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Causes and Risk Factors of Hospitalization among Under-five Children in Kassala, Eastern Sudan

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Abstract

BACKGROUND: According to the World Health Organization estimation, African Region deaths of all under-five deaths in 2015 were over 5 times higher in comparison to the European Region.

AIM: The study aimed to estimate the prevalence, investigate the possible causes and risk factors associated with under-five children's hospitalization in Kassala, Eastern Sudan.

METHODS: A community-based cross-sectional study was conducted from December 2015 to March 2016. The data were collected by interviewing mothers.

RESULTS: A total of 297 mother-child pairs participated in the study. The mean (SD) of maternal age and children's age was 27.6 (5.9) years and 16 (11.3) months, respectively. One hundred and three children were hospitalized over the past 6 months. The most common mentioned causes for the last hospitalization were gastroenteritis 28.1% (29/103), respiratory tract infections 19.4% (20/103), malaria 9.7% (10/103), and trauma 3.8% (3/103). In multivariable analysis, a high birth order (adjusted odds ratio [AOR] 1.25, 95% Confidence Interval [CI] (1.06, 1.47), low paternal education (AOR 2.89, 95% 1.32, 6.30), and bottle feeding (AOR 2.26, 95% CI 1.30, 3.80) were associated with under-five children's hospitalization.

CONCLUSIONS: More than one-third of the children were hospitalized in Eastern Sudan. Urgent action is required to address children's health issues (i.e., the above-mentioned causes and associated factors).

Introduction

According to the World Health Organization (WHO), in 2015, 4.5 million (75%) of all under-five deaths occurred within the 1st year of life and the highest risk was in the WHO African Region (55/1000 live births). This is over 5 times higher in comparison to the European Region (10/1000 live births) [1].

Based on the results of the previous studies on under-five children's hospitalization, the predictors of admission were non-exclusive breastfeeding; delay of initiation of breastfeeding; bottle-feeding; unemployed mothers; having two or more children; and complementary feeds given by a person other than the mother; prolonged rupture of membrane; place of delivery; intrapartum fever; and APGAR score <7 at 5th min [2], [3], [4], [5], [6], [7], [8], [9]. Likewise, exclusive breastfeeding and avoidance of bottle feeding have been documented as key predictors of child survival [9], [10], [11], [12]. Besides, child hospitalization has a heavy burden on the economy [4], [13]. The main

causes of admission reported by the previous studies including Sudan were respiratory tract infections and gastroenteritis [2], [4], [5], [6], [7], [8].

Unfortunately, in Sudan, infants and young children are the most vulnerable ones among the population [2]. Child hospitalization rates, as well as causes and risk factors, have been studied in many countries [4], [5], [6], [14], [15], [16], [17]. However, little data exist in Sudan, especially in the most vulnerable and remote areas.

Kassala, located in Eastern Sudan, was selected to study children's hospitalization for several reasons. First, most of the available data in Sudan regarding child hospitalization were hospital-based studies [9], [18], [19]. Furthermore, the target area of Kassala State is categorized to be among the most vulnerable states where high rates of acute and chronic malnutrition have been reported, especially among children [20]. Most of the previous studies on children's hospitalization were carried out in the capital state of Khartoum and the nearby areas [18], [19] which is a relatively stable region. In contrast, Kassala is

characterized by refugees' settlement mainly from the neighboring country Eritrea from early eighth of the last century [21], [22]. It has had an influx of refugees from that time until now (i.e., according to the last report, influxes of refugees from Eritrea continue on average at a rate of approximately 2000 per month). This has increased Kassala's population and has put stress on the already limited resources [22], [23], [24]. The previous reports for both food [23] and security [25], as well as the recent report for food [26], have shown that Kassala is more vulnerable to humanitarian crises. In the context of food insecurity and unstable security, child morbidly and mortality, especially the under-fives, is found to be high and damaging [27], [28], [29], [30], [31], [32]. Both food insecurity and unstable security are linked to each other [33] as unstable security limits the provision of food production and distribution as well as health-care provision such as child vaccination [29], [34]. Besides, the availability of data before the crisis is of paramount importance to build on when a crisis occurs.

Conducting such a study at a community-level in an area characterized by both food insecurity and unstable security is, therefore, of great importance toward identifying the magnitude of the problem and will ultimately provide the basis for a future community-based intervention. Sudan is one of those developing countries where the rationale use of resources should always be strategic. Furthermore, such kind of research is needed to understand the gap and to prioritize the interventions for child life saving which this study aimed to achieve.

The study aimed to estimate the prevalence of under-five children's admission to health-care facilities and to investigate the possible causes and risk factors over the past 6 months in Kassala, Eastern Sudan by collecting community-level data.

