

Original Research Article

Socio-Demographic and Economic Determinants of Umbilical Cord Infection among Neonates at Pumwani Maternity Hospital, Kenya: A Cross-Sectional Study

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ABSTRACT

Background: Infections are the single most important cause of neonatal mortality and it is estimated that 300,000 infants die annually from tetanus and 460,000 die because of severe bacterial infections, of which cord infections are a major precursor.

Objectives: This study aimed to assess the socio-demographic and economic determinants of umbilical cord infection among neonates aged 3 to 28 days attending Pumwani Maternity Hospital.

Methodology: A cross-sectional study was conducted among 178 mothers with neonates using systematic sampling method. The data was collected using pre-tested semi-structured questionnaire. Neonates were evaluated for signs of umbilical cord infection (pus, redness, and swelling). Chi-square test ($p < 0.05$) and odds ratio with corresponding 95% confidence interval were used to determine the association between dependent and independent variables. Binary logistic regression analysis was performed to determine the independent factors associated with cord infection.

Results: The findings of the study revealed that the prevalence of umbilical cord infection was found to be 37.6%. Of these, 49.3%, 37.3% and 13.4% presented with redness, pus discharge and swelling respectively. The multivariate analysis revealed that being female [AOR=2.24; 95%CI=1.09-4.57; $P < 0.05$], mothers with primary level [AOR=8.36; 95%CI=2.06-33.92; $P < 0.01$] and secondary school level [AOR=4.46; 95%CI=1.20-16.55; $P < 0.05$] than those mothers who had college/university education level, primipara mothers [AOR=9.32; 95%CI=2.69-32.27; $P < 0.001$] and households getting water through handcart [AOR=5.33; 95%CI=1.39-20.37; $P < 0.05$] were factors independently associated with cord infection.

Conclusion: The prevalence of cord infection among neonates was high, indicating that it is a major public health problem. Baby's sex, maternal level of education, parity and source of water are the independent predictors of umbilical cord infection. More campaigning and sensitization on the contributing factors should be tailored among mothers during ANC visits so as to avoid cord infections.

Key words: Neonate; Infection; Pumwani Maternity Hospital; Umbilical cord.

INTRODUCTION

The umbilical cord is the baby's lifeline to the mother during pregnancy. However, it is no longer needed once the

baby is born. Newborns are a vulnerable group and therefore need more attention and care. Annually about 3.3 million neonatal deaths occur around the world; [1]

of these, approximately 36% are caused by infections and 99% of them occurring in the low income and developing countries especially in sub Saharan Africa. [2] Further 460,000 die because of severe bacterial infections, of which umbilical cord infections are an important precursor. [2] Umbilical cord is an important gateway for infections, since it includes necrotic tissue. The umbilical cord infection developing subsequent to bacterial colonization is one of the outstanding reasons of newborn mortality and morbidity in underdeveloped and developing countries. [3-7]

There is wide variation in rates of umbilical cord infections among neonates in nurseries in developing countries, with rates ranging from 2 per 1000 to 54 per 1000 live births and case fatality rates ranging from 0 to 15%. [8] Previous studies revealed that caretaker socio-demographic, socioeconomic status and socio-cultural factors are associated with neonatal umbilical cord infection. [9,10]

However, in developing countries like Kenya, little is known about risk factors for umbilical cord infection though the burden of bacterial infection is presumed to be high. Previous work focused mainly on neonatal tetanus infection, but even where tetanus toxoid coverage rates are high, umbilical cord infections are likely to continue if practices at delivery and during the postnatal period do not reduce exposure of the umbilical cord stump to dangerous pathogens. [9] Therefore, this study was aimed at determining socio-economic and demographic factors associated with umbilical cord infection among neonates at Pumwani Maternity Hospital.

