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Save lives by ending postpartum haemorrhage

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The World Health Organization (WHO) launched the Consolidated Guidelines on the Prevention, Diagnosis and Treatment of Postpartum Haemorrhage (PPH) at the International Federation of Gynecology and Obstetrics (FIGO) World Congress in South Africa on the first-ever World Postpartum Haemorrhage Awareness Day on 5 October 2025.[1]

Postpartum haemorrhage, severe bleeding after childbirth – diagnosed as a blood loss of 500 mL or more – is a leading cause of maternal mortality worldwide, and "affects millions of women annually and causes nearly 45,000 deaths."[1]

South Sudan has one of the highest maternal mortality ratios globally at 692 deaths per 100,000 live births in 2023.[2] One of the key contributors is PPH, with infection and obstructed labour rounding up as the top three.

According to the FIGO President, Professor Anne Beatrice Kihara, the new guidelines "take a proactive approach of readiness, recognition and response. They are designed to ensure real-world impact – empowering health workers to deliver the right care, at the right time, and in a wide range of contexts."

These guidelines were recommendations derived from the WHO study[3] on deploying the "**MOTIVE bundle**" of actions when PPH is diagnosed, which in turn was partly based on the **E-MOTIVE** randomized controlled trial.[4] They cover:

- **M**assage of the uterus;
- **O**xytocic drugs to stimulate contractions;
- **T**ranexamic acid (TXA) to reduce bleeding;
- **I**ntravenous fluids;
- **V**aginal and genital tract examination; and
- **E**scalation of care if bleeding persists.

In addition to managing anaemia in pregnancy and discouraging unsafe practices such as routine episiotomies, the recommendations focus on the management of the third stage of pregnancy. The guidelines "recommend administering a quality-assured uterotonic to support uterine contraction, preferably oxytocin or heat-stable carbetocin as an alternative. If intravenous options are not available and the cold chain is unreliable, misoprostol may be used as a last resort." [1]

One of the studies that most likely contributed to the recommendation for the use of misoprostol was a study in South Sudan on the advanced distribution of misoprostol for home births, where a cold chain is not required.[5] Because of the widespread effects and deaths during delivery from PPH, women who experienced PPH in their previous delivery came and requested the three magic tablets of misoprostol, even though they resided outside the study area. The study proved that we can increase uterotonic coverage by using misoprostol for home deliveries through community distribution.

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The new recommendations are timely as many countries, including South Sudan, have failed to fully institutionalise knowledge on PPH prevention and management due to a lack of funding and other commitments. This lack of action needs to change for the betterment of women's health.

By marking the first World Postpartum Haemorrhage Day to raise awareness, improve clinical training, and speed up the adoption of life-saving treatment guidelines, the maternal health community is not only putting the issue front and centre, but also emphasizing that the commitment that "no woman should lose her life while giving life" is not lost.

Let the work continue.

References

1. World Health Organization, Global Health Agencies Issue New Recommendations to Help End Deaths from Postpartum Haemorrhage, 5 October 2025. WHO. https://www.who.int/news/item/05-10-2025-global-health-agencies-issue-new-recommendations-to-help-end-deaths-from-postpartum-haemorrhage#
2. World Health Organization, Maternal Mortality Data, South Sudan, 2023. WHO. https://data.who.int/countries/728
3. Gallos I et al. Prognostic accuracy of clinical markers of postpartum bleeding in predicting maternal mortality or severe morbidity: a WHO individual participant data meta-analysis. The Lancet 2025;406 (10514):1969 – 1982 https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01639-3/fulltext
4. Gallos I et al. Randomized Trial of Early Detection and Treatment of Postpartum Haemorrhage. N Engl J Med 2023;389 (1):11-21.. DOI: https://dx.doi.org/10.1056/NEJMoa2303966
5. Smith JM et al. Advance distribution of misoprostol for the prevention of postpartum haemorrhage in South Sudan, Int J Gynecol Obstet 2014; 127 (2):183-188 http://dx.doi.org/10.1016/j.ijgo.2014.05.016.

