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Association of umbilical cord care practices with neonatal infection in Katsina, northwest Nigeria

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Abstract:

Background: Significant numbers of neonatal deaths occurring each year are caused by infections that can be directly associated with improper and unhygienic umbilical cord care practices. The objectives of this study were to describe the umbilical cord care practices among mothers whose babies were admitted for suspected sepsis at the Federal Teaching Hospital and Turai Umaru Yar'adua Maternal and Children Hospital Katsina, Nigeria, assess the relationship between umbilical cord care practices and neonatal sepsis, and the influence of home delivery on this relationship.

Methodology: This was a hospital-based descriptive observational study of 60 selected neonates with clinical features of sepsis admitted into the special care baby unit (SCBU) of the two hospitals between July and December 2022. The study involved the collection and microbiological analysis of blood samples using the BacT/Alert microbial detection system, and the administration of a structured questionnaire on the mother of each enrollee to collect relevant information about cord care practices. Data were analyzed using SPSS version 22.0. The Chi-square (χ^2) test and Odds ratio (with 95% confidence interval) were used to determine the association of risk factors with culture-confirmed sepsis, and a p value less than 0.05 was considered statistically significant.

Results: Of the 60 neonates blood samples, 31 (51.7%) were culture-positive for neonatal sepsis while 29 (48.3%) were culture-negative. There was no statistically significant association between risk factors such as application of traditional materials for cord care and place of delivery, and culture-confirmed neonatal sepsis ($p > 0.05$). However, neonates whose mothers use traditional materials for cord care were more likely to develop sepsis than those who do not (OR=2.027, 95% CI=0.716-5.736). Concerning place of delivery, which is an important determinant of umbilical cord hygiene, babies delivered at home were almost 3 times more likely to have culture-confirmed sepsis than those delivered in the hospital (OR=2.975, 95% CI=1.040-8.510). A total of 26 out of the 60 (45.3%) mothers of the neonates agreed to have used unhygienic and traditional materials for cord care, with charcoal (39.0%), local herbs (27.0%), cow dung/urine concoction (19.0%), and others (15.0%), such as lubricants, ash, and balm, being the most commonly used materials for cord care.

Conclusion: Neonatal infection is common among newborns in Federal Teaching Hospital and Turai Umaru Yar'adua Maternal and Children Hospital (TUYMCH), Katsina, northwest Nigeria, with a prevalence of culture-confirmed neonatal sepsis of 51.7%. Although there was no statistically significant association between unhygienic cord practices and neonatal sepsis in this study, babies whose mothers use traditional materials for cord care were more likely to develop sepsis. There is a high rate of use of harmful and unhygienic traditional materials for cord care in our environment. This habit can be discouraged through health education using the mass media and health talks in health facilities. The use of chlorhexidine, the recommended antiseptic for cord care by the World Health Organization and the Nigeria Federal Ministry of Health, should be encouraged.

Keywords: Umbilical cord care; Traditional practices; Culture-confirmed; Neonatal sepsis

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Association des pratiques de soins du cordon ombilical avec l'infection néonatale à Katsina, dans le nord-ouest du Nigéria

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Résumé:

Contexte: Un nombre important de décès néonataux survenant chaque année sont causés par des infections qui peuvent être directement associées à des pratiques de soins du cordon ombilical inappropriées et non hygiéniques. Les objectifs de cette étude étaient de décrire les pratiques de soins du cordon ombilical chez les mères dont les bébés ont été admis pour suspicion de septicémie à l'hôpital universitaire fédéral et à l'hôpital maternel et infantile Turai Umaru Yar'adua de Katsina, au Nigéria, d'évaluer la relation entre les pratiques de soins du cordon ombilical et la septicémie néonatale, et l'influence de l'accouchement à domicile sur cette relation.