Methods

A two-stage random (using a computer-generated number) cluster study was conducted in Kassala, Eastern Sudan from December 2015 to March 2016. Kassala is the capital of Kassala State. Kassala is 550 km from Khartoum on Ethiopian-Eritrean borders. Kassala has an estimated population of 453,159 inhabitants [35]. In stage one, simple random sampling of the localities was performed to randomly identify the household. In stage two, random sampling of the households was done to identify subjects (under-five children).

The houses were mapped to select a representative sample. The main tool used to collect data, in this study, was a structured pre-tested questionnaire. The questionnaire was tested among 15 participants (i.e., not considered in the

final data) and the necessary corrections were done accordingly. Five female medical officers were trained by the investigators to collect the data. The following inclusion criteria were set before conducting the study: Willingness to participate in the study, having under-five children (in case the mother had two children under-5 years and less, and the interview took place based on the youngest child), and availability at the time of data collection. The study excluded any mother, who did not fulfill the above-mentioned inclusion criteria.

A child was considered to be hospitalized when a child was admitted to a health-care facility complaining from any sickness and spent at least 24 h or more [36], [37]. A child admitted for <24 h was included in the study but considered as not having been admitted. For example, a child who came for routine immunization was not considered as child hospitalization and was included in the study as non-hospitalized.

The target participant was approached and before collecting any data, the following information was delivered by the interviewer to the participant, that is, the study purpose was explained, the right to refuse at any time, and the confidentiality of the obtained information. After participant acceptance and success in fulfilling the study inclusion criteria, a questionnaire was applied to collect relevant information from mothers through a face-to-face interview. The questionnaire was developed based on the previous studies [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19]. It included demographics (e.g., education, age, and occupation), mode of delivery (vaginal delivery, and cesarean delivery), infant's information (e.g., age, gender, and history of hospitalization over the past 6 months), and the main cause for hospitalization. For children who were hospitalized more than once, the cause of hospitalization was based on the last hospitalization.

A sample size of 309 participants was calculated using the assumption of the prevalence of (27.8%) which was reported in the previous community survey among children below the age of 5 years in Sudan [38]. This sample was selected to give 80% power with a precision of 5%.

Statistical analysis

The questionnaire was coded, for example, the main outcome variable (child hospitalization) was coded as (0) and (1) for not hospitalized and hospitalized, respectively.

Data were entered into the computer using Statistical Package for the Social Sciences version 20.0 for Windows, International Business Machines Corporation (IBM Corp, New York, United States), and double-checked before analyses. The results were illustrated in tables and text by calculating the means and SD for continuous variables, and frequencies and percentages for categorical variables to describe the participants' responses. t-test and Chi-square were applied for the

continuous and the categorical variable, respectively. Univariate analysis was applied with child hospitalization (hospitalized/not hospitalized) as the dependent variable and the other variables (age, parity, education, residence, mode of delivery, the new-born gender, etc.) as the independent variable. Moreover, variables with p < 0.2 were entered in multivariable analysis to control confounding variables. This cutoff p < 0.2 was chosen because being significant (i.e., the variable) in univariate analysis but not significant in logistic regression and vice versa is not uncommon, as it has been explained in the literature [39], [40]. Odds ratio (OR), adjusted OR (AOR), and 95% confidence interval (CI) were calculated. Variable with p < 0.05 was considered as significant.

Results

From the total (309) enrolled mother-child pairs, 297 (96.1%) had complete data. The mean (SD) of maternal age and children's age was 27.6 (5.9) years and 16 (11.3) months, respectively. Of these 297 participants, 122 (41.1%) were a rural, 269 (88.6%) were housewives, and 197 (66.3%) had education less than the secondary level. Twenty-eight (9.4%) of the mothers had medical disorders (diabetes, hypertension, and others). Less than half 137 (46.1%) of the children were females. More than half 161 (54.2%) of the children were institutional deliveries with a cesarean rate of 18.2%. One hundred and fifteen (38.7%) children were bottle-fed in the first 6 months.

Over the past 6 months, more than one-third of the children 34.7% (103/297) was hospitalized and spent 24 h or more at the hospital at least 1 time over the past 6 months.

The most commonly mentioned causes of hospitalization over the past 6 months based on the last hospitalization were gastroenteritis 28.1% (29/103), respiratory tract infections 19.4% (20/103), malaria 9.7% (10/103), and trauma 3.8% (3/103).

Residence and maternal education were found to be significant in univariate analysis only (Table 1).

