



Factors Associated with Intra-Hospital Mortality of Children from 0 to 59 Months in the City of Mwene-Ditu in DR Congo: A Retrospective Analytical Study

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How to cite this paper: Kazadi Kabeya, T., Beya Tshisungu, B., Okoto, S., Ilunga Tshibangu, F., Ilunga Tshibangu, D., Kalombo Tshakuimba, E. and Luboya Kabila, J. (2022) Factors Associated with Intra-Hospital Mortality of Children from 0 to 59 Months in the City of Mwene-Ditu in DR Congo: A Retrospective Analytical Study. *Open Access Library Journal*, 9: e9584.

<https://doi.org/10.4236/oalib.1109584>

Received: November 18, 2022

Accepted: December 27, 2022

Published: December 30, 2022

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Abstract

Introduction: The mortality of children aged under 59 months remains a public health problem in the majority of low-income countries. Reducing this mortality must be included among the national priorities. The DR Congo (DRC) in general and the city of Mwene-Ditu, in particular, are not spared from this scourge. The objective of this study is to contribute to the reduction of infant mortality by researching the associated factors in order to propose preventive measures. **Methods:** A retrospective analytical study was conducted at the Christ Roi General Reference Hospital in the Makota Health District in Mwene-Ditu (DRC) covering a period of 12 months, from January 1 to December 31, 2021. A structured questionnaire was used for data collection based on the documentary review. The Odds Ratio (OR 95% CI) and the exact Fisher test were used to study the associations between the independent variable and the dependent ones. OR was significant when it was greater than 1 and its lower limit also and the p-value when it was less than 0.05. **Results:** At the end of this study, 216 cases were retained. It appears that children under 12 months accounted for 58.3% and 52% of male children. The intra-hospital mortality rate was estimated at 11.1%. Malaria (37.5%), dehydration (25%) and Acute Respiratory Infection (ARI) (16.7%) topped the list of causes of death. The duration of hospitalization ≤ 3 days (OR = 20.26 [6.54 - 62.77], $p = 0.00$) and dehydration (OR = 11.00 [2.14 - 56.49], $p = 0.00$) were the factors associated with intra-hospital mortality of children aged 0 to 59 months admitted to the Christ-Roi General Reference Hospital. **Conclusion:**

Early recourse to the hospital environment in the event of childhood illnesses and the correct care of children can boost the reduction of mortality in this age group.

Subject Areas

Public Health

Keywords

Associated Factors, Intra-Hospital Mortality, Children Aged 0 to 59 Months, Mwene-Ditu

1. Introduction

Protecting and improving the health of children is of fundamental importance. Progress has been seen in improving health and reducing mortality among children 0 - 59 months. The number of children who died before the age of 5 was halved between 2000 and 2017, from 77 per 1000 live births to 39 per 1000 live births, a reduction of 47%. This mortality is largely due to preventable conditions and treatable causes [1]. However, this mortality is still a public health problem in countries with limited resources where health systems are often poorly organized.

Worldwide, in 2019, an estimated 5.4 million children under the age of 5 died most often from diseases that could be prevented or treated. The mortality rate for children aged 0 to 59 is higher in Sub-Saharan Africa where it accounts for about half of the world's deaths in this age group [1] [2].

According to the latest estimates from the World Bank, the mortality rate under 0 to 59 months (per 1000 live births) in Africa was estimated at 18.7 in Morocco, 22.7 in Algeria, 11.1 in Libya, 48.7 in Ethiopia, 85 in Burkina Faso, 85.9 in Benin, 72.2 in Cameroon, 78.50 in Equatorial Guinea, 41.9 in Kenya, 32.2 in South Africa, 38.6 in Malawi and 54.4 in Burundi [3].

The Democratic Republic of the Congo (DRC) had not reached the target for infant mortality between 1990-2015 within the framework of the Millennium Development Goals [3]. According to the Multiple Indicator Cluster Survey (MICS), the number of deaths recorded in the age group from 0 to 59 months remains among the highest, at 70 per 1000 [4].

Deaths of children under 5 occur both in the community and in health facilities [5]. The death information most often available is that of health facilities because of a good health information system.

In-hospital deaths most often concern early childhood from 0 to 59 months in countries with limited resources. The main causes of these deaths are known worldwide [6]. They are mostly associated with infectious diseases, including pneumonia, diarrhea, and malaria, as well as prematurity, asphyxia, anemia at birth, trauma, and congenital anomalies [2] [7]-[14]. Some authors have found

malnutrition and HIV as the underlying causes of death in children 0 - 59 months [13] [14].

