

# Infant Mortality in Rural and Post-Conflict Areas in South Kivu, Eastern DR Congo: A Cross-Sectional Study

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## Research Article

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# Abstract

**Background:** The infant mortality rate in the province of South Kivu remains one of the highest in the Democratic Republic of Congo (DR Congo). The aim of this study is to estimate this mortality by identifying the associated factors in the health zones of Walungu and Miti-Murhesa, rural and post-conflict health zones of South Kivu, eastern DR Congo.

**Methods:** We conducted a cross-sectional study in two post-conflict rural health zones, Miti-Murhesa and Walungu, between July 2016 and September 2017. Our study population consisted of women giving birth from two aforementioned areas during the period of study in which a structured questionnaire assessing the survival of the child resulting from the previous pregnancy was administered. Qualitative variables were described as counts and proportions and quantitative variables as means or medians depending on their distribution. To determine the factors associated with child survival, simple and multivariate logistic regression models were constructed. The materiality threshold was set at 5%.

**Results:** The infant mortality rate is 49.7 ‰ in the two study areas overall and specifically 52.6 ‰ in Miti-Murhesa and 46.56 ‰ in Walungu. The factors associated with this mortality were the age of the mother under 20 years old [adjusted odds ratio ( ORa) = 2.3, 95% CI : 1.1-4.5 ; p = 0.022], household size greater than or equal to 7 people [( ORa = 3.7 ; 95% CI : 1.9-7.3 ; p < 0.001 )], prematurity [( ORa = 25.5 ; 95% CI : 9.9-65.4 ; p < 0.001)], home birth [( ORa = 1.9 ; 95% CI : 1.3-2.9 ; p = 0.001)], the inter-reproductive space less than 12 months [( ORa = 5.3 ; ORa : 3.3-8.5 ; P < 0.001 )], not using LLINs [( ORa = 2.2 ; 95% CI : 1.4-3.3 ; P < 0.001 )].

**Conclusion:** Infant mortality in the post-crisis rural area of South Kivu remains high although it is relatively low compared to the national average (58 ‰). However, efforts still need to be made in order to hope to achieve the Sustainable Development Goals.

## Background

In the Democratic Republic of Congo (DRC), infant mortality remains one of the highest in the world, despite a remarkable drop of 60.8% over the last two decades, from 148 per thousand in 1995 to 58 per thousand in 2014 [1, 2]. According to the UNICEF, several factors contributed to the decline in infant mortality rates in the DRC. These include immunization, integrated management of childhood illnesses, breastfeeding, use of long-acting insecticide-treated bed nets (LLINs) and supplementation. in vitamin A [3].

According to data from the second demographic and health survey (DHS) carried out in the DRC, there are still large disparities in infant mortality between provinces and between urban and rural areas within the same province. The provinces of South Kivu and Bas-Congo are the most affected (with 92 and 81 deaths per thousand live births respectively) unlike those of Kinshasa and North Kivu (with 50 and 41 deaths per thousand live births [1]).

Since 1994, South Kivu has been the theater of a situation of war and armed conflicts with dramatic consequences for the health of mothers and children. Studies had shown that the repeated armed conflicts in eastern DR Congo had a significant impact on overall mortality [4, 5]. However, a recent study on DHS data from 2013–2014 suggests that infant mortality is not specifically higher in eastern R. D. Congo where armed conflicts persist even during this post-war period [6, 5].

Despite the availability of provincial estimates of the level of infant mortality in the DRC, there is scarcity of local data considering the geographic and socio-political specificities of each health zone. Such data is important to enable political and health actors to develop health programs and policies adapted to the geographic, socio-political, historical and infrastructural specificities of each health zone.

Recognizing that infant mortality is one of the reliable indicators of the state of health of a population [7], this study set out to measure this mortality in two rural and post-rural health zones (ZS). crisis in South Kivu, including the areas of health Miti-Murhesa and of Walungu, two media with a history of e quite different war.