In multivariable analysis (Table 2), a high birth order (AOR 1.25, 95% CI 1.06, 1.47), low paternal education (AOR 2.89, 95% 1.32, 6.30), and bottle feeding (AOR 2.26, 95% CI 1.30, 3.80) were associated with hospitalization of the under-five children.

Discussion

The main finding of the current study was that more than one-third (34.7%) of the studied children were hospitalized over the past 6 months. This prevalence was higher in comparison to the prevalence which was reported in Nigeria (9.7%) [14], in the United Arab Emirates (UAE) (10%) [15] and Ethiopia (21.5%) [16]. The difference could be due to the study methodologies as this is a community based one.

The commonly reported causes of admissions over the past 6 months were respiratory tract infections, gastroenteritis, and malaria. This is consistent with the previous reports in Sudan where the most common clinical presentations for under-five children were gastroenteritis, malaria, urinary tract infections, giardiasis, and tuberculosis [18], [41]. Likewise, the previous studies conducted in food insecurity areas showed that respiratory infection and gastroenteritis were the common causes of under-five children's hospitalization [17], [27], [32], [42].

Table 1: Socio-demographic characteristic of the under-five children's hospitalization in Kassala, Eastern Sudan (n=297)

Variable	Total (n=297) Mean (SD)	Child hospitalization (hospitalized n=103), (non-hospitalized n=194) Mean (SD)	Mean (SD)	p-value
Maternal age, years	27.6 (5.9)	27.1 (6.3)	27.8 (5.7)	0.366
Child age, months	16.0 (11.4)	17.6 (11.9)	15.2 (11.1)	0.086
Birth order	2.5 (1.6)	2.9 (1.9)	2.3 (1.4)	0.006
	n (%)	n (%)	n (%)	
Child gender				
Male	160 (53.9)	55 (53.4)	105 (54.1)	0.905
Female	137 (46.1)	48 (46.6)	89 (45.9)	
Residence				
Rural	122 (41.1)	51 (49.5)	71 (36.6)	0.039
Urban	175 (58.9)	52 (50.5)	123 (63.4)	
Mode of delivery				
Cesarean	54 (18.2)	16 (15.5)	38 (19.6)	0.389
Vaginal	243 (81.8)	87 (84.5)	156 (80.4)	
Place of delivery				
Institutional	161 (54.2)	52 (50.5)	109 (56.2)	0.348
Home	136 (45.8)	51 (49.5)	85 (43.8)	
Bottle-feeding in the first 6 months				
Yes	115 (38.7)	52 (50.5)	63 (32.5)	0.002
No	182 (61.3)	51 (48.1)	131 (67.5)	
Maternal education				
<Secondary level	197 (66.3)	82 (79.6)	115 (59.3)	<0.001
≥Secondary level	100 (33.7)	21 (20.4)	79 (40.7)	
Paternal education				
<Secondary level	167 (56.2)	75 (72.8)	92 (47.4)	<0.001
≥Secondary level	130 (43.8)	28 (27.2)	102 (52.6)	
Maternal medical history				
Yes	28 (9.4)	12 (11.7)	16 (8.2)	0.339
No	269 (90.6)	91 (88.3)	178 (91.8)	
Maternal occupation				
Housewife	262 (88.2)	96 (93.2)	166 (85.6)	0.052
Employed	35 (11.8)	7 (6.8)	28 (14.4)	

Table 2: Multivariable logistic regression analyses of factors associated with the under-five children's hospitalization in Kassala, Eastern Sudan

Variables	Crude OR (95% CI)	AOR (95% CI)	p-value
Child age	1.02 (0.99, 1.04)	1.02 (0.996, 1.043)	0.101
High child order	1.23 (1.06, 1.43)	1.25 (1.06, 1.47)	0.011
Residence			
Rural	1.67 (1.03, 2.71)	1.10 (0.62, 1.95)	0.738
Urban (reference)			
Bottle feeding			
Yes	2.12 (1.30,3.46)	2.26 (1.3, 3.8)	0.002
No (reference)			
Maternal education			
<Secondary level	2.68 (1.54, 4.69)	1.21 (0.50, 2.89)	0.677
≥Secondary level (reference)			
Paternal education			
<Secondary level	2.97 (1.77, 4.98)	2.89 (1.32, 6.30)	0.009
≥Secondary level (reference)			
Maternal occupation			
Housewife	2.31 (0.97, 5.50)	1.13 (0.40, 3.17)	0.820
Employed (reference)			

CI: Confidence interval, AOR: Adjusted odds ratio, OR: Odds ratio.