Research Article

Comparative study between classical two-layer and one-layer extra-mucosal intestinal anastomosis in elective and emergency abdominal operations

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ABSTRACT

Introduction: Intestinal anastomosis can be done in various ways, including the use of staples and hand-sewn methods. The hand-sewn method includes a one-layer technique and a two-layer technique. The safety and efficacy of one-layer or two-layer are controversial. This study aimed to compare the outcomes of these techniques.

Method: Fifty patients were included in the study: 30 males and 20 females. The patients were categorized into two groups: 33 underwent elective surgery, and 17 underwent emergency surgery. Outcome measures included the mean time to anastomosis, mean operative time, anastomotic leak rate, mortality rate, and hospital stay duration. Statistical analysis used the Chi-square test, Fisher's exact or Monte Carlo correction, Student's t-test, and Mann-Whitney U test.

Results: 32 patients were managed with the classical two-layer technique, and 18 with the one-layer extra-mucosal technique. The total operation time ranged from 1.0 to 5.0 hours for single-layer extra-mucosa anastomosis and 0.83 to 4.17 hours for classical two-layer anastomosis. Most wound infections and deaths occurred with the two-layer techniques, accounting for 8 (16%) and 5 (10%), respectively. The most common complications were wound infections, 11 (22%), and anastomotic leaks, 10 (20%), which mainly occurred under emergency conditions with the two-layer technique.

Conclusion: The one-layer technique requires less time to perform compared to the two-layer technique, with no significant differences in the rate of anastomotic leaks. In terms of safety, the one-layer method may be superior to the classical two-layer technique.

Keywords: intestinal anastomosis, anastomotic leak, extra-mucosal, mortality rate.

Introduction

By the beginning of the 20th century, several methods for intestinal suturing had been described, and the essential principles of intestinal anastomosis were firmly established.[1] These principles are: a well-nourished patient with no systemic illness; no faecal or purulent contamination; adequate exposure and access; gentle tissue handling; well-vascularized tissues; absence of tension and distal obstruction; approximation of well-vascularized bowel ends; and meticulous surgical technique.[2]

Two-layered anastomosis consists of an inner layer of continuous or interrupted absorbable sutures and an outer layer of interrupted absorbable or non-absorbable sutures. A one-layer anastomosis consists of a single layer of interrupted or continuous absorbable sutures.[3]

The objections to the classical two-layer anastomosis are that it is costly and takes longer to perform, it ignores the principles of accurately apposing the cut edges, and a large amount of ischaemic tissue is incorporated in the suture line, increasing the risk of a leak. The inner layer increases the risk of mucosal strangulation due to damage to the submucosal vascular plexus, and the outer seromuscular layer may lead to narrowing at the site of anastomosis.[4]

Many studies have reported that one-layer anastomosis takes less time to create, lowers cost, allows more accurate tissue apposition, incorporates the strongest submucosal layer,[5] causes the least damage to the submucosal vascular plexus, has the least chance of narrowing the lumen, and has fewer complications of anastomotic leaks.[6] Anastomotic leak is defined as "an escape of content or a communication between intra- and extraluminal compartments at the anastomotic site."[7]

Method

This study was conducted in the surgical units of Alexandria's main University Hospital from December 1, 2016, to July 31, 2017. Patients with malignancy, inflammatory conditions, trauma, strictures, or ischaemia were included in the study, and those with faecal peritonitis, septic shock, those with proximal diversion, and those who were transferred from outlying hospitals with a leak were excluded.

Prophylactic antibiotics were given at the time of induction of anaesthesia. A 3-0 polyglactin absorbable suture on a round-body needle was used in all cases. The one-layer technique was performed by taking all layers except the mucosa in an inverted, interrupted manner. Two-layer anastomosis was carried out by a transmural inner layer of continuous/interrupted inverted sutures and an outer layer of interrupted seromuscular sutures. All anastomoses were performed by the hand-sewn technique.