## **Methods**

### **Study framework**

The ZS of Miti-Murhesa and Walungu are located respectively 33 and 46.9 km from the city of Bukavu (capital of the province of South Kivu), with an estimated population of 246,943 and 253,871 inhabitants respectively, according to the data. of 2016 from the Provincial Health Division (DPS). These two health zones are accessible by road. Unlike the Miti-Murhesa area which has been relatively spared from persistent conflicts in eastern DR Congo, the Walungu health zone has been more severely affected by chronic armed conflicts and persistent armed groups [8].

In Walungu, 17 out of 23 health centers (74%), three hospitals and a general referral hospital had been selected and in Miti-Murhesa, two health centers (out of a total of 16), 4 hospitals and a general referral hospital was included in the study. These health structures were selected in a reasoned way because of their geographical accessibility and also because of logistical difficulties.

### **Type and duration of study**

We conducted a cross-sectional study from July 2016 to September 2017.

### **Study population and data collection**

Our study population consisted of deliveries from the two aforementioned areas during the study period in which a structured questionnaire evaluating the survival of the child from the pregnancy preceding the one leading to the current delivery. We systematically included in this study all deliveries who gave birth in one of the structures chosen during the study period and who have lived there for at least 6 months in

one of the HZs of our study. Excluded were deliveries who did not consent to the study and those for whom the postpartum state of health did not facilitate the interview.

A structured questionnaire was administered to the deliveries during the period from childbirth to one week of life by data collectors who consisted of 6 people including 3 doctors and 3 nurses. The collectors were trained on the questionnaire and the latter was tested in a center which is not part of the centers concerned by the present study.

### **Study variables**

The main dependent variable was infant mortality. The latter was defined as the number of child deaths occurring during the 1<sup>st</sup> year of life reported in 1000 live births [9]. It was measured as a dichotomous variable. The explanatory variables considered in the analyzes included the socio-demographic characteristics of the childbirth (age, marital status, level of education, occupation ) , information related to the household (size of household and type of house), sleeping under LLINs during pregnancy and information relating to the child from the previous pregnancy [ inter-reproductive space (SAE) , sex, duration of pregnancy, place of birth, state of child on the day of the investigation, length of life or age of death and probable cause of death].

### **Data analysis**

The data was encoded in Access 2016 and imported into version 23 of the SPSS software for cleaning and analysis. Categorical variables were summarized as frequency and proportion and quantitative variables as mean or median depending on whether the distribution was symmetrical or not. To identify the bills associated with infant mortality, we constructed simple and multivariate logistic regression models. The variables were imported into the multivariate regression model on the basis of a p-value less than or equal to 0.2 and / or on the basis of a biological plausibility. As a measure of association, we present the unadjusted and adjusted odds ratios with their 95% confidence intervals. The threshold for statistical significance was set at 5% type 1 error ( $\alpha$ ).

## **Results**

Table 1  
General characteristics of the study population (2016–2017)

Variable	n (%)
<b>Health Zone (n = 2934)</b>	
Walungu	1396 (47.6)
Miti-Murhesa	1538 (52.4)
<b>Mother's age (n = 2904)</b>	27.1 (5.9) *
<18 years	47 (1.6)
18–24 years old	1074 (37)
25–35 years	1489 (51.3)
> 35 years old	294 (10.1)
<b>Marital status (n = 2919)</b>	
Single	68 (2.3)
Married or in union	2826 (96.8)
Divorced / widowed / separated	25 (0.8)
<b>Length of previous pregnancy (n = 2902)</b>	
Term	2804 (96)
Premature	126 (4)
<b>Place of previous childbirth (n = 2842)</b>	
Home	156 (5.5)
Health center or dispensary	835 (29.4)
Hospital	1849 (65.1)
<b>Gender of previous child (n = 2833)</b>	
Male	1354 (47.8)
Feminine	1479 (52.2)
Age of death in months (n = 146)	3.04 (4.05) *
<b>Inter-reproductive space in months (n = 2907)</b>	24 (9-145) ***
> = 24	1602 (55.1)
<12	74 (2.5)
Between 12 and 24	1231 (42.3)

