

RESEARCH ARTICLE

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Prevalence and associated factors of umbilical hernia among Nigerian post-neonatal infants: A prospective cross-sectional study

Alao M¹, Kumolalo F², Ajao A³, Akinkunmi F⁴, Afe D⁴, Alade S⁵, Nwadioke C⁶, Olasehinde O⁷

¹Department of Paediatrics, University College Hospital, Ibadan, Nigeria

²Department of Surgery, University of Medical Sciences Teaching Hospital, Ondo, Nigeria

³Department of Surgery, University College Hospital, Ibadan, Nigeria

⁴Department of Paediatrics, University of Medical Sciences Teaching Hospital, Ondo, Nigeria

⁵Department of Obstetrics and Gynaecology, University of Medical Sciences Teaching Hospital, Ondo, Nigeria

⁶Bowen University, Iwo, Osun State.

⁷Department of Surgery, Obafemi Awolowo University, Ile-Ife, Nigeria

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Abstract

Objectives: To determine the prevalence and associated factors of umbilical hernia development in Nigerian infants aged 1–12 months. Umbilical hernias are disproportionately common among populations of African descent and may present as surgical emergencies. Identifying modifiable risk factors is therefore essential, particularly in Black populations, to inform preventive strategies and reduce associated morbidity.

Methods: A prospective cross-sectional study was conducted at two tertiary centres in Southwestern Nigeria. Consecutive infants attending outpatient and immunisation clinics were enrolled. Sociodemographic characteristics, cord care practices, and relevant clinical variables were assessed. Descriptive and inferential analyses were performed, and predictors of umbilical hernia development were identified.

Results: A total of 159 babies were evaluated with M: F-1:1. Umbilical hernias were recorded in 27 (17%). 158 (99.4%) of infants had 70% alcohol for cord care. The mean duration of cord separation was 7.74±3.46 days. The risk of umbilical hernia occurrence increased in those with umbilical stump infections ($p=0.03$), (OR=5.85; CI:4.15-8.25) and those with a positive family history of umbilical hernia ($p<0.001$) (OR=13.29, CI:4.57-38.64)

Conclusion: We found a 17% prevalence rate of umbilical hernia, which is relatively low in an African population. Umbilical stump infection (omphalitis) and positive family history of umbilical hernia are factors associated with the occurrence of umbilical hernia development in Nigerian post-neonatal infants.

Keywords: Cord Care, Infant, Hernia, Umbilicus, Umbilical Hernia, Risk Factors, Prevalence

Plain English Summary

This study investigated how common umbilical hernias are among Nigerian infants aged 1 to 12 months and what factors might increase the risk of developing this condition. An umbilical hernia is a bulge or protrusion near the belly button that occurs when part of the intestine pushes through a weakness in the

Correspondence:

Kumolalo Felix O

Department of Surgery

University of Medical Sciences Teaching Hospital

Ondo, Nigeria

+234 703 831 5879, okumolalo@unimed.edu.ng

abdominal wall. These hernias are particularly common in babies of African descent, and while most close on their own without treatment, some can become serious and require surgery.

The researchers conducted their study at two teaching hospitals in southwestern Nigeria, enrolling 159 babies who attended outpatient and immunisation clinics. The babies were evenly split between males and females, with an average age of about six months. The researchers collected information about the babies' cord care practices, any infections or illnesses they had experienced, and whether any family members had a history of umbilical hernias.

The study found that 17% of the babies had an umbilical hernia—a figure that is surprisingly low compared to earlier studies in African populations, where rates have been reported as high as 80% or more. The researchers suggest this lower rate might be because their study included older babies, and many umbilical hernias close on their own during the first year of life.

Two factors were found to significantly increase the risk of developing an umbilical hernia. First, babies who had an infection of the umbilical stump (omphalitis) were nearly six times more likely to develop a hernia. Second, babies with a family history of umbilical hernia were 13 times more likely to have one themselves, suggesting a possible genetic predisposition to weaker connective tissue. Other factors examined, such as jaundice, coughing, and abdominal distension in the first month of life, did not show any significant association with hernia development.

