

Prevalence of Hydrocephalus Among Children Under Five Admitted to Edna Adan Hospital, Hargeisa, Somaliland: A Five-year Retrospective Study

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Abstract

Background

In sub-Saharan Africa, hydrocephalus—a condition characterized by abnormal cerebrospinal fluid (CSF) accumulation that causes ventricular expansion—occurs often. Its burden is increased by high infection rates, delayed diagnosis, and restricted access to neurosurgery. Over a five-year period, this study aimed to evaluate the prevalence, sociodemographic, and etiologies of hydrocephalus in children under five who were admitted to Edna Adan Hospital in Hargeisa, Somaliland.

Methods

A retrospective assessment of records was carried out between 2020 and 2024, examining 266 cases that were chosen using simple random sampling. A systematic checklist was used to capture data on age, gender, year of admission, and the causes of hydrocephalus (congenital, acquired, communicative, non-communicating, and unknown). SPSS version 25 was then used for analysis after being checked by trained data collectors. Distributions and relationships were assessed using chi-square tests, cross-tabulations, and descriptive statistics.

Results

91.40% of occurrences occurred in infants between the ages 0–12 months, with females accounting for the majority (50.40%). Congenital hydrocephalus accounted for the majority (62.0%), followed by acquired causes (12.40%) and unknown causes (18.80%). Between 2020 and 2024, the number of admissions decreased from 72 to 49. The year of admission and aetiology ($p = 0.012$) and age and aetiology ($p = 0.002$) showed significant correlations, but not gender ($p = 0.936$).

Conclusion

This study emphasizes Somaliland's congenital dominance and early infancy onset of hydrocephalus, with falling trends that may be related to better prenatal care. In areas with limited resources, improved neurosurgical capabilities, early screening, and diagnostic tools are crucial for addressing unidentified cases and minimizing morbidity.

BACKGROUND

Hydrocephalus, characterized by abnormal expansion of cerebral ventricles due to disrupted cerebrospinal fluid (CSF) dynamics, is a significant paediatric neurosurgical condition worldwide. Traditionally attributed to obstruction of CSF flow, is evolving to include models that incorporate dysfunctional cerebral pulsations, brain compliance, and novel water-transport mechanisms. A build-up of CSF that is categorized as obstructive or non-communicating hydrocephalus may be caused by anatomical disruption of CSF flow and/or CSF pulsatility. While children older than two years typically exhibit indications of cerebral hypertension, infants

frequently present with increasing macrocephaly [1–3]. The condition arises from diverse causes, it can be congenital hydrocephalus, most commonly linked to genetic factors or developmental anomalies like aqueduct stenosis, or acquired conditions, resulting from infections (e.g., meningitis), traumatic brain injury, intraventricular, subarachnoid haemorrhage, or tumours that impair CSF reabsorption or outflow [4, 5].

Nearly 400,000 new cases of paediatric hydrocephalus are estimated to occur annually worldwide, but in Africa, especially in low- and middle-income countries (LMICs), the prevalence is disproportionately high at about 180,000 new cases annually. The burden is greater by delayed diagnosis and inadequate healthcare infrastructure. High rates of infection, inadequate access to prenatal care, delayed hospital presentations, and a lack of community awareness are all problems in many African nations [3, 6]. Study in Ethiopia (2022) reported the aetiologies of hydrocephalus were identified 17.9% aqueductal stenosis, 35.7% neural tube defects, and 10.1% post-infectious [1]. Similarly, with study in Malawi, a total 152 children treated for hydrocephalus within an 18-month period had delayed in both assessed motor domains: gross and fine motor development [7]. In Lusaka, Zambia, postinfectious hydrocephalus accounted for 65% of the 378 patients who presented, while myelomeningocele was present in 9% of them. 42% of head circumferences (greater than 6 cm) had severe hydrocephalus [8].

Postinfectious hydrocephalus (PIH), which occurs after neonatal sepsis and congenital abnormalities such spinal dysraphism, is the most common cause of hydrocephalus in infants in sub-Saharan Africa. These conditions are frequently brought on by neonatal infections like meningitis or ventriculitis which hinder the reabsorption of CSF. Africa has more than 1.3 billion inhabitants, but there are only 500 neurosurgeons, severely limiting timely intervention and resulting in poor outcomes. The scarcity of neurosurgeons and neurosurgery access in Africa can be attributed to a number of factors, including inadequate funding for healthcare, a lack of neurosurgical equipment, poor health care planning, a lack of resources, a lack of encouragement to establish local neurosurgery training, and a lack of suitable local conditions or facilities to allow neurosurgeons to practice appropriately [9–13]. The restriction raises the risk of mortality and long-term neurodevelopmental consequences by delaying treatment, especially in Somaliland where neurosurgery facilities are very limited. Further limiting access to healthcare are cultural norms, shame, financial constraints, and poor transportation. These financial strains are rendered in many low-resource environments, such as Somaliland, by insufficient health insurance programs and restricted access to subsidized care. Managing a child's chronic illness causes caregivers, especially mothers, to experience high levels of stress, worry, and emotional exhaustion [9, 14–17].

