and traditional toilet coded=0. All habits of the mother such as smoking cigarettes, drinking alcohol, taking drugs, and smoking tobacco in pipe also coded 1 if the habit is positive and 0 otherwise. The female sex of child coded=0, the male sex of child coded=1, the birth order of child categorized into two-part ≤5 birth order and above the 5 birth order and coded as: ≤5=0, >5=1.

Table 1: Research variable explanation.

Variables	Description	Measurement	
Mortality			
Neonatal	The probability of death in 28 days	Died=0	Survived=1
Infant	The probability of death in 1 year	Died=0	Survived=1
Child	The probability of death in 5 years	Died=0	Survived=1
Household Characteristics			
Household head gender	Male and Female category	Female=0	Male=1
Household head age	Age category of household head	≤18=0	>18=1
Household wealth index	Poor and Rich	Poor=0	Rich=1
Household residence	The residence type (Rural or Urban)	Rural=0	Urban=1
Mothers characteristics			
Age	Current age of mother	<18=0	>19=1
Education	The level of school attendant	No=0	Yes=1
Occupation	Occupation of mother	No=0	Yes=1
Ethnicity	Pashtun, Tajik, Hazara , Uzbek (1,2,3,4)		
Age at first born	Age of mother at first birth	<18=0	>19=1
Father characteristics			
Age	The age category of father	<18=0	>19=1
Education	Education level of father	No=0	Yes=1
income	Father income	No=0	Yes=1
Housing condition			
Drinking water	Clean water not clean water	No=0	Yes=1
Toilet sanitation	Safe toilet and unsafe toilet	No=0	Yes=1
Maternal habits			
Smoking cigarette	Does mother smoke cigarette?	No=0	Yes=1
Drinking alcohol	Does mother take alcohol?	No=0	Yes=1
Taking drugs	Does mother currently take drugs?	No=0	Yes=1
Smoking tobacco in pipe	Does mother currently use tobacco?	No=0	Yes=1
Child status			
Sex	Gender of child	Female=0	Male=1
Birth order	Birth order number of child	≤5 = 0	>5=1

Resource: research findings

Statistical analysis: The effect of water and sanitation on child mortality is analyzed by classifying children under five into three groups (Neonatal, Infant, and under 5-year age). In this study to examine the causal effects of households using water and toilet

sanitation on children under five years' age mortality, the Binary logistic regression model has been applied. The primary response variables for this study were Neonatal mortality (NNMR), infant mortality (IMR), and under-five years' mortality (U5MR). In order to find the effect of each explanatory variable on the response variable, three separated models for each response variable have been constructed. For this study, the child mortality rate for each age division was calculated as the number of deaths per 1000 live births in a given year. The control variables of this study were household drinking water and household sanitation.

The following three model has been constructed for the research:

$$P(NNMR)=1) = \beta0+\beta1Water+\beta2Sanitation+ \sum_{i=2}^{8} \beta2control+\varepsilon z \quad I$$

$$P(IMR)=1) = \beta0+\beta1Water+\beta2Sanitation+ \sum_{i=2}^{8} \beta2control+\varepsilon z \quad II$$

$$P(U5MR)=1) = \beta0+\beta1Water+\beta2Sanitation+ \sum_{i=2}^{8} \beta2control+\varepsilon z \quad III$$

Where are:

NNMR = Neonatal Mortality Rate
IMR = Infant Mortality Rate
U5MR = Children under 5-year age Mortality Rate
β0 = Intercept of model
β 1,2 = The coefficient (effect) of explanatory variables
εz = Error term

Where the (NNMR) stands for the probability of death for children before 28 days, (IMR) stands for probability of death for children during the first month of birth, (U5MR) stands for the probability of death for children during the first birthday, and fifth birthday. Equation I represent the causal effect of household's drinking water, toilet sanitation, and other variables on neonatal mortality, equation II represent the causal effect of household drinking water, toilet sanitation and other variables on infant mortality and equation III represent the causal effect of household drinking water, toilet sanitation and other variables on children under 5-years age mortality.

In this study, the effect of household sanitation and water on different steps of children under 5-years of age mortality has been examined. In model one, all explanatory variables were included to find the statistical significance of explanatory variables on outcome variables with ($p<0.05$, $p<0.10$, and $p<0.01$) values. In models two and three, the effect of the same variables which significantly affect the outcome variable in model one has been calculated. The depth of effects of independent variables on outcome variables using logistic regression model reporting odds ratio in all three models has been analyzed. By reporting the results of the marginal effects, the analysis is based on percentage points.