The analysis of the data on this problem, the mortality of children under 5, do not show any significant progress in the DR Congo in general and more particularly in the city of Mwene-Ditu in terms of a drop in its rate.

On this, the identification of the factors associated with mortality in children from 0 to 59 months in this region can enlighten the public authorities on the one hand and the health officials, on the other hand, to define a health policy and adequate strategies based on environmental evidence, especially as mortality in children under 59 months is not only linked to illnesses, but also to social and economic conditions.

In view of the above, this study wanted to contribute to the reduction of mortality in children under 5 years of age by researching the factors associated with it in order to propose effective solutions.

2. Methods

A retrospective analytical study was conducted at the Christ Roi General Reference Hospital (GRH) of the Health District (HD) of Makota in the City of Mwene-Ditu in the DRC. The choice of this hospital structure is explained by the fact that its reputation goes beyond the limits of this city and therefore attracts many patients from the square and the surrounding villages which can be considered as a Regional Reference Hospital for pediatric cases. The study covered a period of 12 months, from January 1 to December 31, 2021, but data collection took place in March 2022.

Patients aged 0 to 59 months admitted in 2021 constituted the source population from which the sample for this study was drawn. Probability sampling was used to select the statistical units to be included.

Using the patient consultation register in the pediatric department for the year 2021, the files were selected there in a simple systematic way by calculating the sampling interval according to the following formula: The sampling interval = Number of children aged 0 to 59 admitted to the structure during the study period on the number of children to be selected. Any patient, child of this age group with a complete medical consultation file during the period was automatically admitted and all files that did not meet these criteria were excluded.

A structured questionnaire was designed to facilitate the collection of relevant information using the documentary analysis technique. It was a list of closed questions (in French, the official language used in the professional environment) with answers in the form of assertions. The questions were closely related to the issue raised, the specific objectives and the variables of the study. This questionnaire was pre-tested on a small sample for its improvement before proceeding to the actual collection of data on the consultation forms and in the register.

Notions of ethics have been taken into account. The authors had made a commitment to reassure the management team of the Hospital that all the informa-

tion collected on the patient files was kept confidential and used only for scientific purposes for this work. The independent variable was the mortality of children from 0 to 59 months and the dependents, age, sex, residence, trimester of admission, morbidity, reference, professional status of the children's mothers, vaccination status and therapeutic outcomes.

The sample size was calculated using the STATCALC program of the Epi info software version 7.2.2.6 (CDC, 2018), considering the mortality rate of 15.7% found Kabinda in Lomami Province [15], the confidence level of 95% and the acceptable margin of error of 5%. Using this program, the sample should be 196 cases. We had adjusted the sample size by adding 10% of the statistical units initially planned to minimize errors. Thus, the final adjusted sample size was 216 cases.

Data were collected manually and entered into Excel (Microsoft USA, 2010) and exported for analysis in Epi info TM software version 7.2.2.6 (CDC, 2018). Excel was also used for the presentation of figures (for the qualitative variables) and tables comprising the numbers observed, the frequencies and the proportions. Quantitative variables were expressed by trend and dispersion parameters (Min, Max, standard deviation). The odds ratio (OR 95% CI) and Fisher's exact test were used to study associations between variables. Using statistical associations, certain explanatory variables likely to have influenced the occurrence of deaths were described. The OR was significant when it was greater than 1 and its lower limit also greater than 1. When it was less than 1, there was no significant association between the variables studied. Similarly, when the p-value was less than 0.05, the association was considered significant.

3. Results

A total of 216 children from 0 to 59 months were identified with an average age of 16 months. The minimum age was 0 months and the maximum was 59 months (Table 1). The majority of children surveyed, 52%, were male (Figure 1). 125 of these children or 58% were residents of the Makota Health District and the other 42% lived outside the HD (Figure 2). The majority of the mothers of the children

Table 1. Socio-demographic variables of children.

Variables	Size (216)	%
Tranche d'âge (mois)		
0 - 11	126	58,3
12 - 23	33	15,3
24 - 35	20	9,3
36 - 47	24	11,1
48 - 59	13	6

Average age = 16 mois (Sdv 16 mois); Minimum age = 0 month; Maximum age = 59 months.