The prevalence of hydrocephalus in children under five who were hospitalized to Edna Adan Hospital in Hargeisa, Somaliland, between 2019 and 2024 is investigated in this study. In order to provide crucial information to inform healthcare planning and enhance resource allocation in the area, hospital admission records are analysed in order to measure the local burden, pinpoint the main causes, and assess treatment results.

METHODS

Design and participants

A retrospective record review was conducted at Edna Adan University Hospital, a prominent referral and teaching hospital in Hargeisa, Somaliland, that specializing in maternal and child healthcare, between May and June 2025, in order to determine the prevalence of hydrocephalus in children under five. A representative sample of 266 children with hydrocephalus was chosen using simple random sampling, guaranteeing unbiased representation from the available records. It is worth noting that this study didn't involve a clinical trial design, and as such, clinical trial registration numbers and details are not applicable.

This approach ensured a comprehensive analysis of all documented cases rather than relying on sampling techniques [1]:

Proportion (p) = 22.3% = 0.223

Margin of Error (E) = Typically 5% (0.05)

Confidence interval = 95%

$$n = \frac{(1.96)^2 \cdot 0.223 \cdot (1 - 0.223)}{(0.05)^2}$$
$$n = \frac{3.8416 \cdot 0.223 \cdot 0.777}{0.0025}$$
$$n = \frac{3.8416 \cdot 0.173271}{0.0025}$$
$$n = \frac{0.6656}{0.0025}$$

266.24 = 266 respondents

Data quality control

A standardized checklist intended to capture important variables was used to gather data. Under the supervision of the study supervisor, skilled data collectors examined hospital admission logs and paediatric patient files from 2020 to 2024 to guarantee accuracy and consistency throughout the procedure. Standardized data collection procedures minimized errors and ensured reliability.

Data variables

All participant's age (categorized as 0–1, > 1–3, and > 3–5), gender, year of admission, and cause of hydrocephalus (congenital, acquired, communicating, non-communicating, and unknown) were gathered for the study. These factors were chosen in order to assess yearly trends and demographic patterns in cases of hydrocephalus.

Statistical analysis

Prior coding, the data was thoroughly reviewed for consistency and completeness. SPSS version 25 was used to analyse the cleaned dataset. Frequencies and percentages were among the descriptive statistics used to

analyse the annual trend of instances of hydrocephalus during the five-year period. We used cross-tabulations to determine which age and gender categories were most impacted.

RESULTS

Table 1 Distribution of hydrocephalus children’s characteristics

Characteristics	Frequency (Percentage), n=266
Age	
0-1 year	243 (91.40)
>1 to 3 years	14 (5.30)
>3 to 5 years	9 (3.40)
Gender	
Male	132 (49.60)
Female	134 (50.40)
Cause of hydrocephalus	
Congenital	165 (62.00)
Acquired	33 (12.40)
Communicating	6 (2.30)
Non-communicating	12 (4.50)
Unknown	50 (18.80)
Year of admission	
2020	72 (27.10)
2021	60 (22.60)
2022	45 (16.90)
2023	40 (15.00)
2024	49 (18.40)

Table 2 Distribution of hydrocephalus causes by age, gender, and year of admission with Chi-square test results

Characteristics	Cause of Hydrocephalus					Chi-square test
	Congenital	Acquired	Communicating	Non-communicating	Unknown	
Age						
0-1 year	158 (59.40)	26 (9.80)	5 (1.90)	10 (3.80)	44 (16.50)	0.002
>1 to 3 years	5 (1.90)	2 (0.80)	1 (0.40)	2 (0.80)	4 (1.50)	
>3 to 5 years	2 (0.80)	5 (1.90)	0	0	2 (0.80)	
Gender						
Male	85 (32.00)	16 (6.00)	3 (1.10)	5 (1.90)	23 (8.60)	0.936
Female			3 (1.10)	7 (2.60)		
Year of admission	80 (30.10)	17 (6.40)			27 (10.20)	
2020	48 (18.00)		2 (0.80)	1 (0.40)		0.012
2021	40 (15.00)	8 (3.00)	1 (0.40)	0	13 (4.90)	
2022	29 (10.90)	8 (3.00)	0	3 (1.10)	11 (4.10)	
2023	26 (9.80)	4 (1.50)	2 (0.80)	0	9 (3.40)	
2024	22 (8.30)	3 (1.10)	1 (0.40)	8 (3.00)	9 (3.40)	
		10 (3.80)			8 (3.00)	