Results

Based on a world-bank report (2018), the mortality rate of children under 5-years of age in Afghanistan has declined. The neonatal mortality rate from 2013 to 2018 decreased around 1% each year, nearly a 6.1% decrease occurred from 2013 to 2018 in neonatal mortality. The declination slope of infant mortality is a little steeper than

neonatal mortality, in 2013 the rate of death in the infant period was 57.29 death in 1000 live birth, in 2018 recorded 47.86 death in 1000 live birth, which means from 2013 to 2018 approximately 9.4% decrease has been recorded. In children under 5-years of age mortality from 2013 to 2018, almost 14 deaths were prevented, in each year around 3% declination happened, from 2013 to 2018 in children under 5-year age mortality 14.6% decrease recorded. In female infant mortality from 2013 to 2018 each year between 1-2% decrease occurred, female infant mortality in 2013 was 53.55 deaths per 1000 live births, in 2018 was recorded 44.46 deaths, it means around 9% decrease from 2013 to 2018. In males and females under 5-years of age mortality from 2013 to 2018 around 14.50% and 14.70% decrease reported. The male infant mortality rate in 2013 was 60.79 deaths per 1000 live births, it decreased to 51.12 deaths in 2018, which means from 2013 to 2018 around 9.6% decreased (World, 2018).

According to the 2015 AfDHS survey, our findings in Table 2 demonstrates that, from 10,149 live birth, 3687(36.3%) infants have died before reaching 28 days' age, 4,390 (43.2%) of children have died before reaching the first year, 1,496(14.4%) of children have died before reaching to the fifth year and 576(5.6%) of children have died after five years' age. Household water sources were 12 different categories and toilet facilities were 11 different categories in the 2015 AfDHS project. Based on WHO/UNICEF guidelines, (14) categorized the household water sources and sanitation facilities into improved and unimproved status.

Table 2: Descriptive results for children under-five year mortality, and percentage of safe water and sanitation in Afghanistan.

Child death age	**Freq.**	**Percent**	**Cum.**
Before 28 days (NMR)*	3,687	36.3	36.3
Before 1 year (IMR)**	4,390	43.3	79.6
Before 5 years (U5MR)***	1,496	14.7	94.3
After 5 years age	576	5.6	100
Total	10,149	100	
Water and sanitation	**Improved%**	**Unimproved %**	**Total %**
Water source	47.5	52.5	100.0
Sanitation facility	26.6	73.4	100.0

** Neonatal mortality rate ** Infant mortality rate *** Children under 5-year mortality*
Source: Author calculation.

Household water supply sources and toilet facilities have been categorized as follow: a collection of piped water, public taps, tube wells, protected dug well, protected spring and rainwater into improved and unprotected dug well, unprotected spring, small tank water provider, surface water, lake, pond, stream, canal, irrigation, and bottle water into are taken as unimproved drinking water. Pour-flush system, piped sewer system, septic tank, ventilated improved pit latrine(VIP) and pit latrine with slab categorized to safe sanitation and pit latrine without a slab, bucket, hanging toilet, hanging latrine, no facilities, bush, share, or public facilities categorized to unimproved sanitation facilities (DHS, 2017). As Table 2 shown, around 47.5% of participants have access to improved water sources while 52.5% were using unimproved drinking water supply, 26.6% have access to good sanitation facilities and 73.4% were using unimproved sanitation facilities.

Table 3 illustrates the descriptive statistic of variables, which shows that 98.8% of households are headed by males, 90.2% of household heads are uneducated, 75.7% live in rural areas and 64.7% are in the poor category. Living in rural, uneducated

household heads, male household heads and household wealth index affect the children's mortality. One of the major contributors to the mortality rate of the children is the education level of parents, which is believed to affect sanitation and hygiene as families get more education, which has a direct impact indeed. To illustrate more on this issue, the level of education of the parents has been reported in table 3 where 62% of fathers had no education. Compared with mothers where 90% were uneducated. In a very rough comparison, it is clear that mothers are more uneducated than fathers, which will cause more threats to child care and health.

Table 3: Descriptive statistics of research variables.