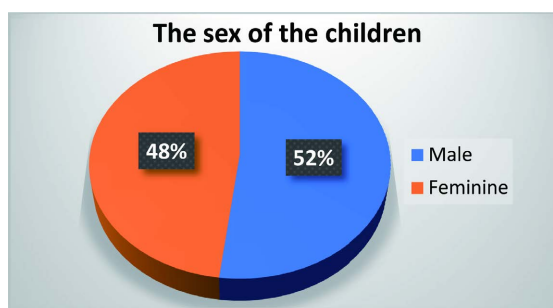


Figure 1. Distribution of children by sex.

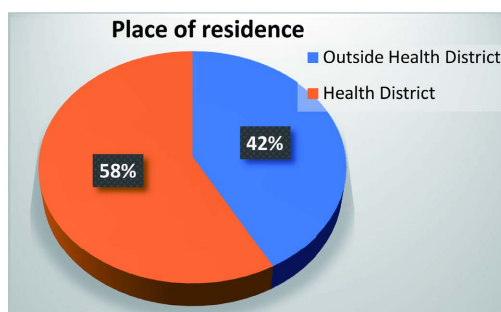


Figure 2. Distribution of children by place of residence.

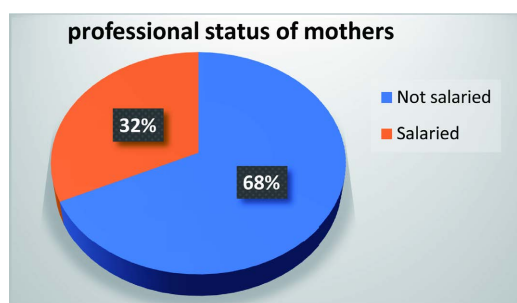


Figure 3. Distribution of children according to professional status of mothers.

surveyed, *i.e.* 68%, were self-employed (**Figure 3**).

The majority of children surveyed were fully vaccinated (72.2%). The 3rd quarter of the year was the busiest (42.6%). The first five reasons for consulting children were fever (27.8%), convulsion and diarrhea (16.7% each), pallor and vomiting (9.2% each). 168 children, or 77.8%, consulted the hospital directly without going through a referral. Malaria was the most common diagnosis (51.6%) followed by meningitis (24.1%) and respiratory infections (7.5%). The majority of children, 73.1%, had been hospitalized between 4 to 7 days. 24 of the 216 children, *i.e.* 11.1%, had a fatal outcome, occurring mainly (66.7%) within 24 hours of admission (**Table 2**).

On the list of causes of death noted, 3 were at the top, namely malaria with 37.5%, dehydration with 25% and ARI with 16.7% (**Figure 4**).

The cross-analysis of the data indicates that in relation to age the mortality was higher in the age group 0 to 11 months. In relation to sex, the proportions of deaths were almost similar. The majority of the children were from the middle

Table 2. Clinical information of children.

Variables	Size (216)	%
Vaccination status		
Fully vaccinated	156	72.2
Incompletely vaccinated	48	22.2
Unknown	12	5.6
Trimester		
First trimester	50	23.1
Second trimester	34	15.7
Third trimester	92	42.6
Fourth trimester	40	18.5
Reason for consultation		
weight loss	12	5.6
Convulsion	36	16.7
Diarrhea	36	16.7
Breathing difficulty	16	7.4
Abdominal pain	4	1.8
Fever	60	27.8
Edema	4	1.8
Pallor	20	9.2
Cough	8	3.7
Vomiting	20	9.2
Intakechannel		
Not referred	168	77.8
Referral	48	22.2
Diagnosisretained		
Dehydration	12	5.6
sickle cell disease	12	5.6
Acute Respiratory Infection (ARI)	16	7.5
Malnutrition	8	3.7
Meningitis	52	24.1
Malaria	112	51.6
HIV	4	1.9
Duration of hospitalization		
≤3 days	58	26.9
4 - 7 days	158	73.1