An overwhelming majority of cases (91.40%) were infants aged 1-12 months, with very few cases in children aged more than 3 to 5 years. This strongly suggest that hydrocephalus often develops in early infancy, reinforcing the importance of early neonatal screening and monitor. Possibly as a result of sex-linked genetic and developmental factors, the results showed that female children (50.40%) were more frequently impacted that male children (49.60%). According to Edna Adan Hospital's annual admission trend for hydrocephalus cases from 2020 to 2024, there were 72 cases of hydrocephalus admitted in 2020, a minor decline to 60 cases in 2021. The following years showed a further decline in the trend, with 45 cases in 2022, 40 cases in 2023, and 49 cases in 2024. Congenital hydrocephalus accounted for 165 (62.00%) of the children with hydrocephalus diagnoses, while acquired hydrocephalus accounted for 33 (12.40%). Less common were the communicative and non-communicating varieties, which accounted for 6 (2.30%) and 12 (4.50%) cases, respectively. 50 cases, or 18.80% of the total, had an unidentified or unknown kind of hydrocephalus, which could be a sign of incomplete diagnostic records or restricted access to sophisticated imaging for precise categorization (Table 1).

Although both genders are equally likely to be impacted by each cause, the chi-square test result ($p=0.936$) indicates that gender does not significantly affect the kind of hydrocephalus detected. The distribution of hydrocephalus causes was fairly balanced between males and females across all categories. In contrast, the majority of hydrocephalus cases were detected in newborns between the ages of 0-1 year, indicating that very

young children are the condition's primary target ($p=0.002$). The most frequent cause, congenital hydrocephalus, accounted for 158 cases (59.40%), followed by acquired hydrocephalus in 26 cases (9.80%), non-communicative hydrocephalus in 10 cases (3.80%), and communicating hydrocephalus in 5 cases (1.90%). In the meantime, the youngest group had a concentration of 16.50% unknown reasons. The fact that hydrocephalus is rarely identified in afterward infants in this study cohort highlights the significance of early screening and surveillance in infancy. The year of admission is also substantially correlated with the cause of hydrocephalus, according to the chi-square test result ($p=0.012$), suggesting that the distribution of causes changed during the study period, either as a result of improved diagnostic techniques or changing healthcare practices. It was demonstrated that there was a considerable decrease in congenital hydrocephalus, communicating hydrocephalus, and unknown causes. Even if the gap between acquired hydrocephalus and non-communicating cases widened between 2020 and 2024, this suggests that an increase in infections or anatomical disruptions may be the cause (Table 2).

DISCUSSION

This retrospective study assessed the prevalence and characteristics of hydrocephalus among children under five years of age admitted to Edna Adan Hospital over a five-year period. In our study, infants aged 0–12 months constituted 91.40% of hydrocephalus cases. This finding is consistent with a study conducted in Mali, the most common age group that affected by hydrocephalus was 0–3 months (40%) followed by 4–6 months (36%) [6]. Similarly, the median age of 378 patients who underwent hydrocephalus surgery in Lusaka, Zambia, was 5.5 months (IQR 3.1–12.7 months), with postinfectious etiologies accounting for the majority of cases. In Uganda, postinfectious hydrocephalus is more common among infants with hydrocephalus than non-postinfectious hydrocephalus, and it is frequently linked to neonatal infections and associated with higher morbidity indicators, such as elevated cerebrospinal fluid white blood cell counts and neuroimaging abnormalities [8, 18, 19]. These comparisons underline the crucial role of early-life exposures, especially infections, in driving hydrocephalus incidence and underscore the necessity for focused neonatal therapies to minimize long-term neurological sequelae.