Variables	Freq.	Percent	Cum.
Household head sex (Male)	124,258	98.8	98.8
Female	1,457	1.2	100.0
Total	125,715	100.0	
Household head (Educated)	12,544	10.0	10.0
Not	113,171	90.0	100.0
Total	125,715	100.0	
Households residence Area (Urban)	30,532	24.3	24.3
Rural	95,183	75.7	100.0
Total	125,715	100.0	
Household Wealth Index(Poor)	81,375	64.7	64.7
Rich	44,340	35.3	100.0
Total	125,715	100.0	
Father (educated)	47,550	38.0	38.0
Not	77,886	62.0	100.0
Total	125,436	100.0	
Mother (educated)	12,544	10.0	10.0
Not	113,171	90.0	100.0
Total	125,715	100.0	
Mother has (habits)	1674	2.5	2.5
Not	123,725	97.5	100.0
Total	125,399	100.0	

Source: Author calculation

One of the big issues affecting child mortality during pregnancy and after birth is the bad habits of the mothers for instance smoking cigarettes, taking drugs, and alcohol. It is not only the habit side that will affect the child but from an economic perspective, the researchers claim that parents smoking habits divert the money from household necessities to buy smoke and drugs and adversely affect the children's lives (31). Table 3 presents the mother habits which indicates that 97.5% of respondents don't have any kind of bad habits and 2.5% of respondents smoke cigarettes, take alcohol and drugs, which means that from 125,399 respondents only 1674 individual mothers smoke cigarettes and take drugs. In this research, all kinds of mother's habits have been combined in one single dummy variable which takes 1 if the mother has bad habits and 0 otherwise.

According to research findings, in the five years' period prior to the 2015 AfDHS survey date, a total of 9,573 children have died between born time and 5 years interval. The highest level of children death occurred in the infant stage (4,390 death), the middle level of death recorded in the neonatal age period (3,687 death), and the lowest children death occurred in one to fifth years' age period (1,496 death). Table 4 illustrates the results of binary logistic regression for neonatal, infant, and children under 5-year age mortality. Households with unimproved

sources of drinking water and sanitation facilities have a significantly higher risk of infant and children under 5-year age mortality. There was no significant evidence to find the risk of unimproved drinking water sources and poor sanitation on neonatal mortality.

Table 4: Logistic regression results for neonatal mortality, infant mortality and children under 5 years mortality in Afghanistan (N=9,573).

Variables	NNMR model (I)			IMR model (II)			U5MR model (III)		
	Odd. Ratio	Z	p	Odd. Ratio	Z	p	Odd. Ratio	Z	p
Unimproved drinking water	1.03	0.72	0.473	1.03	0.72	0.473	1.03	0.72	0.473
Unimproved sanitation	1.07	1.33	0.184	1.07	1.33	0.184	1.07	1.33	0.184
Poor household	1.11	2.28	**0.023**	1.11	2.28	**0.023**	1.11	2.28	**0.023**
Mother age at 1.st birth<18	1.09	2.06	**0.039**	1.09	2.06	**0.039**	1.09	2.06	**0.039**
Mother habits	1.42	3.39	**0.001**	1.42	3.39	**0.001**	1.42	3.39	**0.001**
Father no education	1.09	1.98	**0.048**	1.09	1.98	**0.048**	1.09	1.98	**0.048**
Mother has occupation	0.71	-6.19	**<0.001**	0.71	-6.19	**<0.001**	0.71	-6.19	**<0.001**
Child birth order < 5	0.84	3.01	**0.003**	0.84	3.01	**0.003**	0.84	3.01	**0.003**
Constant term	0.36	-9.03	**<0.001**	0.36	-9.03	**<0.001**	0.36	-9.03	**<0.001**

Source: Research findings

In the neonatal mortality model, other factors in addition to household unimproved water sources and sanitation facilities have shown a statistically significant effect on it. There is a significantly higher risk for children (neonatal) who were born in poor households, which the odds of poor are 1.11 times higher than those of rich class families in 95% confidence level. The age of the mother at first birth also shows an impact on mortality as the odds of mothers under age 18 is 1.08 times higher than their counterparts (which is significant at 95% level). One of the major findings in neonatal mortality rate is the positive impact of mothers' habits, which the odds ratio is 1.42 times of mothers with no bad habits. But comparing the mothers who work outside the house to their counterparts, the odds of them are 0.70 which is statistically significant at 99% level. This finding is relevant to daily life in Afghanistan, as educated mothers tend to work outside and they care and know-how to care for themselves and their infants better than those illiterates. The fathers' education is also affecting neonatal mortality positively, as the odds of non-educated fathers are higher (1.08). The odds of poor families show, that neonatal mortality is 1.11 times higher in poor households compared to rich families.