<b>Variable</b>	<b>n (%)</b>
<b>Tap water use (n = 2928)</b>	
Yes	1331 (45.5)
No	1597 (54.5)
<b>LLIN ** (n = 2927)</b>	
Yes	2466 (84.3)
No	461 (15.7)
<b>Mother's education (n = 2929)</b>	
No education	1222 (41.7)
Primary	911 (31.1)
Secondary or higher	796 (27.2)
<b>Mother occupation (n = 2932)</b>	
Household	1025 (35)
Farmer	1231 (41.9)
Small business	199 (6.7)
Formal employee	477 (16.3)
<b>Type of House (n = 2932)</b>	
Hard	164 (5.6)
In semi hard	2015 (68.7)
Straw / Case	753 (25.7)
<b>Household size (n = 2934)</b>	
<7 people	636 (21.7)
> = 7 people	2298 (78.3)
* Mean (DS), ** LLIN: Mosquito net impregnated with long-acting insecticide, *** Median (Minimum-Maximum)	

Table 1 presents the characteristics of the study population. Two nine thousand one hundred thirty-four children (2934) from the previous pregnancy were identified. The average age of childbirth was 27.1 years and 96.8% are married or in union. 96% of pregnancies have come to term. 41.7% of new mothers have not studied and used the 84% has LLINs during pregnancy, 54.5% do not use tap water. 78.3% of

women born live in households of at least seven people, finally the median inter-reproductive space is 24 months. The sex ratio of children from a previous pregnancy daughter is 1.09  $\frac{\text{girl}}{\text{boy}}$ . The average age of death is 3.04 months.

The infant mortality rate is illustrated in Fig. 1. Of the 2934 previous births, 146 deaths were recorded before the first birthday, for an infant mortality rate of 49.76‰. In Walungu, 65 deaths were recorded, or 46.56‰ against 81 deaths in Miti-Murhesa or 52.6‰.

Table 2  
Pathologies associated with infant deaths in the health zones of Walungu and Miti-Murhesa

Associated pathologies	not (%)
Malaria	18 (12.7)
IVR *	9 (6.3)
Measles	2 (1.4)
Diarrhea	15 (10.3)
Neonatal infection	22 (15.5)
Septicemia	4 (2.8)
Drug poisoning	2 (1.4)
Other	73 (52.1)
* IVR: Upper respiratory tract infection	

The Table 2 shows the pathology most frequently associated with death. Malaria is the most frequently reported pathology (12.7%, n = 18), followed by neonatal infections (15.5 %, n = 22), diarrheal disease s (10.3%, n = 15) and infections upper respiratory tract (6.3 %, n = 9).

Table 3

The factors associated with infant mortality in the health zones of Walungu and Miti-Murhesa

Variables	Raw OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
<b>Mother age</b>				
20–35	(ref)		(ref)	
<20 years	0.5 (0.3–0.9)	0.011	2.3 (1.1–4.5)	0.022
> 35 years old	0.9 (0.5–1.6)	0.719	1.5 (0.6–3.6)	0.334
<b>Household size</b>				
<7 people	(ref)		(ref)	
> = 7 People	2.6 (1.5–4.7)	< 0.001	3.7 (1.9–7.3)	< 0.001
<b>Child gender</b>				
Feminine	(ref)			
Male	1.1 (0.8–1.5)	0.583	1.1 (0.8–1.7)	0.396
<b>Marital status</b>				
Married	(ref)			
Single	1.9 (0.4–8.4)	0.378		
Divorced / widowed	1.2 (0.2–6.8)	0.824		
<b>Duration of pregnancy</b>				
In the long term	(ref)		(ref)	
Premature	30.3 (13.4–68.8)	< 0.001	25.5 (9.9–65.4)	< 0.001
<b>Place of birth</b>				
Hospital	(ref)		(ref)	
Home	1.8 (1.3–2.6)	< 0.001	1.9 (1.3–2.9)	0.001
Health center / Dispensary	0.7 (0.4–1.3)	0.227	0.7 (0.4–1.4)	0.382
<b>Inter-reproductive space (months)</b>				
24 and over	(ref)		(ref)	
Less than 12	4.4 (2.9–6.9)	< 0.001	5.3 (3.3–8.5)	< 0.001
Between 12 and 24	0.4 (0.2–0.7)	< 0.001	1, 2 (0, 9–4, 7)	0.052

\*\* LLIN: Mosquito net impregnated with long-acting insecticide, OR: Odds ratios, CI: Confidence interval