The researchers recommend that healthcare workers pay special attention to babies with umbilical stump infections and those with a family history of hernias. They also suggest that a larger, multi-centre study across Nigeria would be helpful to confirm these findings and better understand the factors that contribute to umbilical hernia development in African infants.

Introduction

Umbilical hernia (UH) is defined as a protrusion of intra-abdominal contents through a defect in the umbilical ring. Historically, the umbilicus has been regarded as an important aesthetic feature, although perceptions of its significance have evolved (1, 2).

Umbilical hernia occurs more frequently among populations of African descent, with reported prevalence rates ranging widely, in some settings reaching between 15% and 80%. Although often benign and self-limiting, it may occasionally be associated with complications such as incarceration, intestinal obstruction, strangulation, and, rarely, evisceration, which may necessitate emergency surgical intervention (3, 4).

While some cases are present at birth, many become clinically apparent only after the umbilical cord separates. The condition is primarily attributed to failure of closure of the umbilical ring, a process that normally involves reinforcement by the surrounding fascial structures, including the transversalis fascia (often referred to as Richet fascia), peritoneum, and remnants of the umbilical vessels and urachus (5). Disruption of these processes during early infancy may increase the likelihood of hernia development.

Several factors have been associated with the occurrence of umbilical hernia, including low birth weight, prematurity, increased intra-abdominal pressure, such as from ascites, and chromosomal abnormalities, such as trisomy 21 (6). Environmental and postnatal factors have also been implicated. In particular, potentially modifiable

factors such as umbilical cord infection and conditions that impair tissue healing may contribute to delayed closure of the umbilical ring.

Identifying modifiable risk factors is therefore important, especially in high-risk populations, to guide preventive strategies and reduce the risk of complications.

The aim of this study, therefore, is to determine the prevalence of umbilical hernia and to evaluate factors that may compromise reinforcement and healing of the umbilical cicatrix, leading to the occurrence of umbilical hernias in Nigerian post-neonatal infants.

Materials and Methods

Study design

This is a prospective cross-sectional two-centre study carried out at the children's outpatient and vaccination clinics of two Teaching Hospitals in southwestern Nigeria.

Study setting

Study Population/ Eligibility criteria

Children between the ages of 1 and 12 months, who had undergone umbilical cord separation, were recruited into this study. Children with omphalocele, gastroschisis, and abdominal distension from other pathologies such as ascites, peritonitis, Hirschsprung's disease and other related disorders were excluded. Others with features suggestive of a genetic disorder, such as Down's syndrome, were also excluded

Sample size estimation and sampling technique

Sample size was calculated using the WinPEPI version 11.65 software.

A standard deviation of the mean of the xiphoid-umbilical distance, 2.74cm from a previous study (7) was used, with a precision set at 50%.

Minimum sample size, $n = 118$

Non-response (NR) factor = $\frac{1}{1-NR}$

Assuming a non-response rate of 10%, then minimum sample size = $n \times \text{NR factor} = 130$

Data collection and analysis

Data collected were the patient's demography, including the age at the time of measurement, sex, weight, length and the gestational age at birth and cord care.

Exposure variables are the events of umbilical cord separation, including umbilical stump infection, the occurrence of jaundice, abdominal distension and coughing in the neonatal period. A positive family history of umbilical hernia was also recorded. The

outcome variable was the presence or absence of an umbilical hernia during evaluation. The size of the umbilical hernia, where present, was the transverse diameter measured from one edge of the umbilical ring to the other edge. Three well-trained individuals participated in the measurements to limit inter-observer errors.

Descriptive and inferential data analysis was performed using the Statistical Package for the Social Sciences version 23 with significance at $p=0.05$ and Odds ratio at 95% Confidence Interval (CI). Informed consent was obtained from the parents/guardians of these children before recruitment into the study. Ethical approval was obtained from the Health Research Ethical Committees of our institution.

Results

Out of 210 patients approached for the study, a total of 159 babies were eventually evaluated in the study. (Figure 1).