PATIENTS AND METHODS

Study setting

The study was conducted at Pumwani Maternity Hospital which is a referral maternity hospital located on the East of Nairobi City (country's capital

city). The hospital is a pioneer in the provision of maternity care in Sub-Saharan Africa. It has 354 obstetric beds, 144 baby cots and 2 theatres. Daily normal deliveries are 50–100, and Caesarean Sections are 10–15. To date the Hospital remains the largest maternity hospital in the country and Sub-Saharan Africa. It is equivalent to a Provincial Hospital in status and is reported to be third busiest maternity hospital in African.

Study design and participants

The study was a cross sectional descriptive study design. The study populations were all neonates aged 3-28 days accompanied by their mothers/care takers. The mothers/care takers were the primary respondents as they provide umbilical cord care to the neonates after delivery.

Sample size determination and sampling method

The sample size was determined by using single population proportion formula (Fischer *et al.* 1998; $n = Z^2pq/d^2$) by considering the following assumptions: 95% confidence interval (CI), 28% proportion of umbilical cord infection in neonatal admissions in Tanzania [11] and 7% margin of error. By adding 10% non-response rate, the final sample size was 178.

Systematic sampling method was used to select study participants. The first neonate to be included in the sample was chosen randomly by blindly picking one of two pieces of paper one with “Yes” and another one “No” for the first two clients in each day. The one that picks the “Yes” paper then becomes the first participant of the day. After that, every second neonate coming for child welfare clinic was included in the sample until the desired sample size was attained.

Data collection

A pre-tested semi-structured questionnaire was used to collect data by trained research assistant from mothers regarding socio-demographic attributes and socio-economic characteristics. The

questionnaire was also translated into a local language. Neonates were evaluated for signs of umbilical cord infection (pus, erythema of the abdominal skin, redness, swelling and/or foul smell).

Statistical analysis

The data was entered into MS excel spreadsheet and analyzed by SPSS version 20.0 (IBM Corporation, Armonk, NY, USA). Descriptive analysis was done using means, proportions and frequencies. Pearson's chi-square test and odds ratio (OR) with corresponding 95% confidence intervals (CI) were computed to find association between independent and dependant variable (cord infection). Binary logistic regression model was used to identify variables associated with cord infection. Variables having a *P*-value ≤ 0.05 in the bivariate analysis were entered into a multivariate analysis for controlling the possible effect of confounders.

Ethical considerations

Ethical clearance was sought from Kenyatta National Hospital/University of Nairobi (KNH/UON), Ethics and Research Committee. Permission was obtained from the hospitals' administration and the study participants. After the purpose of the study was explained, written consent was obtained from each of the study participants. Participants were informed that participation was on a voluntary basis and that they can withdraw at any time if they were not comfortable about the questionnaire. Names or personal identifiers were not included in the questionnaire to ensure participants' confidentiality.

RESULTS

Description and cord status among the neonates

Table 1 shows the description of children by socio-demographic characteristics and cord status. The ages of the neonates ranged from 3 days to 28 days with mean age of 11.7 days. Three

quarters of the neonates 134(75.3%) were aged between 3 to 14 days while the age category of 15 to 28 days were 44(25.7%). The gender distribution among the neonates indicates that there were 95(53.4%) females and 83(46.6%) males. The table further shows that 76(42.7%) of the babies had either generalized rash or nappy rash.

The prevalence of umbilical cord infection was found to be 67(37.6%) with 95% confidence interval of 30.48% to 44.72%. Among those who had umbilical cord infection, 33(49.3%) presented with redness, 9(13.4%) presented with swelling and 25(37.3%) presented with pus.

