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Factors Associated with Mortality in Children Aged 1 Month to 15 Years Hospitalized in the Pediatric Ward of the Kalaban-Coro Reference Health Center: Cross-Sectional Study

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Abstract

Introduction: Infant and child mortality is a worldwide concern, but developing countries such as Mali are more affected. The aim of this study was to investigate morbidity and factors associated with mortality in children aged 1 month to 15 years. **Methodology:** This was a cross-sectional study which took place from January 1 to December 31, 2020 covering children aged 1 month to 15 years hospitalized at the Kalaban-Coro CSRéf. Data were entered into Excel and analyzed using SPSS version 20 software. **Results:** Five hundred children aged 1 months to 15 years were included. The age range 1 to 5 years (53.6%) and male sex (58.2%) were the most represented. Malaria (72.2%), acute respiratory infections (6.2%) and diarrhea/dehydration (3%) were the main morbidities. Mortality was estimated at 10.6%, and the two main causes of death were malaria (56.6%) and acute respiratory infections (7.54%).

Univariate analysis revealed a statistically significant association between the dependent variable (death) and age ($p < 0.030$), length of hospital stay ($p < 0.030$) and mother's level of education ($p < 0.02$). **Conclusion:** This study confirms the high rate of infant and child morbidity and mortality in our health facilities. Strengthening human resources and intensifying behavior-change communication can help reverse the trend.

Keywords

Children Aged 1 Months to 15 Years, Morbidity, Factors Associated with Mortality, Morbidity

1. Introduction

Child mortality is a reliable indicator of a country's level of development, and its trends are influenced by a population's socio-economic, health and cultural conditions. It also reflects poverty levels, precarious conditions and the quality of health care and services available.

According to the World Health Organization (WHO), the probability of a child dying before the age of five is sixteen times higher for children in underdeveloped countries than for those in so-called more affluent countries. Africa is the part of the world where infant and child mortality is highest, with disparities between the different sub-regions [1].

In Mali, sectoral health and population policy is based on principles and strategies, one of whose major objectives is to reduce maternal, neonatal and infant/juvenile mortality and morbidity. Despite the interest shown in maternal and child health in recent decades, notably through the policy of free caesarean sections, free malaria prevention and treatment for children under five and pregnant women, the extension of emergency obstetric and neonatal care (EmONC) and the institutionalization of maternal, perinatal and neonatal death audits, reducing infant and child morbidity and mortality remains a huge challenge.

With the aim of contributing to the reduction of infant morbidity and mortality, we conducted this study to determine the morbidity and factors associated with mortality in children aged 1 month to 15 years admitted to the pediatric ward of the Kalaban Coro referral health center.

2. Methodology

2.1. Type of Study

This was a cross-sectional study on children aged 1 months to 15 years admitted to the paediatric ward of the Kalaban Coro referral health center (RHC).

2.2. Study Location and Period

The Koulikoro region is the second-largest administrative region in Mali. It has

ten health districts, including Kalaban Coro (4th district), which comprised one (01) reference health center (RHC) and twenty-seven (27) community health centers (CHC). The community health centers are the first level of contact for the population, while the reference health centers are the 1st level of referral for patients in Mali's health pyramid.

The Kalaban CSRéf was health facility to several departments, including the pediatrics department which had four units: general pediatrics, neonatology, pediatric emergencies and the intensive nutritional recovery and education unit.

We conducted this study between January 1 and December 31, 2020 with a data collection period ranging from January to June 2019.

2.3. Study Population

The study population was children aged 1 months to 15 years residing in the Kalaban Coro health district. The target population consisted of children aged between one month and 15 years admitted to the Kalaban Coro referral health center.

2.4. Inclusion and Exclusion Criteria

Inclusion criteria were based on age. All children aged 01 months to 15 years hospitalized in the pediatric department and whose records were usable were included in this study. Children whose records could not be used and those whose names did not appear in the hospitalization register were excluded.

2.5. Entry (Hospitalization) and Exit Criteria

The entry criteria were in particular: high fever (body temperature ≥ 39˚C), impaired consciousness (convulsions, coma), alteration of the patient's general condition (hemodynamic disorders, a state of pronounced weight loss, malnutrition), uncontrollable vomiting/dehydration; respiratory distress. The exit criteria depended on the normalization of clinical parameters and paraclinical data.

2.6. Sampling Methods

Given the objective of the study, we carried out an exhaustive sampling of all eligible cases registered during the study period. No sample size was calculated.