As table 4 indicates that the odds of unimproved drinking water and sanitation, and mother habits are higher in infant mortality rate (IMR in model II). As it's obvious the odds of those with an unimproved drinking water source is 1.12 times higher than their counterparts in 99% confidence level. Also, the odds of poor sanitation or unimproved sanitation facilities is 1.14 times of those who have improved one which is statistically significant at 99% level. The other variable which has a higher odds ratio is the mothers' habit. The odds ratio of mothers' who have habits for instance smoking cigarettes is 1.16 times compared to those who don't have this kind of habit. It means that the infant mortality rate is 1.16 times higher if mothers are having habits like smoking compared to their counterparts. The education of fathers is also affecting the IMR, as the odds of uneducated fathers are 1.04 times higher than educated ones.

In the U5MR model, children

between (1-5) years of age are associated with a significantly higher risk from household unimproved drinking water sources, unimproved sanitation facilities, poor household situation, mother habits such as smoking cigarettes and taking drugs, and childbirth order. Children under five, whose born in households that are not drinking clean water sources were 1.14 times more likely to die than those born in households that are using clean drinking water sources by 95% confidence interval (OR=1.42, p=0.040). According to table 8 in the U5MR model the effect of poor sanitation on children under five years' age mortality reported (OR=0.90, p=0.059), means the household which is observing sanitation is more likely to die with a 90% confidence interval. Other factors such as poor household, mother habits, and mother occupation in addition to unimproved drinking water sources and poor sanitation significantly affect the children under five years' age mortality. In addition of unimproved drinking water sources and sanitation facility of poor household condition significantly has a high risk to die children under five years' age (OR=1.14, p=0.004), which means those living in the poor household are 1.14 times more likely at risk of die than rich household.

Table 5: Marginal effect result of logistic regression for neonatal mortality, infant mortality and children under 5-year mortality in Afghanistan (N=9,573).

	NNMR model (I)		IMR model (II)		U5MR model (III)	
Variables	**dy/dx**	**p**	**dy/dx**	**p**	**dy/dx**	**p**
Unimproved drinking water	0.007	0.473	0.029	**0.006**	0.017	**0.041**
Unimproved sanitation	0.016	0.182	0.032	**0.010**	0.018	0.054
Poor Household	0.024	**0.023**	0.001	0.894	0.027	**0.005**
Mother age at first birth<18	0.020	**0.039**	0.023	**0.021**	0.002	0.783
Mother habits	0.080	**0.000**	0.038	0.110	-0.044	**0.033**
Father has no education	0.020	**0.049**	0.009	0.361	-0.012	0.152
Mother has occupation	-0.078	**<0.001**	-0.068	**<0.001**	0.006	0.539
Child birth order<5	0.031	**0.003**	0.005	0.600	-0.025	**0.003**

Source: Research findings

According to the marginal effect result of this research as presented in Table 5, there is no statistical significance evidence to find the effect of unimproved drinking water sources and poor sanitation facilities in the NNMR model but in IMR and U5MR models are significant evidence to find the effect of household drinking water sources and sanitation facilities. In addition to this other factors such as poor household, mother age, father education, mother habits, mother occupation, and child birth order also significantly affect our models.

In the NNMR model, when the poor household economic condition decrease one unit from the current situation the probability of children (neonatal) die will increase by 2.4% with 95% CI, the probability of neonatal die in the case of mother age under 18 years at first birth will increase by 2% when the mother age change from 18 years to 17 age with 95% CI, the probability death of neonatal will increase by 8% when the mothers increase smoking cigarettes and taking drugs with 99% CI, the uneducated father will increase the death probability of neonatal by 2% whit 95% CI, neonatal whose mother is working will decrease the probability of neonatal death by 7.8% with 99% CI.

Household unimproved drinking water and poor sanitation facilities significantly increase

the risk of infant death. As table 5 shows, when the household increases drinking of unimproved water by one unit the probability of infant death will increase by 2.9% with 99% CI, the probability of infant death caused by changes in sanitation is more than water cause, by 99% CI the probability of infant death will increase by 3.2% while the household poor sanitation worsens off one unit more. The age of mother at first birth under 18 years significantly increases the risk of infant death, changing in mother age from 18 to 17 will increase the probability of infant death by 2.3% with 95% CI, whose mother works significantly decreases the probability of infant death by 6.8 % with 99% CI.