Méthodologie: Il s'agissait d'une étude observationnelle descriptive en milieu hospitalier portant sur 60 nouveau-nés sélectionnés présentant des caractéristiques cliniques de septicémie admis dans l'unité de soins spéciaux pour bébés (SCBU) des deux hôpitaux entre Juillet et Décembre 2022. L'étude impliquait la collecte et l'analyse microbiologique d'échantillons de sang à l'aide du système de détection microbienne BacT/Alert, et l'administration d'un questionnaire structuré à la mère de chaque personne inscrite pour recueillir des informations pertinentes sur les pratiques de soins du cordon ombilical. Les données ont été analysées à l'aide de SPSS version 22.0. Français Le test du Chi carré (χ^2) et le rapport de cotes (avec intervalle de confiance à 95%) ont été utilisés pour déterminer l'association des facteurs de risque avec la septicémie confirmée par culture, et une valeur de p inférieure à 0,05 a été considérée comme statistiquement significative.

Résultats: Sur les 60 échantillons de sang de nouveau-nés, 31 (51,7%) étaient positifs à la culture pour la septicémie néonatale tandis que 29 (48,3%) étaient négatifs à la culture. Il n'y avait pas d'association statistiquement significative entre les facteurs de risque tels que l'application de matériel traditionnel pour les soins du cordon ombilical et le lieu d'accouchement, et la septicémie néonatale confirmée par culture ($p > 0,05$). Cependant, les nouveau-nés dont les mères utilisent du matériel traditionnel pour les soins du cordon ombilical étaient plus susceptibles de développer une septicémie que ceux qui ne le font pas (OR=2,027, IC à 95 % = 0,716-5,736). Français Concernant le lieu d'accouchement, qui est un déterminant important de l'hygiène du cordon ombilical, les bébés nés à domicile étaient presque 3 fois plus susceptibles d'avoir une septicémie confirmée par culture que ceux nés à l'hôpital (OR=2,975, IC à 95% = 1,040-8,510). Au total, 26 des 60 (45,3%) mères de nouveau-nés ont convenu d'avoir utilisé des matériaux non hygiéniques et traditionnels pour les soins du cordon, le charbon de bois (39,0%), les herbes locales (27,0%), la concoction de bouse de vache/urine (19,0%) et d'autres (15,0%), tels que les lubrifiants, la cendre et le baume, étant les matériaux les plus couramment utilisés pour les soins du cordon.

Conclusion: L'infection néonatale est courante chez les nouveau-nés de l'hôpital universitaire fédéral et de l'hôpital maternel et infantile Turai Umaru Yar'adua (TUYMCH), à Katsina, dans le nord-ouest du Nigéria, avec une prévalence de septicémie néonatale confirmée par culture de 51,7 %. Bien qu'aucune association statistiquement significative n'ait été observée entre les pratiques non hygiéniques pour les soins du cordon et la septicémie néonatale dans cette étude, les bébés dont les mères utilisaient des matériaux traditionnels pour les soins du cordon étaient plus susceptibles de développer une septicémie. Le taux d'utilisation de matériaux traditionnels nocifs et non hygiéniques pour les soins du cordon dans notre environnement est élevé. Cette habitude peut être découragée par l'éducation sanitaire par le biais des médias de masse et des discussions sur la santé dans les établissements de santé. L'utilisation de la chlorhexidine, l'antiseptique recommandé pour les soins du cordon par l'Organisation mondiale de la santé et le ministère fédéral de la santé du Nigéria, devrait être encouragée

Mots-clés: Soins du cordon ombilical; Pratiques traditionnelles; Confirmé par culture; Sepsis néonatal

Introduction:

The development of the umbilical cord begins at about week 3 of the embryologic period with the formation of the connecting stalk. At week 7 the cord is fully formed and remains attached to the fetus until after delivery, when it is typically detached (1,2).

The cord comprises the two umbilical arteries, the umbilical vein, the primitive allantois, the remaining portion of the omphalomesenteric duct, and a gelatinous material known as the Wharton jelly (1,3). Some structures stay in the base when the cord sloughs after birth. The umbilical vessels are physically patent but functionally closed for 10 to 20 days, making

them possible entry points for infectious pathogens (1,3).