2.7. Data Collection Procedure and Tools Used

Data were collected from medical records and hospital registers using standardized questionnaires.

2.8. Variables Collected

The data collected were:

- social-demographic characteristics such as age, gender, residence, parental education;
- clinical data (mode of admission, reason for consultation, diagnosis, length of

hospital stay, patient outcome (death, recovery), cause of death).

The dependent variable (death) has been defined as the permanent cessation of brain function (*i.e.* brain function is lost, will not spontaneously recover and will not be restored by intervention) and is characterized by the complete absence of any form of consciousness (wakefulness and awareness) and absence of brainstem reflexes, including the ability to breathe independently. This may result from the cessation of blood flow to the brain following circulatory arrest and/or devastating brain injury. Residual brain cell activity not associated with the presence of consciousness or brainstem function does not prevent the determination of death (e.g. release of posthypophyseal antidiuretic hormone, temperature control or neuronal activity at the cellular level). Death cannot be declared if there remains a level of consciousness and/or residual brainstem function, however diminished [2].

2.9. Data Processing and Analysis

After manual tabulation, verification and correction of outliers, the data collected was entered into Microsoft Excel and analyzed using SPSS version 20 software.

The analysis plan comprised two stages:

- a descriptive analysis, which involved describing the study sample. All quantitative variables were described in terms of mean with extremes, and qualitative variables in terms of percentage;
- a comparative analysis, in which a statistically significant association was sought between the dependent variable (death) and several potential explanatory variables. This analysis was limited to univariate analysis, and the Chi-Square test was used for this purpose. The association between the dependent variable and an explanatory variable was defined as significant when the level of significance was less than five percent (5%).

2.10. Ethical Aspects

The purpose of the study was explained to the parents (father, guardian or mother) of each child, and their verbal agreement to the use of their children's medical data to help enrich and disseminate scientific data was obtained. Anonymity and confidentiality were respected throughout the study process.

The authorization of the chief physician of the health district was also obtained for this study.

3. Results

3.1. Sociodemographic Characteristics

A total of 500 children aged 01 months to 15 years who met the inclusion criteria were enrolled. The age range 1 to 5 years and male sex represented 53.6% and 58.2% respectively. Among our patients, 84.4% resided in the Kalaban-Coro health district. Most of the parents (64.8% of fathers and 75.8% of mothers) did not attend school (**Table 1**).

Table 1. Socio-demographic characteristics of children and their parents.

Variables	Number (N)	Percentage (%)
Children's characteristics (n = 500)		
Age range (years)		
<* 1	104	20.8
[1 - 5]	268	53.6
[6 - 15]	128	25.6
Sex		
Male	291	58.2
Female	209	41.8
Residence		
Kalaban-Coro	422	84.4
Outside of Kalaban-Coro	78	15.6
Characteristics of fathers of children (n = 500)		
Marital status		
Married	494	98.8
Single	5	1.0
Widowed	1	0.2
Profession		
Labourer	134	26.8
Farmer	120	24.0
Shopkeeper	94	18.8
Craftsman	63	12.6
Other	46	9.2
Civil servant	35	7.0
Pupil/student	8	1.6
Level of education		
No schooling	324	64.8
Educated	176	35.2
Characteristics of mothers (n = 500)		
level of education		
No schooling	379	75.8
Educated	121	24.2
Profession		
Housewife	405	81.0
Tradeswoman	43	8.6
Civil servant	17	3.4
Pupil/student	15	3.0
Craftswoman	11	2.2

Continued

Other	7	1.4
Manual worker	2	0.4

<*: Lower.

3.2. Patient Clinical Data

The main reasons for consultation were fever (33.8%), convulsions (17%), diarrhea (5.2%), pallor (4.6%) and weight loss (4.8%). The main pathologies encountered were malaria (72.2%), acute respiratory infections (6.2%), and diarrhea/dehydration (3%). Other pathologies encountered were malnutrition (2 cases), meningitis (2 cases) and retrovirosis (1 case). We recorded 37 discharges against medical advice (7.4%) and 9 cases of escape (1.8%).

The average hospital stay was 6 days, with extremes ranging from 2 to over 14 days (Table 2).

Table 2. Patient distribution by clinical data.