Our study observed a female predominance of 50.40% among hydrocephalus cases. The proportion of females diagnosed with hydrocephalus (57.10%) was relatively higher through study in Addis Ababa, Ethiopia, but sex was not considered as one of the risk factors of hydrocephalus ($p > 0.05$) [1]. Similarly with study in Lasaka, Zambia, 51% of the 376 patients diagnosed by hydrocephalus were female, reinforcing a balanced but marginally female-skewed distribution without clear etiological implication [8]. More genetic and epidemiological study is necessary to identify potential vulnerabilities, even if sex variations in hydrocephalus are still poorly understood in African contexts. These trends might be the result of broader demographic or biological factors rather than direct risk modifiers.

The results showed a high prevalence of congenital hydrocephalus, which dominated the etiological landscape, which is consistent with findings in Dessie, Ethiopia, where 469 out of 769 participants had congenital hydrocephalus, 268 had acquired hydrocephalus, and 32 had an unknown cause. The majority of participants had the 446 obstructive type of hydrocephalus, 286 communicative hydrocephalus, and 37 non-postinfectious hydrocephalus [4]. A systematic review and meta-analysis encompassing 12,355 pediatric across Africa reported that mostly congenital hydrocephalus accounted [20]. Regional similarities include

Togo, where congenital abnormalities were the most common cause of hydrocephalus (68.50% accounted of 267 pediatric cases), and Mali, where 110 individuals were diagnosed with macrocephaly at birth, indicating a congenital origin [6, 13]. These consistent trends across various African contexts imply that avoidable causes like perinatal infections and nutritional deficiencies worsen congenital hydrocephalus, supporting improved prenatal care and public health initiatives to address infection prevention and folate supplementation.

Annual hydrocephalus admissions at Edna Adan Hospital decreased between 2020 and 2024 during the five-year review period. This trend could be explained by advancements in prenatal and perinatal care, heightened public health awareness, and improved diagnostic capabilities at outlying health centers. According to recent evaluations, Somaliland has higher rates of acceptable care (22.50%) than its neighboring regions, indicating that targeted interventions, such as facility upgrades for neonatal special care units and increased adoption of essential newborn practices, have been linked to fewer perinatal complications [21]. Concurrently, heightened public health awareness through campaigns—focusing on nutrition and early child development and enhanced diagnostic capabilities at peripheral health centers—despite persistent disparities in antenatal care utilization (47% attendance), these collective advancements indicate broader improvements in Somaliland's child health outcomes, such as decreases in maternal mortality ratios (from 418 to 396 per 100,000 live births between 2014 and 2020) and progress in immunization coverage. Scaling therapies regionally for long-term benefits on pediatric brain health, addressing barriers including poverty and access inequities, and doing ongoing surveillance to establish causation are all important to maintain these gains [22, 23]. In certain sub-Saharan African nations, the ratio of patients with hydrocephalus to neurosurgeons is 5–10 million to 1 neurosurgeon. Fortunately, this is beginning to change as more and more highly qualified neurosurgeons are appearing in low- and middle-income nations [24].

Studies also have consistently demonstrated age-specific patterns in the etiology of hydrocephalus, with correlations highlighting distinct causes predominant in different life stages. Congenital hydrocephalus occurs at or close to birth, and in certain cases, gene abnormalities that interfere with brain morphogenesis and change the CSF-brain interface's biomechanics have been implicated. Even the causes of congenital hydrocephalus were simultaneously detected in 23.5% of the fetuses, including abnormal brain development, blockage of the cerebral aqueduct, Chiari malformations, and Dandy-Walker malformation. Congenital causes such as aqueduct stenosis occur among all people, and better antenatal care including maternal-fetal ultrasound scanning leads to earlier detection of hydrocephalus [24–26]. For example, a global epidemiological review emphasized that among 52 studies mostly reporting the prevalence of hydrocephalus are affected 77% of pediatric population and the prevalence of pediatric hydrocephalus was almost two-fold higher in Africa [11]. Certain advances, like the use of choroid plexus coagulation in conjunction with endoscopic third ventriculostomy to treat hydrocephalus, have made their way up the financial scale from low- and middle-income countries to high-income ones. Globally, the management of hydrocephalus has benefited greatly by the introduction of neuro-endoscopy [24].