Continued**Outcome of the disease**

Death	24	11.1
Healing	192	88.9

Time of death

In 24 hours	16	66.7
After 24 hours	8	33.3

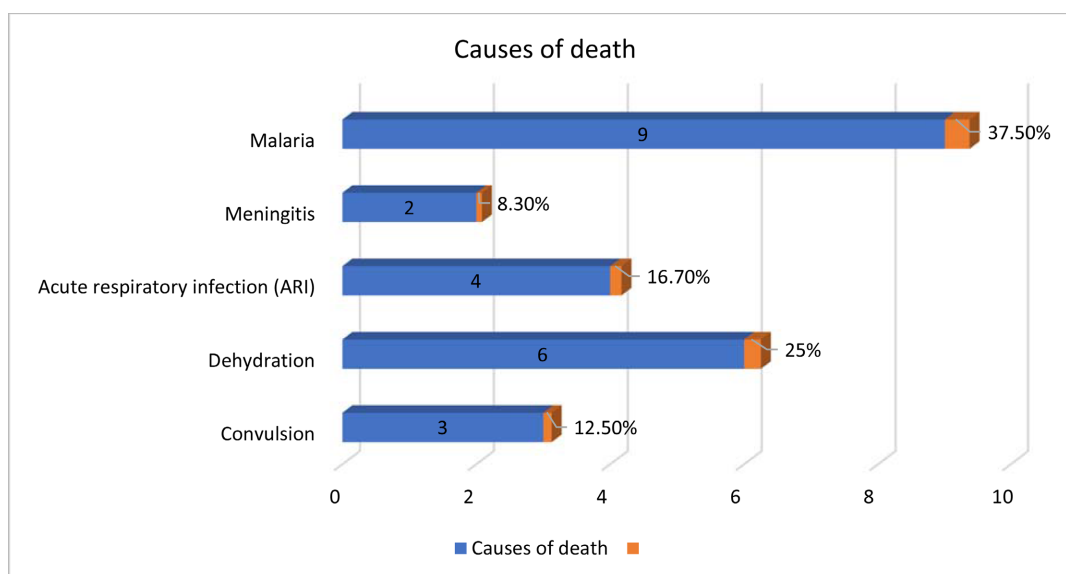


Figure 4. Distribution of children by cause of death.

school. The mortality rate was higher in the 4th trimester compared to the first 3. The mortality rate was higher in children who had stayed less than 3 days in the hospital. Among the various diseases implicated in the occurrence of deaths in children aged 0 to 59 months, malaria was in the lead. The majority of children were admitted directly to the hospital and not referred. After cross-referencing the variables, there was no statistically significant association between intra-hospital mortality with age, sex, children's place of residence, professional status of the children's mothers, period of admission, reference. However, a significant association was established between in-hospital mortality with hospital stay less than or equal to 3 days ($p = 0.00$), dehydration ($p = 0.00$) (**Table 3**).

4. Discussion

This study involved 216 children aged 0 to 59 months followed at GRH Christ-Roi. The short duration of hospitalization and dehydration were the factors associated with intra-hospital mortality.

The various analyzes were carried out on the study sample in order to determine the factors causing intra-hospital mortality. It is possible that the results face certain biases or limitations. Cases released against medical advice, escapees

Table 3. Statistical associations.

	Mortality			OR [95%]	p-value
	Yes (24)	No (192)	Total (216)		
Age (months)					
0 - 11	18	108	126	3.83 [0.48 - 30.17]	0.31
12 - 23	2	31	33	1.48 [0.12 - 17.37]	1.00
24 - 35	2	18	20	2.55 [0.21 - 30.47]	0.58
36 - 47	1	23	24	Reference	
48 - 59	1	12	13	1.76 [0.10 - 30.71]	1.00
Sex					
Feminine	12	92	104	1.08 [0.46 - 2.54]	1.00
Male	12	100	112	Reference	
Residence					
Health District	15	111	126	1.21 [0.50 - 2.91]	0.82
Outside Health District	9	81	90	Reference	
Professional status					
Salaried	17	129	146	1.18 [0.46 - 3.01]	0.81
Not salaried	7	63	70	Reference	
Admission term					
1 st	4	46	50	1.39 [0.24 - 0.05]	1.00
2 nd	2	32	34	Reference	
3 rd	10	82	92	1.95 [0.40 - 9.39]	0.51
4 th	8	32	40	4.00 [0.78 - 20.31]	0.09
Duration of hospitalization					
≤3 days	20	38	58	20.26 [6.54 - 62.77]	0.00
4 - 7 days	4	154	158	Reference	
Sickness					
HIV	0	4	4	Indefinite	1
Malaria	9	79	88	1.25 [0.31 - 4.92]	1.00
Meningitis	2	38	40	0.57 [0.09 - 3.67]	0.66
Dehydration	6	6	12	11.00 [2.14 - 56.49]	0.00
sickle cell disease	0	12	12	Indefinite	1
IRA	4	12	16	3.66 [0.71 - 18.83]	0.18
Malnutrition	0	8	8	Indefinite	1
Febrile seizure	3	33	36	Reference	
Case reference					
No	20	148	168	1.48 [0.48 - 4.57]	0.61
Yes	4	44	48	Reference	

or transferred to other health facilities were excluded from our study to avoid selection bias in the statistical analysis.