Results

Fifty patients were included in this study, comprising 30 males and 20 females. Their ages ranged from 16 to 76 years. The average age for the one-layer extra-mucosal technique was 46.72 ± 15.52 years, while for the traditional two-layer method, it was 45.97 ± 15.62 years.

Thirty-three patients were operated on under elective conditions and 17 under emergency conditions; 32 patients were managed using the two-layer technique, and 18 using the one-layer extra-mucosal technique.

The distribution of the studied cases, based on operation time and anastomotic time, is shown in Table 1. The total

Table 1. Distribution of the studied cases according to operation time and anastomotic time

	One layer (n = 18)	Two layers (n = 32)	Test of sig.	p-value
Operation time (hour)				
Min.	1.0	0.83#	U= 174.5*	0.018*
Max.	5.0	4.17		
Mean ± SD.	1.98 ± 1.03	2.35 ± 0.72		
Anastomotic time (min.)				
Min.	15.0	23.0	t= 9.559*	<0.001*
Max.	29.0	45.0		
Mean ± SD.	18.56 ± 3.93	31.34 ± 4.84		

**: Statistically significant at p ≤ 0.05*

Table 2. Complications and their distribution in relation to anastomotic technique

Complication	One layer (n = 18)	Two layers (n = 32)	Total (n = 50)	X^2	FE*p
	n (%)	n (%)	n (%)		
Wound infection	3 (6.0)	8 (16.0)	11 (22.0)	0.466	0.724
Wound dehiscence	0 (0.0)	2 (4.0)	2 (4.0)	1.172	0.530
Prolonged ileus	1 (2.0)	2 (4.0)	3 (6.0)	0.010	1.000
Anastomotic leak	3 (6.0)	7 (14.0)	10 (20.0)	0.195	0.730
Intra-abdominal abscess	2 (4.0)	3 (6.0)	5 (10.0)	0.039	1.000
Re-exploration	2 (4.0)	5 (10.0)	7 (14.0)	0.195	1.000
Mortality	2 (4.0)	5 (10.0)	7 (14.0)	0.195	1.000

*FE*p: p-value for Fisher's Exact for Chi-square test*

Table 3. Complications and their distribution in relation to the type of surgery

Complication	Elective (n = 33)		Emergency (n = 17)		Total (n = 50)	X^2	MC**p
	Two layers (n = 21)	One layer (n = 12)	Two layers (n = 11)	One layer (n = 6)			
	n %	n (%)	n (%)	n (%)	n (%)		
Wound infection	3 (6.0)	2 (4.0)	5 (10.0)	1 (2.0)	11 (22.0)	4.035	0.245
Wound dehiscence	0 (0.0)	0 (0.0)	2 (4.0)	0 (0.0)	2 (4.0)	4.665	0.061
Prolonged ileus	2 (4.0)	0 (0.0)	0 (0.0)	1 (2.0)	3 (6.0)	2.794	0.326
Anastomotic leak	1 (2.0)	1 (2.0)	6 (12.0)	2 (4.0)	10 (20.0)	11.536*	0.004*
Intra-abdominal abscess	0 (0.0)	1 (2.0)	3 (6.0)	1 (2.0)	5 (10.0)	6.271*	0.049*
Re-exploration	1 (2.0)	1 (2.0)	4 (8.0)	1 (2.0)	7 (14.0)	5.629	0.074
Mortality	3 (6.0)	1 (2.0)	2 (4.0)	1 (2.0)	7 (14.0)	0.915	0.940

**: Statistically significant at $p \leq 0.05$*

***MCp: p-value for Monte Carlo for Chi-square test*

operation time ranged from 1.0 to 5.0 hours for single-layer extra-mucosal anastomosis, with an average of 1.98 hours ± 1.03 hours standard deviation (SD). In contrast, the overall operation time ranged from 0.83 to 4.17 hours for classical two-layer anastomosis, with a mean of 2.35 hours ± 0.72 hours SD. Anastomotic times for the cases are listed in Table 1.