Significant number of neonatal deaths that occur each year are caused by infections that can be directly linked to improper umbilical cord care practices (4). Because of the high prevalence of improper cord care techniques, infections from cord care are more common in underdeveloped nations (5,6). Globally, there is still great concern over the high rate of newborn death, which is especially high in many low-income sub-Saharan African nations. Over 3 million newborns are thought to have died globally in 2010 alone (7). The majority of the global burden of newborn fatalities was in Nigeria and India (7,8,9). There has been no significant reduction in newborn mortality rate (NMR) in Nigeria since the late 1990s. In 1999, 2003, 2008, and 2013, the NMR in Nigeria were projected to be 37, 48, 41, and 37 per 1000 live births, respectively (10). The worst-hit regions in Nigeria were the northeast and northwest. For example, in the northeastern state of Bauchi, the NMR was 33, 61, 53, and 43 per 1000 live births in 1999, 2003, 2008, and 2013, respectively. Similarly, the NMR estimates in the same respective years were 36, 55, 47, and 44 per 1000 live births in Sokoto State, northwest Nigeria (10).

Umbilical cord care is the sequence of procedures used in the handling of the umbilical cord of the newborn after delivery and if not carefully carried out could contribute significantly to the risk of infection and mortality in the baby (11). In many parts of Africa, cultural influences, beliefs, and practices in child care are long-standing phenomena (12,13). Most of these phenomena existed before orthodox medicine was introduced, and many tribes and families continue to practice and adhere to them (14). Harmful and ineffective cord care practices are common in Nigeria and other sub-Saharan African nations. These practices are driven by various sociocultural ideas passed down from generation to generation regarding the care of the newborn umbilical cord (15,16). This customary practice is growing, particularly in rural areas where home delivery is highly prevalent (16).

Some regions of sub-Saharan Africa are dominated by cultural customs that carry potential risks, especially home delivery (17). Materials such as petroleum jelly, cooking oil, ash or burnt gourd powders, commercial baby lotion, and breast milk were frequently used for umbilical cord care (17). Certain cultural settings use charcoal, baby powder, dust, lubricants (such as vaseline, cooking oil, or used motor oil), cow dung, and chicken droppings

on the umbilical cord (17). Due to many factors, women who deliver at home are more prone to using harmful materials for umbilical cord care, than those who deliver at the hospital (1). The fact that about 59% of mothers in Nigeria deliver their babies at home lacking the help of a skilled birth attendant exposes women to unhygienic practices recommended by traditional birth helpers (1). Also, in sub-Saharan Africa, applying different materials to the recently severed cord is a widespread old-style practice by many mothers who find it acceptable due to their wrong perception that such practices promote speedy healing and drying of the cord (1).

Cow dung, charcoal, hot fermentation, mustard oil, ghee, and ash are among some traditional materials substantially associated with a higher risk of omphalitis and newborn sepsis (6,13). It has been discovered that mothers who adopt these practices are putting their babies at the risk of illnesses such as omphalitis and neonatal tetanus, which are significant causes of neonatal mortality (18). These unhygienic traditional practices are still widespread in different parts of Nigeria (1,4,6,18-20). To prevent life-threatening sepsis from cord infections, the World Health Organization (WHO) released a new recommendation in 2014 that called for the application of daily chlorhexidine gel to the umbilical stump during the first week of life (1). This recommendation was made because optimal cord care at birth and during the first week of life, including the use of chlorhexidine, is especially important in settings with poor hygiene (1). It was then advised that mothers in impoverished nations should use chlorhexidine in place of the harmful materials when taking care of the umbilical cord of their newborn (1).

The choices made immediately after giving birth regarding the management of the cord and the enduring negative societal norms and beliefs were linked to the primary causes of newborn infection (17). The care of the umbilical cord is critical during the neonatal period of life and poor cord care practices have been associated with newborn infections (19). Cord infection may be confined to the umbilical cord (omphalitis) or enter the bloodstream to become systemic (19). Neonatal infections such as omphalitis, a persistent concern in developing nations, are caused by improper handling of the umbilical cord (1).