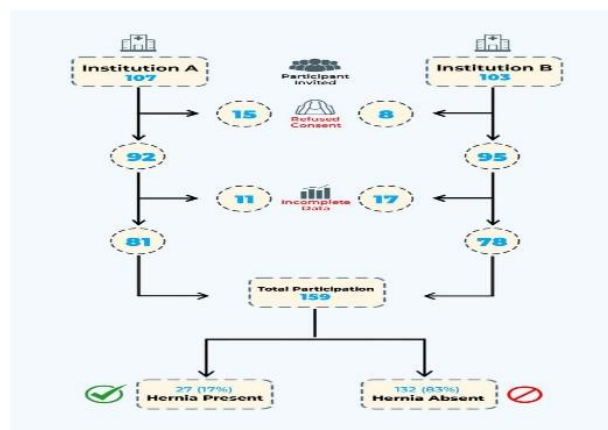


Figure 1. Recruitment Flow Diagram

The males constituted 80 (50.3%), giving M: F-1:1. Their ages ranged from 2 to 12 months, with a mean age of 6.31 ± 3.43 months. The birth weight ranged from 1.2 kg to 5.2 kg (mean= 3.2 ± 0.57 kg) while their present weight ranged from 2.7kg to 11.70 kg (mean= 6.86 ± 1.80 kg). Their length

ranged from 37cm to 85 cm (mean= 64.35 ± 8.77 cm).

Umbilical hernias were recorded in 27 (17%) of cases, and the size of the umbilical defect ranged from 1.1 cm to 7.5 cm with a mean of 2.8 ± 1.24 cm. 60% of affected individuals have defects less than 3cm (Figure 2).

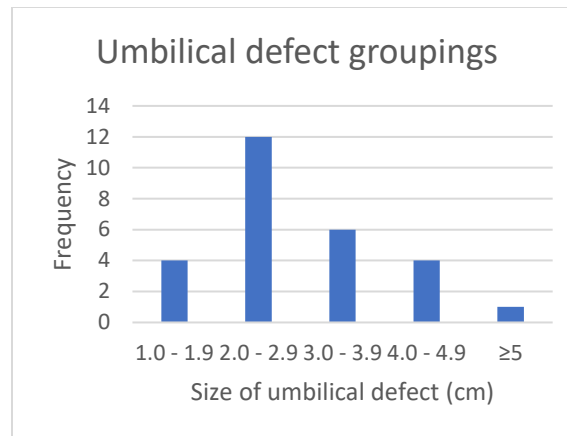


Figure 2: Frequency of different umbilical defect sizes

Cord care was carried out using methylated spirit swab in 156 cases (98.1%), methylated spirit and hot water compress in 2 cases (1.3%) and the cord care gel in only 1 case (0.6%). The duration of cord separation ranged from 3 to 33 days, with a mean duration of 7.74 ± 3.46 days. We recorded one case (0.6%) with a history of umbilical cord infection and 19 (11.9%) cases with a positive family history of umbilical hernia. Table 1

27 babies had jaundice, the majority of whom were noticed between days 2 and 4. Out of these jaundiced cases, 18(66.7%) were managed with phototherapy, 4(14.8%) had exchange blood transfusion, 1(3.7%) was treated with antibiotics, while the remaining 14.8% had resolution without any form of treatment. Also, 6 (3.8%) babies had a cough within the first day of life, and only 2 (1.2%) had abdominal distention around the time of delivery. Table 1

Table 1: Descriptive statistics of associated factors around umbilical cord separation

Associated Factors around umbilical cord separation	Frequency	Percentage
Umbilical stump infection	1	0.6
Family history of umbilical hernia	19	11.9
Jaundice	27	16.9
Abdominal distension	2	1.3
History of cough	6	3.8

N = 159

We found a significant relationship ($p=0.03$) and an almost 6-fold ($OR=5.85$; $CI: 4.15-8.25$) risk of umbilical hernia in those with umbilical stump infection. Similarly, we found a significant association ($p<0.001$) and a 13-fold ($OR=13.29$, $CI: 4.57-38.64$) risk of umbilical hernia in infants with a positive family history of umbilical hernia when compared with infants without similar exposures.