Variables	Number (N)	Percentage (%)
Type of admission		
Referred	141	28.2
Non-referred	359	71.8
Reasons for consultation		
Fever	169	33.8
Pallor	23	4.6
Cough	20	4
Convulsion	85	17
Diarrhea	26	5.2
Vomiting	13	2.6
Altered general condition (AEG*)	24	4.8
Other (rash, abdominal pain, agitation, dehydration, intoxication, obnubilation)	140	28
Diagnosis retained (pathology)		
Severe malaria	361	72.2
Acute respiratory infection (ARI)	31	6.2
Diarrhea/DH_2O	15	3
Malnutrition	2	0.4
Meningitis	2	0.4
Retroviruses	1	0.2
other	88	17.6
Length of hospital stay (days)		
≤7	379	75.8
>7	120	24.2

3.3. Patient Outcome and Mortality Analysis

The outcome of patients on treatment was marked by cure (78.6%), death (10.6%), transfers (1.6%), discharge against medical advice (7.6%) and escapes (1.8%). The male gender was more affected by death with 52.83% (n = 28). Concerning mortality according to age groups, we noted 12.2% (6 cases) in subjects aged 0 - 6 months, 21.8% (12 cases) in 7 to 11 months and 9.3% (25 cases) in 1 to 5 years old., 7.8% (n = 10) among 6 to 15 years old. Of the patients who died, 49% were not referred and 84.90% had parents who did not attend school. The two main causes of death were malaria (56.6%) and acute respiratory infections (7.54%) and the majority of deaths occurred within the first two days of hospitalization (81.13%).

The case-fatality rate for severe malaria was 9.6%, for acute respiratory infections 9.3% and for diarrhea 6.6% (Table 3, Table 4).

Table 3. Distribution of patients according to outcome and case fatality by condition.

Characteristics	Number (N)	Number of deaths (n)	Percentage (%)
Outcome (n = 500)			
Cured	393		78.6
Death	53		10.6
Discharge against medical advice	37		7.4
Escape	9		1.8
Transfer to other facilities	8		1.6
Lethality by condition			
Pathology (n = 500)			
Severe malaria (n = 361)	361	30	8.3
Malnutrition (n = 2)	2	0	0
Diarrhea/Dehydration (n = 15)	15	1	6.6
ARI (n = 31)	31	4	13
Retrovirus (n = 1)	1	1	100
Meningitis (n = 2)	2	2	100
OTHER UD* (n = 88)	361	15	17.04

UD*: UNDIAGNOSED pathologies.

Table 4. Factors associated with the occurrence of deaths in children aged 01 months to 15 years, Kalaban Coro district health center.

Variables	Deaths		p-value
	Yes	No	
	n (%)	n (%)	
Sex (n = 500)			
Male	28 (52.8)	263 (58.8)	p < 0.40
Female	25 (47.2)	184 (41.2)	

Continued

Age range (n = 500)			
[0 - 6] months	6 (11.3)	43 (9.6)	
[7 - 11] months	12 (22.6)	43 (9.6)	$p < 0.03$
[1 - 5] years	25 (47.3)	243 (54.3)	
[6 - 15] years	10 (18.8)	118 (26.5)	
Mother's level of education (n = 500)			
Educated	8 (15.1)	113 (25.3)	
Uneducated	45 (11.9)	334 (88.1)	$p < 0.02$
Profession of parents			
Function with generating income (civil servant, merchant, tailors, craftsmen)	2 (3.8)	190 (42.5)	
Low income generation functions (labourer, famer, manual worker)	51 (96.2)	257 (57.5)	$p < 0.003$
Pathology (n = 500)			
Severe malaria	30 (9.6)	331 (90.4)	0.973
Acute respiratory infection	4 (12.9)	27 (87.1)	
Diarrhea	2 (13.3)	13 (86.7)	
Malnutrition	0 (0)	2 (100)	
Meningitis	0 (0)	2 (100)	
Retroviruses	0 (0)	1 (100)	
Other (undetermined pathologies)	11 (12.5)	77 (87.5)	
Length of hospital stay (days)			
[1 - 2]	43 (26.5)	119 (73.5)	
[3 - 6]	4 (1.8)	214 (98.2)	$< 10^{-3}$
[7 - 14]	6 (5.9)	96 (94.1)	
>14	0 (0)	18 (100)	

3.4. Factors Associated with the Occurrence of Death

In the univariate analysis, the explanatory variables statistically associated to the occurrence of deaths were age ($p < 0.03$), the level of education of parents ($p < 0.02$), the parents' profession ($p < 0.003$), the duration of hospitalization ($p < 0.001$).

4. Discussions

4.1. Sociodemographic Characteristics

The aim of this study was to describe the morbidity and mortality of children aged between one month and fifteen years hospitalized in the pediatric ward of the Kalaban-Coro referral health center.