With standard cord care, the cord typically falls off 5 to 15 days after birth (19). Where hygienic cord care is not practiced, it could be colonized by pathogenic organisms (19). Sepsis (21%) and tetanus (16%), two

consequences of umbilical infections, are reported to account for 36% of all causes of newborn fatalities (17). There is a general lack of agreement on the definition of neonatal sepsis because of the non-specificity of the presenting features in neonates (21). However, according to Shane et al., (22), neonatal sepsis is a systemic bacterial, fungal, or viral illness that is marked by bio-physiological alterations such as abnormal leucocyte count, temperature, or tachycardia, and clinical symptoms such as fever, feeding difficulties, or umbilical discharge, with notable high morbidity and mortality rate.

An estimated 2.9 million newborn fatalities occur annually worldwide, with the neonatal period accounting for 40% of deaths in children under 5 years of age (22,23). Developing nations have the greatest rates of neonatal mortality, with illnesses contracted during or shortly after childbirth accounting for a third of these deaths (22,23). According to reports, sepsis is the primary cause of about 30 to 50% of infant mortality in Nigeria, which ranks third globally behind China and India (22,24). The prevalence of neonatal sepsis, as reported by past research conducted in hospitals, varies from 7.04 to 22.9 per 1000 live births (22,25). Thirty percent of newborn mortality in Nigeria is attributed to umbilical cord infections, according to several hospital-based studies (19). The guidelines for umbilical cord care are often disregarded, despite efforts to enhance these practices. Even newborns delivered in the hospital may be impacted by customs that are carried out after discharge, which frequently result in umbilical cord infections and neonatal deaths (19).

In resource-limited settings, pathogenic microorganisms are more likely to enter through the umbilical cord (21). This might not be unconnected to the poor sanitary conditions in the surrounding of the neonate, which could lead to localized infection of the umbilical cord (omphalitis) and possibly septicemia or infection of other organs (21). The microorganisms could spread through the patent umbilical vessels into the bloodstream (24). Although clean delivery practices are strongly recommended due to their ability to reduce the incidence of omphalitis and neonatal sepsis, cultural norms that influence how to care for the umbilical cord may hinder cord hygiene in many developing countries (21).

While there are several risk factors for neonatal sepsis, including maternal and neonatal factors, a critical determinant is umbilical cord hygiene (21). When an umbilical stump is dry and shows no signs of redness, warmth,

swelling, pain, bad odor, or pus, it is considered hygienic (24). Appropriate umbilical cord care regimen is required to keep it clean through application of either methylated spirit or chlorhexidine to the base of the cord, letting it air dry to promote natural healing, or sponge bathing of newborns without submerging them in water could also be considered appropriate cord care. (24). In settings where mortality is low (less than 30 deaths per 1000 births), the WHO advises the use of dry cord care at home births or in medical institutions. In settings of high infant mortality, chlorhexidine, in particular, is recommended for cord care in home births as an alternative to the hazardous traditional materials (24).

The objectives of this study are to describe the umbilical cord care practices of mothers whose babies were admitted for suspected sepsis at the Federal Teaching Hospital and Turai Umaru Yar'adua Maternal and Children Hospital Katsina, assess the relationship between umbilical cord care practices and neonatal sepsis, and the influence of home delivery on this relationship

Materials and method:

Study area:

The study was conducted at the special care baby units (SCBU) of the Federal Teaching Hospital, and Turai Umar Yar'adua Maternity and Children Hospital, in Katsina, northwest Nigeria. Katsina is positioned about 260 kilometres east of the city of Sokoto and 135 kilometres northwest of Kano, it shares an international border with the Republic of Niger and has a total area of 24,192 km² and geographical coordinates of 12⁰15'N and 7⁰30'E.

As of 2022, the estimated population of Katsina metropolis was over half a million. A largely agrarian society with the majority of the residents being of the Hausa and Fulani tribes. The two hospitals were chosen due to the availability of the study population and laboratory facilities required for the study. The hospitals provide neonatal healthcare services to the residents of the metropolis and the surrounding local government areas.