Variables	Raw OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
<b>Use of tap water</b>				
Yes	(ref)		(ref)	
No	1.5 (1.1–2.1)	0.017	1.2 (0.8–1.8)	0.321
<b>Mother's education</b>				
Secondary and above	(ref)			
No study	0.8 (0.5–1.2)	0.312		
Primary	0.9 (0.6–1.4)	0.798		
<b>Father's education</b>				
Secondary and above	(ref)		(ref)	
No study	1.4 (0.9–2.1)	0.104	1.5 (0.9–2.4)	0.074
Primary	0.8 (0.5–1.2)	0.256	0.9 (0.6–1.6)	0.953
<b>Type of house</b>				
Hard	(ref)		(ref)	
In half hard	1.8 (0.8–4.3)	0.179	0.9 (0.4–2.5)	0.991
Case or straw	1.4 (0.9–2.0)	0.056	1.2 (0.8–1.8)	0.428
<b>LLIN**</b>				
Yes	(ref)		(ref)	
No	1.9 (1.354–2.92)	< 0.001	2.2 (1.4–3.3)	< 0.001
** LLIN: Mosquito net impregnated with long-acting insecticide, OR: Odds ratios, CI: Confidence interval				

Table 3 shows that factors associated with infant mortality are maternal age less than 20 years [(OR = 2.3, 95% CI : 1.1–4.5 ; p = 0.022)], the upper cleaning or equal at 7 [(AOR = 3.7 ; 1.9–7.3 ; p < 0.001 )], prematurity [(AOR = 25.5 ; 95% CI : 9.9–65.4 ; p < 0.001)], home birth [(AOR = 1.9 ; 95% CI : 1.3–2.9 ; p = 0.001 )], the interbreeding space of less than 12 months [(AOR = 5.3 ; AOR : 3.3–8.5 ; P < 0.001 )] and finally the non-use of LLINs [(AOR = 2.2 ; IC 95% : 1.4–3.3 ; P < 0.001 )].

## Discussion

Our study indicated an infant mortality rate of 49.76‰ overall. The factors associated with this mortality are the age of the mother under 20 years old, the household size greater than or equal to 7, prematurity, home birth, the inter-reproductive space of less than 12 months and finally no. use of LLINs.

The infant mortality rate obtained in our study (49.76‰) remains lower than the infant mortality rate at the national level in 2015 (58‰) [1] and at the provincial level of South Kivu (92‰) [1]. The areas concerned by our study are two relatively stable areas from a security and humanitarian standpoint at present, with in particular more than 80% of deliveries are attended by staff. In addition, the health structures are well organized and accessible to the population. The province's overall estimate of the mortality rate is high, this would be justified by the fact that there are areas where the health situation remains deplorable as a result of the crisis context making basic structures inaccessible. In South Kivu, some basic health structures have been attacked by armed groups [6]. Despite this decrease, mortality remains high, justifying efforts in terms of reducing infant mortality and geographic inequalities.

The young age of the mother (less than 20 years) is associated with a risk of infant mortality of about 2 times ( $p = 0.022$ ) unlike a maternal age of 35 years or more. These results corroborate with those from Brazil and France which showed that the age of less than 20 years was associated with infant death [10, 11].

Prematurity is a factor strongly associated with mortality. Prematurity is responsible for more than 290,000 deaths per year in sub-Saharan Africa. According to the WHO, premature infants are 13 times more likely to die than term infants [12]. Other studies have confirmed this association [11, 13, 14, 15, 16].

The inter-reproductive space (EIG) has a great influence on infant mortality ( $p < 0.001$ ); the more it is less than 12 months the more the risk of death increases. Our results are similar to those of Naoko Kozuki et al who found that the EIG shorter s introduced him in t increased likelihood of neonatal mortality and under-five [17]. The longer the inter-reproductive interval, the greater the chance of survival for the child. An inter-reproductive interval of less than two years not only leads to weaning of the preceding child but also to poor nutritional status and weakening.