In our study, we observed a predominance of males. These results concur with those reported by some authors. The age range from one to five years was the most represented, which is different from that reported by Coulibaly. A, in Mali, and

Ghorbal F.S in Tunisia, where infants under one year of age accounted for more than half the patients, but their studies included newborns [3] [4].

Concerning the socio-demographic data of parents, the majority of fathers were aged between 30 and 39 years while the 20 - 29 age group was the most represented among mothers. Age is an important factor because it often serves as a benchmark for acquiring an individual's level of experience and sense of social responsibility, although it is not very reliable. In Malian society, it is believed that the younger you are, the less the sense of family responsibility is engaged and this observation can have a negative impact on the care of children in the event of illness. Regarding marital status, we found that the majority of mothers and fathers were married at the time of the study, with a fairly low proportion of singles and widowers. These results are close to those of certain authors in the literature series [5]. In terms of profession, most of the children's fathers were manual workers and farmers, and most of the mothers were housewives. This could be answered by the fact that in Mali, the man is the head of the family and therefore the support, and with the obligation to take care of the couple's expenses. The fact that the women were not gainfully employed may have a negative impact on the family's purchasing power, just like the parents' profession, and does not contribute to guaranteeing better care. These observations are almost identical to those reported in the literature [6]. Low socio-economic status is considered a risk factor for morbidity [7]. Indeed, children of poor parents are more exposed to promiscuity, poor housing conditions, indoor air pollution and poor basic sanitation, or to the precarious health of the mother during pregnancy [8] [9].

Like age, education is an important factor in decision-making. In our series, two out of three women were uneducated.

4.2. Analysis of Clinical Data

In terms of morbidity, malaria was the leading cause of hospitalization. This finding is consistent with the literature [7] [10]. Malaria is an endemic disease in our country, with periods of high transmission between July and December, and a peak generally observed in October. According to the national malaria control program, this pathology is a real public health problem and represents the primary reason for consultations in Mali, with rates reaching up to 34%. It is one of the priorities of the national health policy [11] [12]. In our context, the high frequency of hospitalization for malaria can be explained by the late recourse of patients to the health service. Acute respiratory infections (ARI), particularly pneumonia, are the leading cause of death in children under five in developing countries [1]. In our study, acute respiratory infections (ARI) were the second leading cause of hospitalization, with a frequency of 8.6%. This result differs from the 6.4% and 23.7% reported by these authors [9] [13]. These infections are most often due to a lack of hygiene in the children's environment, and to parents' lack of knowledge about how to protect their children against these infections.

Diarrhoeal diseases and their consequences, notably dehydration, are one of the

main causes of death among children in most developing countries. The WHO estimates that diarrhoea is the second leading cause of death in children under five, accounting for 525,000 child deaths a year [14]. In our study, diarrhoea was the third leading cause of hospitalization, with a frequency of 3% and a case-fatality rate of 6.6%. The literature reports varying frequencies of digestive disorders and their lethality. In studies conducted by some authors, digestive disorders were the third leading cause of hospitalization, with frequencies of 12.6% and 11.2% respectively, and mortality rates of 4.2% and 20.4% respectively [10] [13]. In underdeveloped countries like Mali, even simple interventions can help combat diarrhoeal diseases in general. These include access to drinking water, use of improved sanitation services and handwashing with soap.

Meningitis is a devastating disease, with a high case-fatality rate and potentially serious long-term complications. Bacterial meningitis is of particular concern. Around 1 in 10 people with this type of meningitis die, and 1 in 5 develop serious complications [15]. Licensed vaccines against meningococcal, pneumococcal and *Haemophilus influenzae* meningitis have been available for many years. Despite their introduction in Mali's Expanded Program on Immunization, many children do not benefit from this preventive measure, due to a number of factors, including parents' lack of awareness of the benefits of full immunization, non-compliance with the immunization schedule, and women's low use of antenatal and postnatal consultation services. In our series, we recorded 2 cases (0.4%) of meningitis with a case-fatality rate of 100%. Simpara B. Sidibé T reported in their series a frequency of hospitalization due to meningitis of 4.6% and 9.6 and a case-fatality rate of 1.4% and 12.7% respectively [3] [10].

The most lethal pathologies observed in our study were meningitis (100%), retrovirosis (100%), severe malaria (8.3%), ARI (9.3%) and diarrhea (6.6%). This same trend has been reported by some authors [7] [10].