The majority of children was from Makota health HZ and admitted to hospital in the third quarter of the year. More than three quarters were admitted without being referred. The third quarter of the year is often characterized by the alternation of the seasons (dry and rainy season), considered as an environmental factor that can positively influence the morbidity of children. All of these demonstrated characteristics had no significant association with the deaths of the children in this study. The calculated intra-hospital mortality was 11.1%, influenced by two factors, in particular the short duration of hospitalization and dehydration. In the town of Kabinda, this mortality rate was 15.7% [15]; 9.8% in Lubumbashi [16]; 39.9% in the Province of Tanganyika specifically in Manono and Ankoro [17]; 8.6% in Senegal [13] and 2.95% in Nkongsamba in Cameroon [18]. Kabinda's result is similar to that of our study. On the other hand, it was low in Lubumbashi, Senegal and Cameroon. However, in studies conducted in Tanganyika [17] and Douala (estimated at 20.3%) [9], it was higher. This difference could be due to socio-economic and environmental conditions. After our analysis of the situation, it appears that the mortality rate is low in large urban areas and very high in rural areas. This is the case of the study carried out among the pygmies whose way of life is still too rudimentary and conditioned by their beliefs, habits and customs.

The short duration of hospitalization and dehydration influenced intra-hospital mortality in this series, a situation similar to that demonstrated at the regional hospital in Cameroon [18]. This situation is justified by the fact that some children are often brought to the hospital in very critical condition. For this purpose, these children have a high probability of dying before doing 48 hours in the care environment. Diarrhea is very common as a disease but also as a complication of other diseases in children, especially those suffering from severe acute malnutrition. It causes dehydration which increases the probability of death if rehydration is not early and sufficient.

Infant and child morbidity was more represented in children aged 0 to 11 months, unlike those aged 47 to 59 months. The age group of children before celebrating their first birthday is the most critical phase following various pathological exposures and the immune system which is still maturing. The morbid predominance in children in the age group under one year is similar in several studies which have been carried out respectively in Bukavu [12], Lubumbashi [16], Tanganyika [17] and Kindu [19]. In the environment where this study was carried out, hospital attendance is higher in this age group. This is a period of food diversification for children. The change in diet brings certain disorders that go so far as to cause certain food diseases such as diarrheal diseases, if the food supplementation is not well respected by the mother or the nurse. Moreover, this is the age group where there is a decrease in antibodies received passively from the mother around the 6th month, thus making the child vulnerable.

For the age group beyond 11 months, children are exposed through their games. They sometimes handle abandoned tin cans which are breeding grounds for mosquitoes containing waste water. By playing around stagnant water, being a vulnerable group, they are exposed to higher risks of developing malaria in our environment. Despite this observation, there is no relationship between the age of hospitalized children and intra-hospital mortality.

This study demonstrated a great predominance of hospitalization among male children unlike those of female sex. The similar situation has been demonstrated in the city of Douala [9], in Lubumbashi, at Nsendwe hospital [16] and in the city of Kindu [19]. The predisposition of the male sex to morbid phenomena during childhood would be justified by a genetic phenomenon. Authors were able to find that the male XY genotype would be more susceptible to infections than the female XX genotype. This was explained by the fact that the X chromosome would have a determining role in the defense against infections [19]. However, intra-hospital mortality was more represented in female children, comparable to the situation described by a Cameroonian study [18]. In Manono and Ankoro in Tanganyika, Algeria and Madagascar, on the other hand, it has been shown that mortality was more represented in male children [10] [17] [20]. Despite this demonstrated parallelism, the statistical analyzes in these studies do not show a significant difference in mortality between the two sexes. The difference observed would be related to sampling fluctuations.

The study showed that almost three quarters of the children were fully vaccinated. This result does not significantly influence the intra-hospital mortality of children. This does not corroborate the finding demonstrated in a Guinean study where low vaccination coverage significantly explained mortality in children aged 0 to 59 months [20]. The situation demonstrated in our study would be linked to a mobilization of community agents on vaccination on the one hand and on the other hand, the education of women during the consultation near school.