Table 1: Description and cord status among the neonates

Socio-demographic characteristics	Frequency (n=178)	Percentage (%)
Sex		
Female	95	53.4
Male	83	46.6
Age in days		
3 to 14	134	75.3
15 to 28	44	24.7
Birth weight in Kg		
2.0-3.0	84	47.2
3.1-4.2	94	52.8
Whether the child had generalized/nappy rash		
Yes	76	42.7
No	102	57.3
Current status of umbilical cord infection		
Present	67	37.6
Absent	111	62.4
Description of umbilical cord infection		
Reddened	33	49.3
Swollen	9	13.4
Pus	25	37.3

Socio-demographic and economic characteristics of the mothers

The mean age of the mothers was 24.6 years. The findings also show that about half of the mothers 83(46.6%) were within the age group of 23-29 years and about a third 61(34.3%) were 16-22 years while the age group of 31-39 were only 34(19.1%). The educational level of the mothers was as follows; 59(33.2%), primary level, 94(52.8%), secondary and 25(14.0%) in tertiary. On religious affiliation, most of the mothers interviewed 168(94.4%) were Christians whereas the remaining 10(5.6%) were Muslims. Regarding marital status of the

mothers, majority 127(71.9%) was married. Majority of the mothers 105(59.0%) were primiparas. With respect to occupation, 60(33.7%) of the mothers were unemployed, 26(14.6%) were casual workers and 74(41.6%), were self-employed. However, only 18(10.1%) had permanent job (Table 2).

Table 2: Socio-demographic characteristics of the mothers

Socio-demographic characteristics	Frequency (n=178)	Percentage (%)
Mean age (+SD) of mothers	24.6(±5)	
Mother's age in years		
16-22	61	34.3
23-29	83	46.6
31-39	34	19.1
Mother's level of education		
Primary	59	33.2
Secondary	94	52.8
College/University	25	14.0
Mother's religion		
Christian	168	94.4
Muslim	10	5.6
Mother's marital status		
Married	128	71.9
Single	50	28.1
Parity		
1	105	59.0
2	42	23.6
3 and above	31	17.4
Mother's occupation		
None	60	33.7
Casual	26	14.6
Self employed	74	41.6
Permanently employed	18	10.1
Nature of house		
Permanent	126	70.8
Semi-permanent	20	11.2
Temporarily	32	18
Ownership of house		
Self	13	7.3
Rental	165	92.7
Availability of electricity		
Yes	166	93.3
No	12	6.7
Source of water		
Handcart	14	7.9
Piped	164	92.1
Type of toilet		
Pit	55	30.9
Flash	123	69.1
Ownership of toilet		
Communal	124	69.7
Individual	54	30.3

A majority of mothers 126(70.8%) indicated that they were living in permanent houses. Nevertheless, a large percentage of the respondents 165(92.7%) were staying in a rental house. Most of the

mothers 166(93.3%) had electricity supply while the remaining 12(6.7%) were living without electricity. The main source of water of the households was piped at 164(92.1%) while the rest 14(7.9%) was handcart supplied. Flash toilet was the most common 123(69.1%) type of toilet used and majority of the respondents 124(69.7%) were using communal toilet (Table 2).

Factors associated with cord infection using unadjusted and adjusted logistic regression

In the bivariate analysis, baby's sex, generalized/diaper rash, mother's level of education, parity, source of water, availability of electricity and ownership of toilet were factors associated with umbilical cord infection. However, following multivariate analysis baby's sex, mother's level of education, parity and source of water remained significantly and independently associated with cord infection among neonates.

Female babies were 2.68 fold more likely to develop cord infection compared to their male counterparts [AOR=2.24; 95%CI=1.09-4.57; P<0.05]. Babies whose mothers attained primary school [AOR=8.36; 95%CI=2.06-33.92; P<0.01] and secondary school [AOR=4.46; 95%CI=1.20-16.55; P<0.05] were more likely to acquire cord infection than those whose mothers had college/university education. Households getting water through handcart were significantly about 8 fold more likely to have babies with umbilical cord infections compared to those using piped water [AOR=5.33; 95%CI=1.39-20.37; P<0.05]. Primipara mothers had 10.38 times more likely to have babies with umbilical cord infection than mothers with three parity and above [AOR=9.32; 95%CI=2.69-32.27; P<0.001] (Table 3).