However, there was no significant association or significant risk of developing umbilical hernia in infants with history of jaundice($p=0.127$), ($OR=0.33$, $CI: 0.07-1.47$), history of abdominal distension($p=0.226$), ($OR=0.93$, $CI: 0.11 - 8.31$) and history of coughing in the first month of life ($p=0.951$), ($OR=4.82$, $CI: 0.29 - 79.39$). (Table 2)

Table 2: Odds ratio of umbilical hernia in relation to Associated Factors around umbilical cord separation

		Umbilical hernia		Odds Ratio	95% CI	p-value
		Yes	No			
Family history of umbilical hernia	Yes	12	7	13.29	4.57 - 38.64	<0.001
	No	16	124			
History of umbilical cord infection	Yes	1	0	5.85	4.15 - 8.25	0.03
	No	27	131			
History of jaundice	Yes	2	25	0.33	0.07 - 1.47	0.127
	No	26	106			

History of coughing during the first month	Yes	1	5	0.93	0.11 - 8.31	0.226
	No	27	126			
History of abdominal distension during the first month	Yes	1	1	4.82	0.29 -	0.951
	No	27	130		79.39	

Discussion

In this prospective cross-sectional two-centre study, we found no difference in sex distribution, similar to previous reports (8, 9). We also found that methylated spirit (70% alcohol) was used for cord care in more than 99%, in agreement with previous studies about uptake of modern cord care practices in Nigerian mothers (10, 11). The mean time of cord separation of 7.74 ± 3.46 days, which is comparable with the use of other dressing agents, despite reports that the use of alcohol for cord care is associated with delayed cord separation when compared with the use of chlorhexidine or dry dressing (12).

This study also revealed an umbilical hernia prevalence of 17%, which is surprisingly low in an African population where incidence can be above 90% (6). This finding is, however, comparable to those in non-African populations, where values ranged from 1.9 -18.5% (13). Moreover, since more than 64% of umbilical hernias close within the first year (14). Our finding of lower prevalence may be due to our study population of post-neonatal infants, where spontaneous closure of umbilical hernias is in progress, compared with neonates in the previous Nigerian studies, where hernias may be more prevalent. Moreover, ours is a hospital-based cross-sectional study carried out in specific clinics where incidence may not be reflective of what is obtainable in the general population.

We observed a significant relationship between umbilical stump infection and umbilical hernia, similar to that described in other species like cattle (15). This finding is, however, not readily described in human literature, probably because umbilical hernia in humans is considered a congenital condition (16). Studies have, however, shown that the presence of both bacteria and endotoxins in wounds can lead to prolonged elevation of pro-inflammatory cytokines, thereby elongating the inflammatory phase of wound healing, invariably resulting in chronicity and failure of wound healing (17). Umbilical stump infection may therefore explain a delay in the consolidation of the umbilical cicatrix, precipitating umbilical hernia development. Similarly, we found a significant relationship between positive family history of umbilical hernia and occurrence of umbilical hernia, similar to a previous report by Sazhin et al from Russia (18). Even though umbilical hernias are said not to be directly inherited, a family history can increase the

risk due to a genetic predisposition for weaker connective tissue (19), consequently compromising healing and precipitating the development of UHs. This may therefore explain the significant relationship of positive family history and the occurrence of umbilical hernias. Conversely, the presence of jaundice did not show any significant relationship with the occurrence of umbilical hernia (OR=0.33, CI:0.07-1.47). Even though it is established that obstructive jaundice compromises wound healing (20, 21), the lack of association between jaundice and umbilical hernia in our study may be because neonatal jaundice is mainly non-obstructive and the bilirubin levels seen in our patients (with more than 80% resolving spontaneously or following phototherapy) were not severe enough to compromise healing of the umbilical cicatrix and precipitate umbilical hernia. Also, cough (OR=4.82, CI:0.29 - 79.39) and abdominal distension (OR=0.93, CI:0.11 - 8.31) did not reveal any significant risk of occurrence of umbilical hernia. These are factors that are known to precipitate hernia development in other parts of the body (22). One would expect that the increased intra-abdominal pressure generated by these factors would compromise the healing of the umbilical cicatrix, thereby precipitating umbilical hernia development. However, to be able to precipitate an umbilical hernia, these factors are expected to compromise the reinforcement of the umbilical cicatrix after cord separation (5). If these factors manifest early and resolve before cord separation, they may not adversely affect the healing process and precipitate an umbilical hernia. Also, if these factors manifest after full consolidation of the umbilical cicatrix, they may not precipitate hernia development. Nevertheless, we did not determine the timing of occurrence of these factors in relation to umbilical cord separation, which may explain why there was no significant relationship with umbilical hernia development.