This study has a number of limitations because of its retrospective design and low-resource setting, even if it offers insightful information about the prevalence and features of pediatric hydrocephalus at Edna Adan Hospital. First, the significant percentage of unknown hydrocephalus causes (18.80%) may have been caused by biases introduced by the use of pre-existing hospital data, such as inconsistent or inadequate recording. In low- and middle-income countries (LMICs), where accurate etiological classification is hampered by restricted

availability to sophisticated diagnostic techniques like CT or MRI scans, such data gaps are typical in retrospective assessments. Unaccounted for external factors could complicate observed patterns in reducing incidence, such as the COVID-19 pandemic potentially interrupting hospital access and admissions throughout 2020–2021. Although based on previous prevalence estimates, the sample size of 266 cases may limit statistical power for subgroup analyses, especially for rarer subtypes such as non-communicating (4.5%) or communicating (2.3%) hydrocephalus, where small cell counts in chi-square tests could affect reliability and violate assumptions. Furthermore, the study's single-center design limits its generalizability because results from a tertiary referral hospital in Hargeisa might not represent larger trends in Somaliland or other LMICs, where obstacles like poverty, transportation problems, and cultural stigma could affect case presentation and underreporting. To overcome these limitations, future studies should use multicenter, prospective designs with improved diagnostic capabilities.

CONCLUSION

Congenital hydrocephalus is the most prevalent kind, followed by acquired, communicative, and non-communicating variants, according to the study's findings. An unidentified or unknown type of hydrocephalus was discovered, which may indicate that diagnostic data are lacking or that access to advanced imaging is limited for accurate classification. With a notable female preponderance, the majority of patients were infants between the ages 1–12 months. The distribution of admissions over five years (2020–2024) remained relatively stable, with the highest proportion in 2020 and a slight decline in subsequent years, especially congenital hydrocephalus, communicating hydrocephalus, and unknown causes. These findings highlight the necessity of improved diagnostic and treatment approaches, especially for early-infancy congenital hydrocephalus. Further studies should explore regional risk variables and develop classification systems to reduce the fraction of unidentified cases. Better results for impacted children in Somaliland and the surrounding areas may result from closing these gaps.

Abbreviations

CSF
Cerebrospinal Fluid
CT scan
Computed Tomography scan
LMICs
Low- and Middle-income Countries
MRI
Magnetic Resonance Imaging
PIH
Post-infectious Hydrocephalus

Declarations

Acknowledgment

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Authors' contributions

AAA assumed responsibility for the study's design and data gathering. As the thesis supervisor, HD supervised the thesis's guidance and review process and offered suggestions all along the way. PG took full responsibility for evaluating and polishing the text into a publishable format, adding pertinent citations, and doing cross-tabulation and chi-square analysis to enhance its quality.

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Availability of data and materials

The dataset used and analysed during the current study is available from the corresponding author on reasonable request.

Ethical Considerations

Ethical approval was given by Edna Adan University's Ethics Review Committee (Ref: 9526/25). Informed consent was not directly solicited from individual participants which utilized anonymized data and involved no direct participant intervention. The request for waiver of informed consent was submitted to the ethical committee and the relevant hospital authorities; however, all obtained data was kept secure and anonymous. The final dataset did not contain any personal identification, and only the research team had access to it. Every method was applied in accordance with the Helsinki Declaration.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