The causal effect of unimproved drinking water and lack of sanitation is statistically significant due to the U5MR model. Increasing the household unimproved drinking water by one unit the probability of children under 5-year death also will increase by 1.7% with 95% CI, demolishing household sanitation by one unit the probability of children under 5-year age death will increase by 1.8% with 90% CI. In addition to household unimproved drinking water and poor sanitation, change in poor household condition by one unit the probability of death in children under 5-year age also increased by 2.7% with 99% CI.

Discussion

Using data from 2015 AfDHS and three NNMR model, IMR model, and U5MR model, we examined the risk of households' unimproved drinking water and poor sanitation on children under 5-year age mortality. We found that the causal effect of unimproved drinking water, poor sanitation was statistically significant and increase the risk of infant and children under 5-year mortality, however, there was no significant evidence to find the effect of unimproved water and poor sanitation on the risk of neonatal mortality. According to previous researches (14), conducted that sanitation and water significantly affect post-neonatal and child mortality and statistically do not affect neonatal mortality in Nigeria (33), reported in their research findings that lack of access to water and sanitation strongly affects the children under 5-year age in low-and middle-income countries. The water supply and toilet facilities significantly affect the post-neonatal and children's living periods in Eritrea (25, 33) found that the impact of sanitation is more than water on childhood mortality in Egypt. In Malaysia did not appear that access to piped water and toilet sanitation have much impact on children mortality risk (32).

According to our findings, addition of unimproved drinking water and poor sanitation facilities, households' poor economic condition strongly increases the risk of death at neonatal and children under 5-year age period, there is no significant evidence to show the effect of poor household condition on the death of children in infant period. Our findings are much more consistent with (14, 32-33) findings in Egypt, low-and middle-income countries, and Nigeria. Poor households, because of low income, consume unimproved water and use unclean and disposal sanitation facilities.

And addition to unimproved drinking water and poor sanitation, mother age at first birth under 18 years age conducted significantly affecting the probability of death at neonatal and infant period, however, the age of mother at first birth statistically does not affect the probability of death at children under 5 age period. Children at neonatal and infant period are more likely to die whose mother's age was under 18 years old at first birth than whose mother was more than 18 years old at first birth. In low- and middle-income countries, the age of women between (12-17) at birth significantly more affects their children to die than women between 27-29 (34). Children whose mothers smoke cigarettes and use drugs

are significantly more likely to die in the neonatal period than whose mothers do not smoke cigarettes and do not take drugs, there is no statistical significance to find the effect of whose mothers smoke cigarettes and take drugs in infant mortality. Our results indicated that parent education strongly affects the probability of children dying in different periods, the children whose father is not educated in the neonatal period significantly more likely to die than those whose father is educated, in infants and children under 5-year age mortality there is no significant evidence to examine the father's education on death risk.

Conclusion

This study approached that unimproved drinking water and poor sanitation strongly affect the childhood under 5-year life in Afghanistan. The finding shows children at the age of 1-5 years are more sensitive to water supply and sanitation than the age of neonate period. The result highlighted that the risk of poor sanitation is greater than the risk of unimproved water supply. Additionally, the result confirms that households' poor economic status, mother habits, maternal age at first birth, father education, mother occupation, and child birth order partially affect child under 5-year mortality in Afghanistan. The probability of death among infants and children under the 5-year age period is significantly more likely to die by the causes of unimproved drinking water sources and poor sanitation in Afghanistan. Children in infant and under 5-year periods are more likely affected by poor sanitation facilities than water sources. There is no significant evidence to find the causal effect of unimproved drinking water sources and poor sanitation facilities on neonatal mortality.

The article suggests needed further studies to find the association of children mortality and hygiene in rural areas based on household’s accessibilities to types of water sources, education level of parents, and multidimensional poverty index. Our contribution is, we found the exact impact of unimproved drinking water and poor sanitation on different life stages of children under five years’ age period. We provide evidence that the risk of poor sanitation is higher than the risk of unimproved drinking water in infants and children between 1-5 years’ age. Also, we suggest that by providing a clean drinking water supply and observing sanitation the risk of children under five years’ mortality significantly will be decreased.

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