The distribution of complications in relation to the anastomotic techniques is presented in Table 2. Most wound infections and deaths occurred with the two-layer techniques, accounting for 8 (16%) and 5 (10%), respectively.

The complications and their distribution related to the type of surgery, whether elective (33) or emergency (17), are presented in Table 3. The most common complications were wound infections, 11 (22%), and anastomotic leaks, 10 (20%), which mainly occurred under emergency conditions with the two-layer technique.

Operators were categorized into three levels based on experience: Senior Surgeons (A), Senior Junior Surgeons (B), and Junior Surgeons (C) (Table 4). With 10 anastomotic cases in this study, leaks were more frequently observed among junior surgeons, accounting for six of these cases.

Table 4. The relation between anastomotic leak and the operator

Operator	Complications (n = 17)		X^2	^{MC}p
	No AL** (n = 7) n (%)	With AL** (n = 10) n (%)		
Senior Surgeons (A)	6 (85.7)	1 (10.0)	9.956*	0.003*
Senior Junior Surgeons (B)	1 (14.3)	3 (30.0)		
Junior Surgeons (C)	0 (0.0)	6 (60.0)		

**: Statistically significant at p ≤ 0.05*

*** = Anastomotic leak.*

Discussion

The time taken for anastomosis using the one-layer extra-mucosal method in both elective and emergency conditions was less than that taken to perform the classical two-layer anastomosis (Table 1). This finding aligns with various studies, which concluded that a one-layer extra-mucosal anastomosis can be performed significantly faster than the classical two-layer anastomosis.[8,9]

Various studies have reported no difference in anastomotic failure rates between one- and two-layer techniques.[10] However, other studies comparing the two techniques have found that the one-layer extra-mucosal method is superior to the two-layer method in terms of safety and leakage.[11] In our study, three disruptions occurred with the one-layer extra-mucosal method, while seven happened with the classical two-layer anastomosis technique (p-value 0.730) (Table 2). Hence, there may be a slight increase in the leak rate when the two-layer technique is used compared to the one-layer technique.

Six out of ten leaks occurred in the hands of junior surgeons during emergency cases. Three of ten leaks occurred in the hands of senior juniors, two in emergency conditions and one in an elective condition. Only one leak happened in the hands of senior surgeons. The anastomotic leak rate was significantly higher (p-value 0.003) in the hands of junior surgeons (Table 4). This finding correlates with those of others, who reported that leakage rates varied significantly between surgeons, with lower rates observed among more experienced surgeons.[12]

Reported mortality rates after major abdominal surgery vary. In our study, we observed that death occurred among the severely ill patients, and the overall mortality rate was 14%. Regarding mortality rate, by technique, five deaths occurred in the classical two-layer group and two in the one-layer extra-mucosal group; this difference was not significant. This result is consistent with other reported findings, which show no mortality differences between the two techniques.[13,14]

Conclusion

The one-layer extra-mucosal anastomosis technique requires less time compared to the classical two-layer technique. Regarding the rate of anastomotic leaks, the differences did not reach statistical significance. There was no significant difference in mortality between the methods.

References

1. Kalokhe SA et al. Single interrupted vs. continuous all layer closure in bowel anastomosis in emergency surgeries: a comparative study. Int J Res Med Sci. 2023;11(2);518-22. DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20233678
2. Shah MK et al. Comparative Study between Uses of Single Layer Interrupted Extra Mucosal Technique versus Double Layer Continuous Technique in Intestinal Anastomoses. International Journal of Pharmaceutical and Clinical Research 2023;15(2);612-619.
3. Abu Sayeed Md. Aminul Islam et al. Single Versus Double Layer Intestinal Anastomosis: A Comparison of Features and Treatment Outcomes. SAS J Surg. 2025;11(2):123-128. DOI: https://dx.doi.org/10.36347/sasjs.2025.v11i02.003