Study design and duration:

This was a hospital-based descriptive observational study of neonates with clinical features of sepsis and involved the collection and microbiological analysis of blood samples as well as the administration of a structured questionnaire on the mother of each enrollee to collect relevant socio-demographic and clinical information. The study was carried out between July and December 2022.

Ethical consideration:

Ethical approvals were obtained from the Research and Ethics Committees of the Federal Teaching Hospital, Katsina (FMCN/HR EC/REG.N003/082012) as well as the Katsina State Ministry of Health (MOH/ADM/SUB/1152/1/350). The study was carried out in line with the WHO guidelines for research conduct on human subjects. Participant information sheet was distributed, and consent form was signed by the parent of each newborn.

Sample size, selection criteria, and sampling:

A total of 60 neonates admitted into the special care baby units (SCBU) of the two hospitals being evaluated for sepsis during the period of the study, were included. Neonates whose parents or guardians declined consent, and those already commenced on antibiotics were excluded from the study.

Data and sample collection:

Structured questionnaires were used to extract information from the mothers of the neonates on the types of materials used for cord care as well as the place of baby delivery. About 2 milliliters of blood samples were aseptically collected from each neonate's peripheral vein before administration of empirical antibiotic therapy. The blood was inoculated directly into an appropriately labeled BacT/Alert sample bottle, which was then moved into a closed container and instantly transported to the laboratory for analysis.

Bacterial detection with BacT/Alert blood culture system:

Inoculated bottles were arranged into the BacT/Alert microbial detection system, which employs a colorimetric sensor and reflected light to detect the existence of carbon dioxide (CO₂) formed when bacteria grow and metabolize the substrates in the culture medium, with the color of the gas-permeable sensor, installed in the bottom of each culture bottle, changing to yellow (if bacteria are present in the sample), and then recorded as culture-positive (26). The procedures for loading and unloading the culture bottles into the BacT/Alert machine were done as stipulated in the manufacturers' user-instruction manual.

The bottles were incubated aerobically and continuously observed for the presence of microbial growth for 5 days. Culture-positive bottles were then removed for bacterial identification by Gram stain smears and sub-cul-

ture on Blood and MacConkey agar plates. Bacteria were identified to species level using conventional biochemical tests scheme.

Data processing and statistical analysis

Data were analyzed using SPSS version 22.0. The Chi-square (χ^2) test and Odds ratio (with 95% confidence interval) were used to determine the association of risk factors with culture-confirmed neonatal sepsis, and a *p*-value of less than 0.05 was considered statistically significant.

Results:

A total of 60 hospitalized neonates assessed for suspected sepsis at the special care baby units (SCBU) of the Federal Teaching Hospital and Turai Umaru Yar'adua Maternal and Children Hospital (TUYMCH), Katsina, Nigeria, were enrolled for the study between July and December 2022. Of the 60 blood samples collected from the neonates, 31 (51.7%) were culture-positive while 29 (48.3%) were culture-negative (Table 1).

Table 1: Blood culture results of study neonates

Blood culture status	No of neonates (%)
Culture positive (confirmed)	31 (51.7)
Culture negative	29 (48.3)
Total	60 (100)

Table 2 shows the association between maternal risk factors, such as application of traditional materials for cord care and place of delivery, with culture-confirmed sepsis. No statistically significant associations exist between both risk factors and neonatal sepsis ($p > 0.05$). However, neonates whose mothers used traditional materials for cord care were more likely to developed culture-confirmed sepsis than those who do not (OR=2.027, 95% CI=0.716-5.736).