Table 3: Factors associated with cord infection using unadjusted and adjusted logistic regression

Variables	Cord infection		Bivariate analysis	Multivariate analysis
	Yes, n(%)	No, n(%)	COR (95%CI)	AOR(95%CI)
Baby's Sex				
Female	44(46.3%)	51(53.7%)	2.25(1.20-4.22)	2.24(1.09-4.57)*
Male	23(27.7%)	60(72.3%)	1.00	1.00
Baby's age in days				
3 to 14	48(35.8%)	86(64.2%)	0.73(0.37-1.47)	-
15 to 28	19(43.2%)	25(56.8%)	1.00	
Whether the child had generalized/nappy rash				
Yes	35(46.1%)	41(53.9%)	1.87(1.01-3.45)	1.91(0.89-4.08)
No	32(31.4%)	70(68.6%)	1.00	1.00
Birth weight in Kg				
2.0-3.0	34(40.5%)	50(59.5%)	1.26(0.69-2.31)	-
3.1-4.2	33(35.1%)	61(64.9%)	1.00	
Mother's age in years				
16-22	29(47.5%)	32(52.5%)	1.90(0.79-4.55)	-
23-29	27(32.5%)	56(67.5%)	1.01(0.43-2.37)	
31-39	11(32.4%)	23(67.6%)	1.00	
Mother's level of education				
Primary	25(43.9%)	32(56.1%)	3.44(1.14-10.36)	8.36(2.06-33.92)**
Secondary	37(39.4%)	57(60.6%)	2.86(0.99-8.21)	4.46(1.20-16.55)*
College/University	5(18.5%)	22(81.5%)	1.00	1.00
Mother's religion				
Christian	64(38.1%)	104(61.9%)	1.44(0.36-5.75)	-
Muslim	3(30.0%)	7(70.0%)	1.00	
Parity				
1	47(44.8%)	58(55.2%)	3.38(1.28-8.91)	9.32(2.69-32.27)***
2	14(33.3%)	28(66.7%)	2.08(0.70-6.25)	3.11(0.98-12.70)
3 and above	6(19.4%)	25(80.6%)	1.00	1.00
Mother's marital status				
Married	49(38.3%)	79(61.7%)	1.10(0.56-2.17)	-
Single	18(36.0%)	32(64.0%)	1.00	
Mother's occupation				
None	26(43.3%)	34(56.7%)	1.53(0.51-4.62)	-
Casual	11(42.3%)	15(57.7%)	1.47(0.42-5.13)	
Self employed	24(32.4%)	50(67.6%)	0.96(0.32-2.87)	
Permanently employed	6(33.3%)	12(66.7%)	1.00	
Source of water				
Handcart	9(64.3%)	5(35.7%)	3.29(1.05-10.28)	5.33(1.39-20.37)*
Piped	58(35.4%)	106(64.6%)	1.00	1.00
Nature of house				
Permanent	44(34.9%)	82(65.1%)	0.61(0.28-1.33)	-
Semi- permanent	8(40.0%)	12(60.0%)	0.76(0.24-2.35)	
Temporarily	15(46.9%)	17(53.1%)	1.00	
Ownership of house				
Self	5(38.5%)	8(61.5%)	1.04(0.33-3.32)	-
Rental	62(37.6%)	103(62.4%)	1.00	
Availability of electricity				
Yes	58(34.9%)	108(65.1%)	0.18(0.05-0.69)	0.46(0.09-2.28)
No	9(75.0%)	3(25.0%)	1.00	1.00
Type of toilet				
Pit	24(43.6%)	31(56.4%)	1.44(0.75-2.76)	-
Flash	43(35.0%)	80(65.0%)	1.00	
Ownership of toilet				
Communal	53(42.7%)	71(57.3%)	2.13(1.05-4.32)	1.14(0.48-2.70)
Individual	14(25.9%)	40(76.1%)	1.00	1.00
Abbreviations: COR= Crude Odds Ratio, AOR= Adjusted Odds Ratio, CI= Confidence Interval,				
* p<0.05, **p<0.01, ***p<0.001				