4. Sharma S, Sudhansu S, Mohanty, Das SK. Intestinal Anastomosis Single Layer versus Double Layer - A Prospective Study. J. Evid. Based Med. Healthc. 2020;7(13):2349-2562. DOI: https://dx.doi.org/10.18410/jebmh/2020/146
5. M. Sandeep Raj, Jyoti Ranjan Pani, G.T. Patra. A Comparative Study between Single versus Double Layered intestinal anastomosis. Annals of R.S.C.B 2021;25(4):14508–14515.
6. Elian MA et al. Single Layer versus Double Layers Technique in Hand Sewn Intestinal Anastomosis: A Comparative Study. Med. J. Cairo Univ. 2024 June;92(2):443-447. DOI: https://dx.doi.org/10.22608/MJCU. 443-447
7. SkrabecCG et al. Early and late anastomotic leak after colorectal surgery: A systematic review of the literature. CIR ESP. 2023;101(1):3-11. https://dx.doi.org/10.1016/j.ciresp.2022.06.014
8. Rajesh Kumar Dora et al. A Prospective Study on Single Layer versus Double Layer Anastomosis in Emergency Colonic Surgery in a Tertiary Care Hospital. Ann. Int. Med. Den. Res. 2019;5(4):41-45.
9. Tejaswini Murari Pawar et al. Single Layer versus Double Layer Anastomosis of Small Intestine – A Comparative Study from Karnataka, India. J Evolution Med Dent Sci 2021;10(30):2300-2304. DOI: https://dx.doi.org/10.14260/jemds/2021/470.
10. Modi JV et al. A comparative study of single layer versus double layer small bowel anastomosis. Int Surg J. 2023;10(5):888-891. DOI: https://dx.doi.org/10.18203/2349-2902.isj20231386.
11. Kumar A et al. Single layer versus double layer intestinal anastomoses: a comparative study. Int. Surg. J. 2020;7(9):2991-2998. DOI: http://dx.doi.org/10.18203/2349-2902.isj20203782.
12. Saikaly E, Saad MK. Anastomotic Leak in Colorectal Surgery: A Comprehensive Review. Surg Clin J. 2020;2(4):1031.
13. Okafor DK, Katyal G, Kaur G, et al. Single-Layer or Double-Layer Intestinal Anastomosis: A Systematic Review of Randomized Controlled Trials. Cureus 2023;15(10):e46697. DOI https://dx.doi.org/10.7759/cureus.46697
14. Aniruthan D, et al. Efficacy of single layered intestinal anastomosis over double layered intestinal anastomosis-an open labelled, randomized controlled trial. International Journal of Surgery 2020;(78):173–178.

Comparison of improvised negative pressure wound therapy and conventional wound dressing in abdominal wounds dehiscence after surgery

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ABSTRACT

Introduction: Negative pressure wound therapy (NPWT) is an effective novel technique of wound dressing resulting in faster wound healing. The technology is not widely adopted, partly due to the high price of industrially made products and limited awareness of their effectiveness. Some hospitals in resource-limited settings have developed an improvised gauze-based NPWT (iNPWT) to attain a similar effect. Several published case reports have shown good outcomes with these improvised prototypes. This study aimed to compare the effectiveness and safety profiles of these approaches in patients with gapped abdominal wounds post-surgery.

Method: This was a hospital-based, non-randomized study that involved eighty participants (aged ≥18 years) with abdominal wounds dehiscence (gapping) from two central Tanzania regional referral hospitals. Patients voluntarily chose to be treated by either iNPWT or CWD. The iNPWT was applied using the Chariker-Jeter technique and dressings were changed at 48-hour intervals before secondary closure. The primary efficacy endpoint was time until wound closure achieved by secondary suture within 42 days of follow-up and was compared between groups by Kaplan-Meier curve and statistical significance was confirmed by log-rank test.