Study Limitation

The non-determination of the timing of occurrence of some evaluated factors (exposure variables) in relation to cord separation and the self-reported identification of umbilical stump infection by mother and caregivers are limitations of this study.

Conclusion

Despite the established high incidence of umbilical hernia in the African population, we recorded a prevalence of 17% in post-neonatal infants. We conclude that umbilical stump infection (omphalitis) and a positive family history of umbilical hernia are associated factors implicated in the development of umbilical hernia in Nigerian post-neonatal infants. Nevertheless, to overcome the limitations of the study, we propose that a multi-institutional cohort study across several regions on a national scale may be required to confirm or refute these findings.

Declaration

Ethics approval and consent to participate

Ethical approval for the study was obtained from the University of Medical Sciences Teaching Hospital, Ondo Research and Ethics Committee, with reference number: UNIMEDTH/IRC/020/009. Informed consent was obtained from all parents/caregivers of all patients. Only those who consented were recruited into the study.

Consent for publication

All authors gave consent for the publication of this work under the Creative Commons Attribution Non-Commercial 4.0 license.

Availability of data and materials

The datasets used and/or analysed in this study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Author contributions

AM and KF conceptualised the study, conducted the literature review, helped with data analysis, drafted the introduction, prepared and analysed data, contributed to writing methodology and findings, and edited all sections of the final manuscript. Both authors contributed equally to this work and share first authorship.

AA contributed to data acquisition and curation and helped with the design of the analytical strategy. AF contributed to data acquisition and curation and helped with the design of the analytical strategy. AS contributed to data acquisition, critical review, and editing of the manuscript.

NC contributed to data acquisition, critical review and editing.

OO drafted the discussion section and edited all sections of the final manuscript.

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References

1. Crump EP. Umbilical hernia: I. Occurrence of the infantile type in negro infants and children. *The Journal of Pediatrics*. 1952 Feb 1;40(2):214-23. [https://doi.org/10.1016/S0022-3476\(52\)80184-2](https://doi.org/10.1016/S0022-3476(52)80184-2)
2. Mitchell OH, McKelvey ST. *Davey's Companion to Surgery in Africa*. A. Adeloje. 195× 255 mm. Pp. 486+ xii. Illustrated, 1987. Edinburgh: Churchill Livingstone.£ 40.00.
3. Meier DE, OlaOlorun DA, Omodele RA, Nkor SK, Tarpley JL. Incidence of umbilical hernia in African children: redefinition of "normal" and reevaluation of indications for repair. *World Journal of Surgery*. 2001 May;25(5):645-8. <https://doi.org/10.1007/s002680020072>
4. Ameh EA, Chirdan LB, Nmadu PT, Yusufu LM. Complicated umbilical hernias in children. *Pediatric Surgery International*. 2003 Jun;19(4):280-2. <https://doi.org/10.1007/s00383-002-0932-y>
5. Cilley RE. Disorders of the umbilicus. In *Pediatric Surgery: Sixth Edition*. Elsevier Inc. 2006 May 25:1143-1156. <https://doi.org/10.1016/B978-0-323-02842-4.50075-9>
6. Rakotomalala JH, Poenaru D. Disorders of the umbilicus. In *Pediatric Surgery: A Comprehensive Textbook for Africa*. Cham: Springer International Publishing. 2020 Nov 24:605-614. https://doi.org/10.1007/978-3-030-41724-6_57
7. Ogundoyin OO, Olulana DI, Lawal TA. Positioning the umbilicus in African newborns with large anterior abdominal wall defects. *Journal of Indian Association of Pediatric Surgeons*. 2018 Jul 1;23(3):127-30. https://doi.org/10.4103/jiaps.JIAPS_201_17
8. Onal ER, Turan O, Karabulut RA, Hirfanoglu I, Turkyilmaz CA, Sonmez KA, Turkyilmaz Z, Kapisiz A, Basaklar AC. Where should the normal position of the umbilicus be in the neonate?. *European Journal of Pediatric Surgery*. 2010 Sep;20(05):339-40. <https://doi.org/10.1055/s-0030-1255098>
9. Yu D, Novicoff WM, Gampper TJ. The average size and position of the umbilicus in young men and women. In *Adult Umbilical Reconstruction*:

- Principles and Techniques. Cham: Springer International Publishing. 2017 Sep 5:43-47. https://doi.org/10.1007/978-3-319-43887-0_6
10. Oyeade A, Olarinmoye A, Oshineye A, Nureni D, Ayuba R. Knowledge and practice of umbilical cord care among post-natal mothers in Southwest, Nigeria, 2023. Journal of Interventional Epidemiology and Public Health. 2024;7(3):1-2. <https://doi.org/10.37432/jieph.2024.7.3.127>
 11. Sibeudu FT, Okoli PC. Knowledge and Practice of Umbilical Cord Care Amongst Mothers Attending Post Natal Clinic at Nnamdi Azikiwe University Teaching Hospital Nnewi. International Journal of Science Health Care Research. 2025 Jan 27;10(1):11-25. <https://doi.org/10.52403/ijshr.20250102>
 12. Quattrin R, Iacobucci K, De Tina AL, Gallina L, Pittini C, Brusaferrero S. 70% alcohol versus dry cord care in the umbilical cord care: a case-control study in Italy. Medicine. 2016 Apr 1;95(14):e3207. <https://doi.org/10.1097/MD.00000000000003207>
 13. Marinković S, Bukarica S. Umbilical hernia in children. Medicinski Pregled. 2003 May 1;56(5-6):291-4. <https://doi.org/10.2298/MPNS0306291M>
 14. He K, Graham DA, Vernacchio L, Hatoun J, Patane L, Cramm SL, Rangel SJ. Age and probability of spontaneous umbilical hernia closure. JAMA Pediatrics. 2024 May;178(5):497-8. <https://doi.org/10.1001/jamapediatrics.2024.0087>
 15. Steenholdt C, Hernandez J. Risk factors for umbilical hernia in Holstein heifers during the first two months after birth. Journal of the American Veterinary Medical Association. 2004 May 1;224(9):1487-90. <https://doi.org/10.2460/javma.2004.224.1487>
 16. Armstrong O. Hernies ombilicales [Umbilical hernia]. Rev Prat. 2003 Oct 15;53(15):1671-6.
 17. Guo SA, DiPietro LA. Factors affecting wound healing. Journal of Dental Research. 2010 Mar;89(3):219-29. <https://doi.org/10.1177/0022034509359125>
 18. Sazhin A, Zolotukhin I, Seliverstov E, Nikishkov A, Shevtsov Y, Andriyashkin A, Tatarintsev A, Kirienko A. Prevalence and risk factors for abdominal wall hernia in the general Russian population. Hernia. 2019 Dec;23(6):1237-42. <https://doi.org/10.1007/s10029-019-01971-3>
 19. Welly. Are Umbilical Hernias Hereditary? A Guide to Causes and Risk. 2025: Cited 2026 Feb 19. <https://welly.it.com/are-umbilical-hernias-hereditary-unpacking-the-genetic-and-environmental-factors>
 20. Armstrong CP, Dixon JM, Duffy SW, Elton RA, Davies GC. Wound healing in obstructive jaundice. Journal of British Surgery. 1984 Apr;71(4):267-70. <https://doi.org/10.1002/bjs.1800710405>
 21. Taube M, Elliot P, Ellis H. Jaundice and wound healing: a tissue-culture study. British Journal of Experimental Pathology. 1981 Jun;62(3):227.
 22. Cobb WS, Burns JM, Kercher KW, Matthews BD, Norton HJ, Heniford BT. Normal intraabdominal pressure in healthy adults. Journal of Surgical Research. 2005 Dec 1;129(2):231-5. <https://doi.org/10.1016/j.jss.2005.06.015>