The current study showed a high rate of bottle feeding (38.7%) and children who were bottle-fed were

at 2.26 higher risk of hospitalization. In Khartoum, among bottle-fed infants, 100 and ten bacterial species including *Escherichia coli* were isolated from contents [43]. Many studies documented that poor breastfeeding practices (e.g., using bottle feeding) were the main key risk factor for children's hospitalization mainly due to respiratory tract infection and gastroenteritis[2], [4], [5], [6], [7], [8], [9]. Breastfeeding, particularly when exclusive and prolonged, protects against severe morbidities such as diarrhea and respiratory infections [4]. Various studies documented that bottle-feeding is associated with child morbidity (e.g., diarrhea, respiratory infection, and allergies) and mortality [9], [10], [43], [44], [45], [46]. For example, in Sudan, bottle-fed children were at high risk of malnutrition and hospitalization due to infectious causes as 83.3% of hospitalized children used bottle feeding [9].

The result of the current study showed that high birth order was a risk factor for child survival. In line with the current results, high birth order was reported by many studies in different countries including Sudan as a key risk factor for poor children's health due to morbidity and mortality [9], [47], [48], [49], [50]. This could be explained by the fact that high parity and extensive periods of breastfeeding presumably result in deletion of the reserved maternal nutrition such as anemia [51], and this could lead to a low birth outcome with its catastrophic effects [52]. In addition, in Sudan, Ibrahim, and Nabag found that the majority of the under-five malnourished children had increased birth order (i.e., their birth order was second and above). They attributed the effects of higher birth order on child health to access to less food and reduced time received per child [9].

The study showed that paternal education level (≥ Secondary level) was higher in comparison to maternal education 43.8% and 33.7%, respectively. Such variations between paternal and maternal education in Sudan have been reported previously [9]. This variation of education levels was also reflected in the employment rate as only 12% of the mothers were employed. This may raise the issue of gender inequality in both education and employment. In Africa, education gender-based inequality is not only confined to the years and level of education but also in the provided quality of the education itself, that is, poor quality for girls at schools [53].

Unlike maternal education, high level of paternal education was found to be a protective factor of child hospitalization. In line with the current results, other studies reported that maternal education does not influence the incidence of child morbidity and mortality [53], [54]. Interestingly, Sudan Household Health Survey 2000 revealed a positive correlation between maternal education and incidence of diarrheal diseases, that is, high maternal education level associated with a high rate of diarrheal diseases [41]. In contrast, the previous studies in different regions of Sudan including the study area revealed that maternal education was associated with poor perinatal and maternal outcomes [55], [56]. This contradiction could be due to the complex relationship between parental education and child health and the necessity of the presence of others preconditioning factors (e.g., equity, and women empowerment), for education to be more effective in improving knowledge, the income, and child survival [50], [53], [57].

For example, regardless of maternal education, a child of an educated father was more likely to be vaccinated against measles [58]. The influence of paternal education on child hospitalization could be explained by the small family size (i.e., less birth order) as the evidence provided by the literature is that educated parents desire smaller families than those with less education [59], [60]. By having fewer children more time and care can be given to each child. Besides, parents with higher education level may have more chances of employment, as well as better socioeconomic status, better food security status, accessibility to health insurance, and more knowledgeable about child health [58], [59], [61], [62]. Thus, we can conclude that factors such as low paternal education and high child order are correlated. Therefore, in Sudan, the impacts of parent education on infants and young child health need to be explored through more research.

In this study, residence in rural or urban areas was not significantly associated with child hospitalization. In contrast to another study [63], residence showed associated with children's hospitalization only in the univariate analysis. A recent study in Bangladesh revealed that disparity between urban and rural residency regarding child health has decreased over time [50].

The study has given valuable information regarding child hospitalization. However, the study had some limitations such as recall bias and the causes of child hospitalization were only based on the mother's memory (i.e., not on hospital records). In addition, the comorbidities among the reported causes are not uncommon [42], [64], [65], [66] and even among children who were hospitalized for more than 1 time over the past 6 months different causes were observed between the first and second hypostatization; and the children's weights were not measured as they have been done in the previous studies [2], [4], [5], [6], [7], [8]. Furthermore, the study investigated only living children that were hospitalized and it failed to trace children who were hospitalized and died.

Conclusions

More than one-third of the children were hospitalized in Eastern Sudan. The most common

mentioned causes of hospitalization were gastroenteritis, respiratory tract infections, malaria, and trauma. A high birth order, paternal education, and bottle feeding were associated with hospitalization of the under-five children. Urgent action is required to address children's health issues as the situation is fragile and unpredictable and the consequences will be more severe, if the situation worsens in the future.

Authors' Contributions

AAH, ZT, and IA designed the study and participated in the manuscript drafting. MAA, ZT, and AAA collected the data. AAH, AAA, and IA conducted the statistical analyses. All authors read and approved the final manuscript

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