Concerning place of delivery, an important determinant of umbilical cord hygiene, babies delivered at home were 3 times more likely to have culture-confirmed sepsis than those delivered in the hospital (OR=2.975, 95% CI=1.040-8.510, $p=0.0717$). Twenty-six (43.3%) mothers used traditional unhygienic for cord care in the study. Charcoal (39%), local

Table 2: Maternal risk factors for culture confirmed neonatal sepsis

Risk factors		Neonatal sepsis		x ²	OR (95% CI)	p value
		No positive (%)	No negative (%)			
Application of traditional materials	Yes	16 (51.6)	10 (34.5)	1.161	2.027 (0.7158-5.738)	0.281
	No	15 (48.4)	19 (65.5)			
Place of delivery	Home	20 (64.5)	11 (37.9)	3.243	2.975 (1.040-8.510)	0.0717
	Hospital	11 (35.5)	18 (62.1)			

x²=Chi square; OR=Odds ratio; CI=Confidence interval

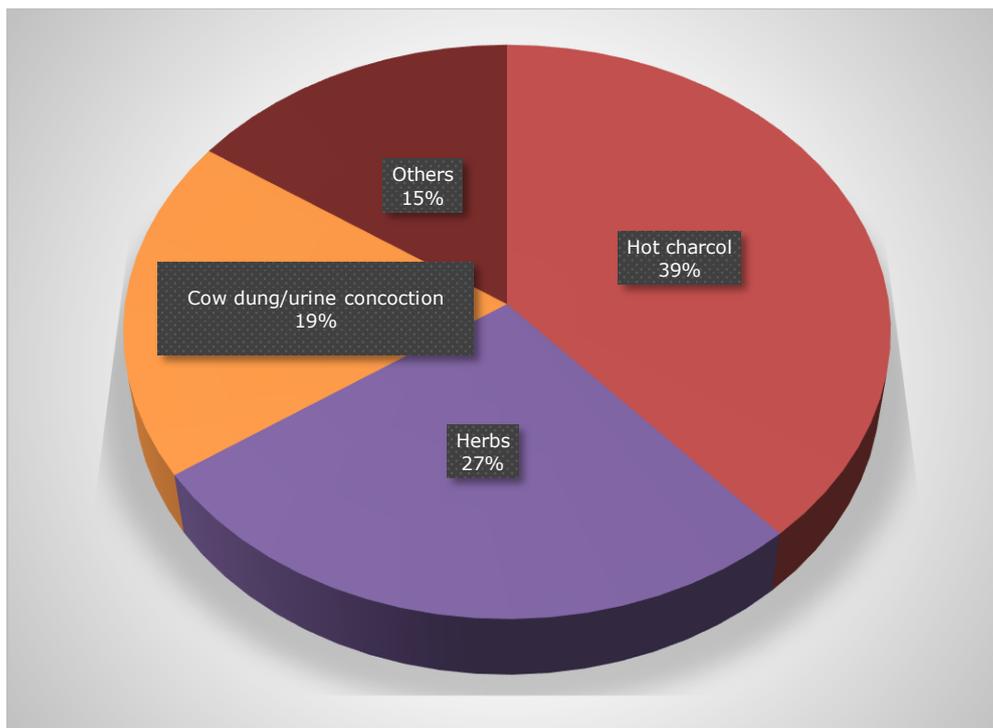


Fig 1: Common unhygienic materials used for cord care in Katsina, Nigeria

(27%), cow dung/urine concoction (19%), and other materials (15%) such as lubricants, ash, and balm, were the most commonly used unhygienic materials for cord care in the study (Fig. 1).

Discussion:

In this study, 31 (51.7%) of the 60 neonates were culture-positive for sepsis, while mothers of 16 (51.6 %) of the 31 culture-confirmed neonatal sepsis, responded that they used traditional materials for cord care. Although no statistically significant association was established (*p*=0.285), neonates whose mothers used traditional materials for cord care were more likely to develop neonatal sepsis than those who do not (OR=2.027, 95% CI=0.716-5.736). This agrees with the findings of Moraa et al., (21) who confirmed that the odds of neonatal sepsis were many times

higher (OR=13.24, 95% CI=7.5-23.4) among infants whose caregivers had improper hygiene compared to those who had proper hygiene.