Fever was the first reason for admission of children to hospital in our static series. This is influenced by the area which is endemic to malaria of which fever is the main sign. These results are similar to those of other studies carried out in children of all ages. Despite the statistical differences observed between various studies, fever remains the main reason for consultation in pediatric practice [18] [21] [22]. The child's high susceptibility to infections (especially respiratory) at this age and the endemicity of malaria in Sub-Saharan Africa may explain this domination of child symptoms by fever. Maintaining a good vaccination policy and intermittent preventive treatment against malaria are effective means that can reduce infant and child morbidity linked to febrile illnesses.

Malaria was the main cause of hospitalization and infant-child death in this study with almost half of the cases. Children under 5 are a high risk group for severe malaria in a malaria-endemic area due to lack of immunity and rapid progression of the disease. Although this pathology was the main cause of hospita-

lization, malaria had no statistically significant link with intra-hospital mortality. This is justified by the fact that the management of this pathology in an endemic environment is well known and integrated into the management structures. Compared to studies conducted in a tropical environment like ours, it appears that our observation corroborates those of several authors [17] [19] [23] [24] [25] [26]. These studies were carried out both in the context of hospitalizations in the emergency room and in normal times. However, malaria also remains the cause of hospital emergency admissions in the town of Mwene-Ditu.

The mothers of the children were predominantly self-employed in almost three quarters of the sample. Despite this observation, the professional situation of the mother had no influence on the intra-hospital mortality of the children, unlike a Cameroonian study where a relationship was demonstrated between the death of the children and the socioeconomic level of the mothers [18]. In our study, this non-significant relationship is explained by the fact that the care of children at the GRH Christ-Roi is carried out at a lower cost since this hospital benefits from the support of the European Union project. Even in the absence of money, medical interventions are well undertaken with the aim of maintaining and restoring the health of the child.

In this study, mortality due to malaria was 37.5%. This pathology is the leading cause of death in hospitals. This result corroborates with that of the study conducted at Panda Hospital in Likasi where it was found 35.3% [27]. Our result is also close to the results of the study conducted among pygmies in the Province of Tanganyika where 30.2% were found. This situation is justified by the fact that the DR Congo is among the countries where malaria is endemic.

Acute respiratory infections are the third leading cause of death for children aged 0 to 59 months in our series. Despite this important place they occupy, they have no significant link with intra-hospital mortality. This is dependent on their support which was made within the considerable time. In the study carried out in the medical structures of the city of Lubumbashi [28] and Senegal [13], this situation is not similar. The difference could be justified by the sampling fluctuation. Our study was carried out in one structure, moreover, that of Lubumbashi was carried out in several structures. Since each structure has its own characteristics, the technical platform is not the same. Therefore, the rate of therapeutic success depends on it.

The nutritional deficit was observed in 3.7% of children. This proportion is lower than those demonstrated in certain studies conducted in pediatric settings [17] [19] [29]. Malnutrition being of multifactorial origin, it is possible that its prevalence varies from one environment to another. To this, in the context of this study, it could also be linked to the fact that the majority of the mothers of these children were not employed.

Admittedly, mortality among children aged 0 to 59 months does not only occur in hospitals but also in the community. Therefore, it would be desirable in subsequent studies to consider dressing this aspect so that the strategies to be

put in place to reduce it are as exhaustive as possible.

5. Conclusion

Infant and child mortality, although a good indicator of the state of health of the child, nevertheless remains a major public health problem that threatens socio-economic and health progress in Sub-Saharan Africa, in DR Congo and also in the Town of Mwene-Ditu. It was estimated at 11.1% in children aged 0 to 59 months after a hospital study. Malaria, meningitis, dehydration, ARI and convulsion were the causes of death. The short duration of hospitalization and dehydration were the factors associated with intra-hospital mortality of children aged 0 to 59 months admitted. Early recourse in a hospital environment by the parents of the children and the early and correct management of children with illnesses in general and those with dehydration, in particular, must be observed. On this, it is up to everyone to educate and sensitize the population in this sense but also to the health authorities to insist on compliance with therapeutic protocols in hospital settings.

Acknowledgements

The authors sincerely thank the management team of Hôpital Christ Roi for agreeing to make available the data that enabled this study to be carried out. These thanks also go to the Chief Medical Officer of the Makota Health District for facilitating this collaboration.

Authors' Contributions

Kazadi Kabeya designed the study, conducted the data analysis and drafted the manuscript; Okoto contributed to the development of the manuscript, and the data collection; Beya Tshisungu contributed to the data collection and analysis; Ilunga Tshibangu, Kalombo Tshakuimba and Luboya Kabila carried out the final analysis of the data. All have read and approved the latest version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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