Home birth is associated with the death of children. This result is in agreement with those of a study conducted in Uganda [18]. In addition, our results contradict those of Kambale et al who show that there was no difference in the risk of death between birth at home and that of maternity [19] as well as those of Johan et al who Neither have they demonstrated a significant association between childbirth in a sanitary setting by a health professional and reduction in neonatal death [20]. Home births often take place in precarious hygienic conditions and first aid is not administered. This would explain the predisposition of children to diseases and therefore a high mortality.

Non-use of LLINs was associated with infant mortality ( $p < 0.001$ ). This corroborates the data of Victoria et al [18] pointing out that all perinatal deaths occurred in women who did not sleep under a mosquito net. Malaria is the second most suspect pathology of infant mortality in our study (12.7%). In 2015, worldwide, the number of malaria cases was estimated at 2.4 million with 438,000 deaths [21]. Africa alone has recorded 1.88 million cases with 395,000 deaths [21]. The non-use of LLINs would explain this proportion of malaria among the pathologies suspected of infant mortality, but also the fact that we are in an endemic area with malaria which is the most frequent pathology in the whole country. Malaria,

together with diarrheal diseases and respiratory tract infections constitute the most determining pathologies of infant and juvenile death in the DRC [22].

This work has strengths and limitations. The main strength of this work is its relatively large sample size. This study is one of the very few to study, with such a large sample size, the level and factors associated with infant mortality in post-crisis rural areas of eastern DRC. The limitations of this work include the fact that it is based on data collected from health facilities and the generalization of these results to the entire population is therefore limited. In fact, due to logistical difficulties, we reasonably limited our sampling to health areas close to general referral hospitals in these two health areas. This may have introduced a selection bias in that people living further from general hospitals may have poor accessibility to health services and therefore a higher risk of infant mortality compared to those living closer to general referral hospitals. Another limitation of this work is that it is based on data collected from health facilities. It therefore does not allow data to be collected from mothers who had given birth at home. Finally, some important factors have not been studied, including vaccination, pregnancy monitoring and the course of childbirth.

## Conclusion

The infant mortality rate in rural areas of health and Miti-Murhesa Walungu in South Kivu for the period 2016–2017 remains one of the highest in the world, which is less than the national average. This infant mortality remains associated with indicators of the low socioeconomic level, in particular the age of the mother under 20, household size greater than or equal to 7, prematurity, birth at home, inter-reproductive space of less than 12 months and the non-use of LLINs. Significant efforts are still needed to hope to reduce this infant mortality rate to the levels targeted by the objectives of sustainable development.

## Abbreviations

UNICEF

United Nations International Child Emergency Fund, DRC:Democratic Republic of Congo, UN:United Nations Organizations, WHO:World Health Organization, DHS:Demographic and Health Survey, MDG:Millennium Development Goals, SDGs:sustainable development objective, OR:odds ratio, AOR:Adjusted Odds Ratio, ZS:health Zone, HC:health Center, HGR:General Hospital Reference, SD:Standard Deviation, LLINs:Mosquito net Impregnated Insecticide Long Term Action, RIPSEC:Renforcement Institutionnel Pour des Politiques de Santé Basées sur l'Évidence

## Declarations

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### **Authors' contributions**

Ghislain Bisimwa Balaluka, Aimé Cikomola and Gaylord Amani Ngaboyeka conceptualized the study and developed the initial research plan. Gaylord Amani Ngaboyeka and Espoir Bwenge Malembaka helped design the study, conducted data analysis, and critically reviewed the manuscript. Amani wrote the first draft of the manuscript. Pacifique Mwene-batu Lyabayungu, Pierrot Mulumeoderhwa, Samuel Makali Lwumushi, Albert Mwembo Ntambwe, and Ghislain Bisimwa Balaluka provided advice on the study and critically reviewed the manuscript. All authors have read and approved the final version of the manuscript for publication.

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### **Availability of data and materials**

All relevant data are within the manuscript.

### **Ethical approval and consent to participate**

Ethics approval was granted by the Ethics Committee of the Catholic University of Bukavu. The principle of confidentiality was observed and the informed consent of the participants was obtained before participation in this study. For participants under the age of 18, informed consent has been obtained by the parent and / or legal guardian.

All procedures performed were in accordance with the ethical standards of the institutional ethical committee and with the 1964 Helsinki declaration and its later amendments.