1. Mulugeta B, Seyoum G, Mekonnen A. Assessment of the prevalence and associated risk factors of pediatric hydrocephalus in diagnostic centers in Addis Ababa, Ethiopia. *BMC Pediatrics*, 2022; 22(145):1-8.
2. Hale AT, Boudreau H, Devulapalli R. The genetic basis of hydrocephalus: genes, pathways, mechanisms, and global impact. *Fluids Barriers CNS*, 2024; 21(1):1-135.
3. Grace N, Mbabazi E, Mukunya D. High burden of wasting among children under-five with hydrocephalus receiving care at CURE children's hospital in Uganda: a cross-sectional study. *BMC Nutrition*, 2024; 10(14):1-10.
4. Menberu MS, Mohammed AS, Kebede YN. Survival status and determinant factors of mortality among pediatric patients who underwent ventriculoperitoneal shunting surgery for hydrocephalus in Ethiopia. *BMC Surgery*, 2025; 25(158):1-13.
5. Faquini IV, Fonseca RB, Correia AO. Endoscopic third ventriculostomy in the treatment of hydrocephalus: a 20-year retrospective analysis of 209 consecutive cases. *Surg Neurol Int*, 2021; 12(383):1-6.
6. Diallo O, Dama M, Konan L. Endoscopic third ventriculostomy with choroid plexus cauterization in infantile hydrocephalus: an experience from Mali. *Pediatr Neurosurg*, 2023; 58(1):38-44.
7. Manda M, Nambuzi E, Kaphesi F. Comparing motor development in children with hydrocephalus after treatment with ventriculoperitoneal shunt and endoscopic third ventriculostomy: a cross-sectional study. *Malawi Med J*, 2024; 36(1):7-12.
8. Reynolds RA, Bhebhe A, Garcia RM. Pediatric hydrocephalus outcomes in Lusaka, Zambia. *J Neurosurg Pediatr*, 2020; 26(6): 624-635.
9. Kantawala B, Khattab M, Elawad SO. Addressing hydrocephalus in Africa: challenges and way forward. *Health Sci Rep*, 2023; 6(1):1-5.
10. Ericson JE, Burgoine K, Kumbakumba E. Neonatal paenibacilliosis: paenibacillus infection as a novel cause of sepsis in term neonates with high risk of sequelae in Uganda. *Clin Infect Dis*, 2023; 77(5):768-775.
11. Aukrust CG, Paulsen AH, Uche EO. Aetiology and diagnostics of paediatric hydrocephalus across Africa: a systematic review and meta-analysis. *Lancet Glob Health*, 2022; 10(12):1793-1806.
12. Jesuyajolu DA, Zubair A, Nicholas AK. Endoscopic third ventriculostomy versus ventriculoperitoneal shunt insertion for the management of pediatric hydrocephalus in African centers – a systematic review and meta-analysis. *Surg Neurol Int*, 2022; 13(467):1-9.
13. Kpelao E, Ahanogbe KM, Egu K. Children hydrocephalus in Togo: etiologies, treatment, and outcomes. *Surg Neurol Int*, 2022; 13(560):1-4.
14. Sidamo NB, Hebo SH, Kassahun AB. Exploring family caregiver burdens and coping mechanisms for patients with comorbid neglected tropical diseases and mental illness in Southern Ethiopia: insights from qualitative findings. *Front Trop Dis*, 2025; 6:1475955. Doi: 10.3389/fitd.2025.1475955.
15. Aukrust CG, Kamalo PD, Tembenu E. Hydrocephalus, healing, and disrupted daily living: exploring maternal experiences at Queen Elizabeth Central Hospital in Blantyre, Malawi. *Malawi Med J*, 2024; 36(4):260-275.
16. Smith ER, Concepcion TL, Shrimel M. Waiting too long: the contribution of delayed surgical access to pediatric disease burden in Somaliland. *World J Surg*, 2020; 44(3):656-664.

17. Dahir S, Condor CC, Grimm A. Delays in care for hydrocephalus and spina bifida at a tertiary hospital in Somaliland. *World Jnl Ped Surgery*, 2023; 6:1-7.
18. Paulson JN, Williams BL, Hehnly C. The bacterial and viral complexity of postinfectious hydrocephalus in Uganda. *Sci Transl Med*, 2020; 12(563):1-25.
19. Morton SU, Hehnly C, Burgoine K. Paenibacillus spp infection among infants with postinfectious hydrocephalus in Uganda: an observational case-control study. *Lancet Microbe*, 2023; 4(8):1-11.
20. Darko K, Guirguis M, Kakulamari S. Presentation, management, and outcomes of pediatric hydrocephalus in Africa: a systematic review and meta-analysis of 12,355 patients. *J Neurosurg Pediatr*, 2024; 33(4):456-467.
21. Heen E, Strordal K, Abdi A. Facility-based care of small and sick newborns: experiences with establishing a neonatal special care unit in Somaliland. *Journal of Global Health Reports*, 2022; 6: e2022015. Doi:10.29392/001c.33619.
22. Abdi AK, Jayamohan MK, Adem M. The nexus between poverty and maternal healthcare utilization with a focus on antenatal care visits and choice of place of birth in Somaliland. *Front Public Health*, 2024; 12:1-13.
23. Mothupi M, Ahmed MA, Mohamud AM. Maternal and newborn health prioritization in post-transition Somalia: analysis of key stakeholder perspectives at the federal level. *Health Systems*, 2025; 4:1-10.
24. Enslin JM, Thango NS, Figaji A. Hydrocephalus in low and middle-income countries – progress and challenges. *Neurology India*, 2021; 69(2):292-7.
25. Kahle KT, Klinge PM, Koschnitzky JE. Paediatric hydrocephalus. *Nat Rev Dis Primers*, 2025; 10(1):1-39.
26. Abebe MS, Seyoum G, Emamu B. Congenital hydrocephalus and associated risk factors: an institution-based case-control study, Dessie Town, North East Ethiopia. *Pediatric Health Med Ther*, 2022; 13:1765-182.

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