In most cases, the decision to use the health service depends on the men. Involving men in awareness-raising and community education for health promotion through local approaches such as model husband schools, as well as motivating community health relays and agents, can contribute significantly to improving health indicators in general. Even if we have not processed the data on prenatal and postnatal care, it is important to point out that the refocused prenatal consultations during which the pregnant woman is sufficiently advised and oriented on the essential care of the new-born, danger signs and healthy eating practices including breastfeeding play a very important role in the health of the children.

Globally, infectious diseases are the main reason for consultations at health facilities in so-called underdeveloped countries, and are responsible for most infant and child deaths. According to a study carried out in Morocco, post-natal mortality was dominated by infectious pathologies [16]. Effective socio-economic intervention and access to family planning could reduce the morbidity and mortality of young people and children in regions such as sub-Saharan Africa.

4.3. Follow-Up and Discharging Children under Treatment

Rapid referral and rapid access to care services are decisive in the prognosis of patients. This rapid orientation and access of patients to health care and services depends on several factors including the quality of the health system but also socio-cultural factors. In our country, the health system is organized in a pyramid including community health centers (1st level of population contact), reference health centers (First level of reference for patients), regional hospitals (Second level of reference) and university hospital centers (Third and final reference level). This pyramid is not respected as indicated in our study where the majority of patients (71.8%) consulted the reference health center directly without going through the nearest community health center. This attitude of patients most often aggravates the risk of complications because patients are admitted without conditioning or first aid which could save them. The same observation has been reported in the literature [9] [10]. This state of affairs denotes non-compliance with health policy and could be explained by the population's lack of awareness of the referral/evacuation system, as well as by parents' low level of education.

Concerning the monitoring of hospitalized children, its frequency depended on the severity of the illness but in most cases, it was done twice daily by the treating doctor. Upon discharge, an appointment for outpatient follow-up was given to patients based on their clinical condition.

The length of hospitalization generally depends on age, type of pathology and, above all, prognosis. The average length of stay for our patients was 6 days. This figure is close to those of Kanté and Simpara in Mali and Ghorbal in Tunisia, who found an average hospital stay of 5 days [4] [17].

The evolution of patients undergoing treatment was mixed. Cured patients accounted for 78.6%, deaths (10.6%) and transfers to university hospitals (1.6%). We also recorded 7.6% discharges against medical advice and 1.8% cases of escape. The high proportion of deaths in our study could be explained, on the one hand, by patients' late recourse to health structures, low household income and parents' low level of education, and on the other hand, by the health structure's lack of qualified human resources and technical facilities. As for the discharge of patients against medical advice and escapes, they can be explained by the fact that parents in most cases did not have the financial means to take care of their children, but also by the fact that the social services intended to help indulgent and destitute patients were not functioning properly.

4.4. Factors Associated with the Occurrence of Child Deaths

One of the aims of this study was to determine the factors associated with the occurrence of death in children aged 01 months to 15 months. In our series, we found a statistically significant association between the dependent variable (death) and age ($p < 0.03$), parental education ($p < 0.02$), parents' professions ($p < 0.003$) and length of hospital stay ($p < 0.001$). These results corroborate those reported in the literature, where lack of financial resources, inadequate quality of social and

health infrastructures, poor sanitation and public hygiene measures, and the low level of education of the population were reported as the main factors associated with mortality [3] [18] [19].

There is a real challenge in changing community behavior. In fact, in our context, patients are brought in late in a serious condition when the prognosis is compromised after having tried all traditional means of treatment. The desired change will not see the light of day without the involvement, motivation and commitment of all those involved in the health sector, and more particularly of traditional healers and health workers, who are the first point of contact for patients. Tradithérapists need to be made fully aware of patient referral. As for health workers, they must seize every contact with patients as an opportunity to raise awareness.

5. Limitations of the Study

In the course of our work, we were confronted with the problem of insufficient archiving of medical records. We were also unable to obtain information on the review of parents, the time elapsed between the first signs of illness and referral to the health service, or the time between admission of the children and their first treatment.

Data analysis was also limited to a univariate analysis, which did not allow confounding factors to be identified.

6. Conclusion

This study reveals that hospital morbidity and mortality in children aged 1 month to 15 years remain high, and are dominated by malaria, ARI and diarrhea/dehydration. It also confirms that low levels of education, age and length of hospital stay are factors associated with the occurrence of deaths in children aged 1 months to 15 years. Strengthening human resources, improving the quality of health care provision and services, and stepping up behavior-change communication can help reduce infant and child morbidity and mortality.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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