DISCUSSION

The present study showed that the prevalence of umbilical cord infection among neonates was high at 37.6% while in other developing countries it is reported at 6.18% [12] and in the developed world is around 0.7%. [9] However, the figure is

relatively comparable to a study conducted among neonates admitted to an African general paediatric ward in Tanzania which reported at 28%. [11] No previous study on the prevalence of cord infection among neonates has been reported in Kenya, to our knowledge. The results further showed

that 49.3% of the neonates with cord infection presented with redness, 37.3% presented with pus discharge while swelling was at 13.4%. The percentage of pus discharge was high which indicated the severity of infection in this study. The prevalence of neonatal umbilical cord infection varies with considerable fluctuation over time and geographical location and even from hospital to hospital. These variations may be related to the nature of labour conduction and environmental conditions [12] and also knowledge and practice of cord care by mothers.

In this study interestingly female babies were found more likely to develop cord infection compared to their male counterparts after adjustment was made for other associated factors. This could be due to some preference/favouritism towards male children with concomitant disregard for daughters. It has been reported that more male infants were treated with beneficial cord care than the female infants probably because of the preference of the male child over the female. [13] However, the finding contradicts with two hospital-based reports from developing countries that reported increased risk among males. [11,13] This might be a reflection of preferential treatment among the opposite sex and provision of better quality of umbilical cord care. There is need for further research on this area.

According to this study, the educational level of mothers had a strong relationship with the umbilical cord status of their babies. Babies whose mothers had attained primary level education and those who had secondary school education were seven and six times respectively more likely to acquire umbilical cord infection than those whose mothers had college/university education. The reasons for the increased prevalence of umbilical cord infection in this group may include poor hygiene, overcrowding in homes, lack of clean, safe water and poor cord

care practices. [14,15] It has also been reported by Sobita [16] in the rural areas of Nepal that higher level of education among mothers with new-born babies had a positive impact on clean cord care practice. This may perhaps further underscore the importance of female education.

Parity was significantly associated with umbilical cord infection among the babies. Babies of Primiparas mothers were more likely to have umbilical cord infection than those born of multiparous mothers who had more than three deliveries. Babies of multiparous mothers could be less likely to have umbilical cord infection because of experience gathered over time from previous deliveries. A study carried out on risk factors for neonatal sepsis in Soweto, South Africa demonstrated that first birth remained strongly associated with sepsis. [17] This could be because women delivering for the first time typically have longer duration between rupture of membrane and delivery. This longer duration between rupture of membrane and delivery may in turn contribute to umbilical cord infection. Besides this, primiparous mothers are more likely to be influenced by other caregivers on the umbilical cord care. There is therefore increased need for health education on care of the umbilical cord for primiparous mothers.

In this study, mothers whose households were getting water through handcart were significantly more likely to have babies with umbilical cord infection compared to those getting piped water. Such water may be fetched from unsafe sources. Water can harbour dangerous micro-organisms especially bacteria. This might put both mothers and their babies at grave risk of contracting a potentially fatal infection. Moreover, the water might be contaminated in the process of collecting it from the source all the way to the consumers. Mothers using this kind of water may transfer the micro-organisms to

their babies or the babies might contract the infection while bathing. But there are no previous reports of the role of using water from handcart on umbilical cord infection.

Limitation of Study

The study relied only on physical examination to assess cord infection. It did not include swab/pus samples that would have determined the specific bacterial infection. The results of this study were generated from a health facility and may not be generalized to other sites. Despite these limitations, key findings of the study are of value for umbilical cord care in the study area.

CONCLUSION

The findings of the study revealed that the prevalence of umbilical cord infection among neonates was high suggesting an urgent need for intervention. Female babies, mothers with low level of education, primipara mothers and handcart source of water were found to be factors associated with umbilical cord infection. The findings in this study confirm that socio-demographic and socioeconomic factors contribute significantly to neonatal cord infection therefore it is recommended that an improved standard of living, education and empowerment of women and increased provision of basic social amenities would be most effective interventions.

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