Results: The median time for wound closure was shorter with iNPWT than with CWD (difference: 7 days, $p<0.001$). At the end of the follow-up period, all wounds dehiscence treated with iNPWT were closed while four wounds in CWD were not closed, including those of three patients who died before 42 days. Most participants in the CWD arm experienced pain more than those treated with iNPWT. There was no statistically significant difference in the occurrence of other adverse events.

Conclusion: iNPWT is a safe and effective wound dressing technique in a resource-limited setting to promote swift patient recovery.

Keywords: negative-pressure, wound dehiscence, resource-limited, Tanzania

Introduction

Caring for complicated abdominal wounds is one of the most challenging tasks in the surgical field. Impairment of abdominal wound healing might show up as either spontaneous dehiscence (gapping) or the requirement for reopening.[1] Surgical site infections, along with patient-related variables such as malnourishment, advanced age, and alcohol misuse, frequently result in impaired abdominal wound healing.[2,3]

Abdominal wound dehiscences must be regularly treated until adequately granulated before secondary suturing. Available techniques for abdominal wound dressing include conventional wound dressing (CWD) and negative pressure wound therapy (NPWT). CWD is a simple treatment for wound treatment. It involves daily dressing changes with gauze, lint, plasters, bandages and the application of antimicrobial cream protecting the wound from contamination.[2] Surgical site infection has been the most common (77.5%) reported complication faced with CWD.[3] NPWT applies sub-atmospheric pressure to the system on a continuous or sporadic basis.[4] NPWT was first reported by Argenta and colleagues in 1997 and was shown to remove chronic oedema, boost local blood flow, stimulate the creation of granulation tissue, and decrease wound depth in chronic wounds. It accelerates wound healing and has proven very promising and beneficial in managing difficult-to-heal wounds.[5] The technique may be used on acute, sub-acute and chronic wounds. NPWT is also linked to a lower rate of delayed primary closure and an increased clearance of bacteria.[6] Research indicates that NPWT does not raise the risk of death or intestinal fistulation in individuals with an exposed abdomen.[7]

A standard commercially available vacuum-assisted closure system consists of a portable vacuum machine, suction canister and adhesive dressing packages, which need to be changed three times a week, and cost around 94 US dollars per day.[7] These appliances are not readily available in most parts of the country including Dodoma and Iringa regional hospitals. Hospitals in resource-limited settings have developed a less expensive, gauze-based NPWT, known as the Chariker-Jeter technique.[8,9] Multiple layers of gauze are applied over the wound with a nasogastric tube (NG tube) sandwiched in the gauze layers connected to a regular suction machine. Cling film was applied over the gauzes to provide air tightness. Locally assembled gauze-based NPWT combined with comprehensive surgical assessment, exploration, and meticulous debridement, further facilitates wound healing.[10] The effectiveness of industrially-made NPWT is well documented in the literature[4,10] while the studies on improvised NPWT (iNPWT) are based on case reports.[4,5] The authors are unaware of any studies to evaluate the effectiveness of iNPWT on infected/gapped abdominal wounds. This study aimed to compare the effectiveness and safety profile of iNPWT and CWD in treating gapped abdominal wounds, to provide information which is crucial to both patients and clinicians in resource-limited settings.

Method

This was a non-randomized clinical trial conducted at Iringa and Dodoma Regional Referral Hospitals from April 2023 to June 2024, comparing improvised negative pressure wound therapy (iNPWT) with CWD for gapped abdominal wounds. The study involved 80 patients, with 40 receiving the iNPWT intervention and 40 unmatched CWD controls. In order to calculate the required sample size we used a study by Ondieki et al,[11] which found a mean of 8.1 days to complete wound closure, with a standard deviation of 2.4 days. Using the formula:

$$n = (Z_{\alpha/2}+Z_{\beta})^2 * 2 * \sigma^2 / d^2$$

where $Z_{\alpha/2}$ is 1.96 for 95% confidence, Z_{β} is 0.84 for 80% power, σ is the standard deviation (2.4 days) and d is the desired detectable difference (1.6 days), we calculated 36 per group, which we increased to 40 to allow for any loss to follow-up.