About 51.7% (31/60) of the babies were delivered at home while 48.3% (29/60) were delivered in the hospital, but those delivered at home (64.5%, 20/31) were about 3 times more likely to have culture-confirmed sepsis compared to those delivered in the hospital (37.9%, 11/29) (OR=2.975, 95% CI=1.040-8.510). This is in keeping with the findings of Shobowale et al., (27), who reported that neonates delivered at home were more likely to develop infection when compared to those delivered in a hospital. This also agrees with the findings of Mohammad et al, (18) who reported that women who delivered in government and private hospitals practiced cord care that are beneficial to their babies more, than

those who delivered at home.

The most commonly used unhygienic materials for cord care in this study were charcoal (39.0%), local herbs (27.0%), cow dung/urine concoction (19.0%), and others such as lubricants, ash, and balms (15.0%). This finding agrees with studies from other parts of Nigeria which reported that use of unhygienic and traditional materials/substances for umbilical cord care by mothers is still highly prevalent with a rate of 43.3%. In a cross-sectional study of mothers whose neonates were admitted into the SCBU of the Usmanu Danfodiyo University Teaching Hospital, Sokoto, north-west Nigeria in 2017, Mohammad et al., (18) reported that the majority of the mothers (67.3%) practiced non-beneficial cord care practices. The mothers used various materials and methods such as hot fermentation (26.6%), methylated spirit (16.7%), and toothpaste (10.6%) for cord care while only 16.3% of the mothers' used chlorhexidine. In another study in the Konduga area of Borno State, northeast Nigeria in 2008, Ambe et al., (6) reported widespread unhygienic cord care practices such as the application of hot fermentation (31.5%) and use of rag and lantern (19.5%), vaseline (9.3%), ash/charcoal (9.3%), and red sand (3.5%) for cord care.

Furthermore, in a study on the determinants of cord care practices by Abhulimhen-Iyoha et al., (19) in Benin, south-south Nigeria, 76.8% of mothers were aware of healthy cord practices and yet preferred the use of other materials and substances (19), and according to a study in Ibadan southwest Nigeria, 18.0% of newborn mortality was caused by umbilical cord infections, largely due to unhygienic cord care practices (20). Also, in a study in the Yenagoa area of Bayelsa State, Opara et al., (4) reported the use of methylated spirit (29%), antibiotic ointment (40.2%), herbs/cow's urine (8.1%), vaseline (8.1%) and hot balms (3.6%) for cord care. Yet, in another study to determine common cord care practices amongst mothers in the Makurdi area of Benue State, northcentral Nigeria in 2022, Ochoga et al., (1) reported that 68.3% of mothers clean their babies' cords with methylated spirit alone while 2.8% cleansed with methylated spirit and other materials, the commonest material being vaseline (14.6%).

Conclusion:

Neonatal sepsis is common among newborns in Federal Teaching Hospital and Turai Umaru Yar'adua Maternal and Children Hospital (TUYMCH), Katsina, northwest Nige-

ria, with a prevalence of culture-confirmed sepsis of 51.7%. Although there was no statistically significant association between unhygienic cord practices and neonatal sepsis ($p > 0.05$) in the study, babies whose mothers used traditional materials and delivered at home have greater odds of developing neonatal sepsis.

There is a high rate of use of harmful and unhygienic materials and substances for cord care in our environment and this habit can be discouraged through health education using the mass media and health talks in health centres. The use of chlorhexidine, the recommended antiseptic for cord care by WHO and the Federal Ministry of Health should be encouraged. Since women who deliver at home are more likely to use unhygienic materials for umbilical cord care than those who deliver at the hospital, health talks and community engagement aimed at discouraging home delivery should also be targeted.

Contribution of authors:

OHK, AB, AS, YSA, AOB, SA, OM, SJS, ONAE, ABT, ISO, OOS, OOS, and OSO, conceived and developed the idea of this study. OHK and AS performed the laboratory work. All authors contributed and approved the final manuscript submitted for publication.

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Conflict of interest:

No conflict of interest is declared.

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