### **Consent to publication**

Not applicable, as no data is reported on an individual basis.

### **Competing interests**

The authors declare that they have no competing interests.

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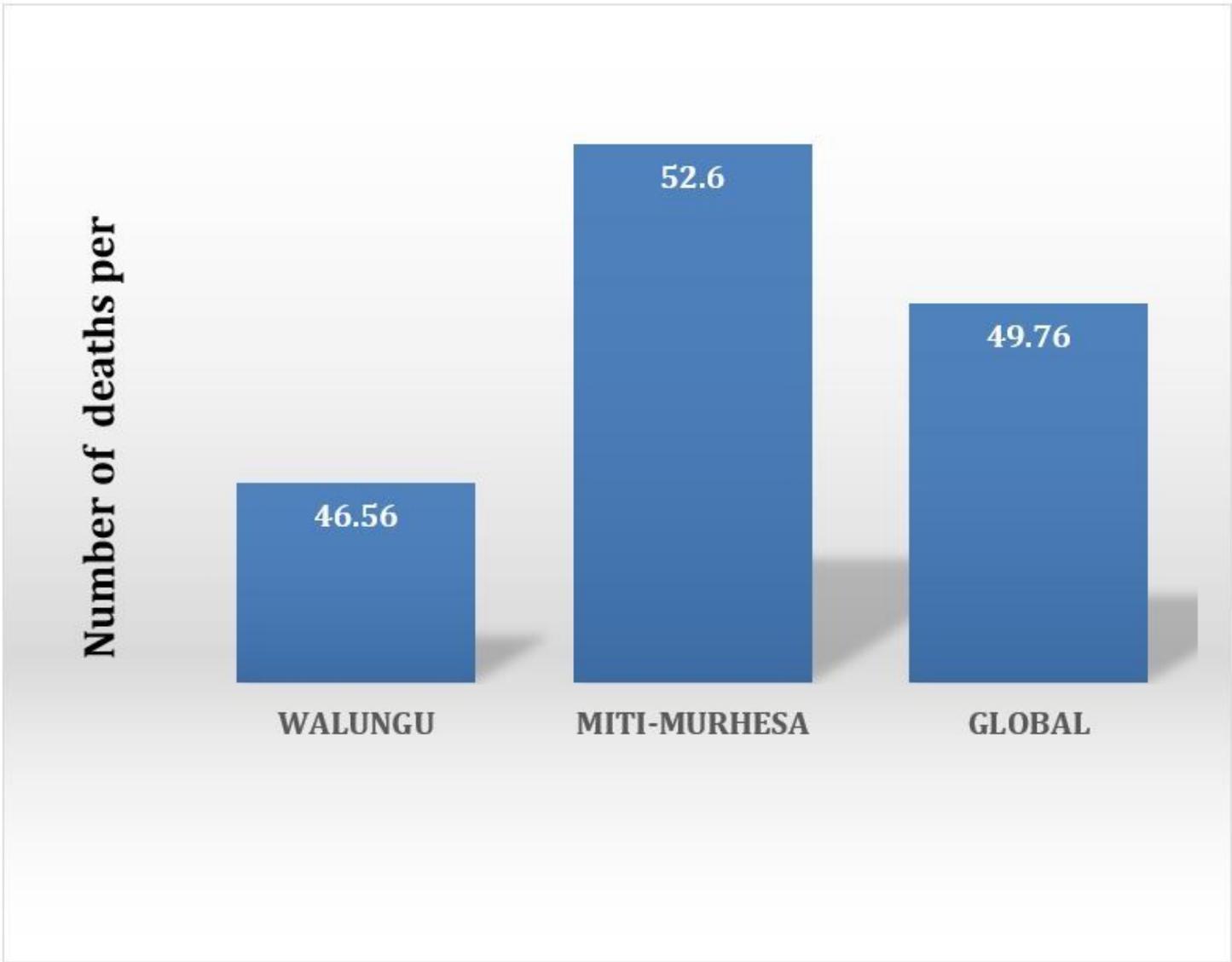
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## Figures



**Figure 1**

Infant mortality in the health zones of Walungu and Miti-murhesa (2016-2017)