The study involved patients who had primary abdominal surgery for any reason, who subsequently experienced spontaneous gapping, suture removal (due to infection) or post-surgical abdominal wounds which were not possible to close primarily without fascial dehiscence, and who presented within 48 hours of this event. Those with unexcised necrotic tissues/eschar that was incompletely removed and those who had an exposed anastomotic site/intestines/blood vessels within or directly surrounding the wound that could not be adequately covered, were excluded from the study. After being informed about the various wound treatment modalities, the patients made an informed decision. Those who chose either of the two treatment modalities were included in the study after giving verbal consent. Recruitment continued until 40 patients were included in each group.

In both treatment arms, wounds were prepared by removing necrotic tissues and irrigating with normal saline. Wound areas were measured using the imitoMeasure® Android

application. Participants in the treatment arm were treated with an iNPWT using the Chariker-Jeter technique. A fenestrated nasogastric tube was positioned between five layers of non-adhesive gauze that were applied to the wound. To guarantee airtightness, cling film was used to cover the entire dressing. After that, the tube was attached to a suction device. Initially, a steady negative pressure of 125 mm Hg was maintained until the wounds were cleaned.[12] Once the cleaning was done (after reduction of exudates), the pressure was reduced to a minimum of 50 mm Hg. Because of the noises generated by the suction machine, it ran for four hours, followed by a four-hour rest period, and this cycle was repeated. The dressing was changed after every 48 hours. In the control group, the traditional dressing was used; three layers of non-adhesive gauze were placed over the wound after it was cleaned and topical antiseptic or antibiotic applied. The dressing was changed daily, and the dressing materials were held in place with adhesive tape. Participants in both groups were evaluated during the 42-day follow-up period[10] for fever (defined as any temperature above 36.5°C), the presence of necrotic tissue, pain experienced during dressing (using verbal rating scale), wound area and other adverse events.

Participants' demographic data, treatment outcome parameters, and adverse effects were gathered using a data collection sheet. SPSS version 26 was used to code, clean, and analyse the data. Kaplan-Meier curves were used to illustrate the time to wound closure, and the log-rank test was used to compare the two interventions. Descriptive data were presented in proportions and means. To evaluate the factors associated with the time until wound closure, Cox proportional hazards regression analysis was employed. The relationship between the type of intervention and the incidence of adverse events was evaluated using chi-squared tests. A p-value of <0.05 was considered to be statistically significant.

Results

The study enrolled 80 patients between 21 April 2023 and 15 June 2024 from the two study sites. Sixty percent of study participants were female, and they were split equally between the treatment groups. The median baseline wound areas in the iNPWT and CWD arms were 97.4cm^2 and 96.6cm^2, respectively, but the interquartile range was much larger for the CWD arm (240cm^2) than for iNPWT (110cm^2) (Figure 1). HIV was equally prevalent in the treatment groups, but more were obese or underweight in the iNPWT group (14 versus 3). More participants in the CWD arm (8) than in the iNPWT arm (1) were alcohol drinkers (Table 1).

All patients treated with iNPWT had their wounds closed by the twenty-second day; however, one patient passed away a day after the wound was closed because of a coexisting medical condition. By the end of 42 days of follow-up, 36 patients (90%) in the CWD arm had their wounds closed. One patient showed no signs of wound closure by the end of the study period, and three patients passed away prior to the wound closure. The iNPWT and CWD arms had median times to wound closure of 15 days (IQR 9 days) and 22 days (IQR 17 days), respectively (difference of 7 days, log-rank test p<0.001) (Fig 2 and 3).

In both the unadjusted and adjusted Cox proportional hazard analyses, the type of intervention was statistically

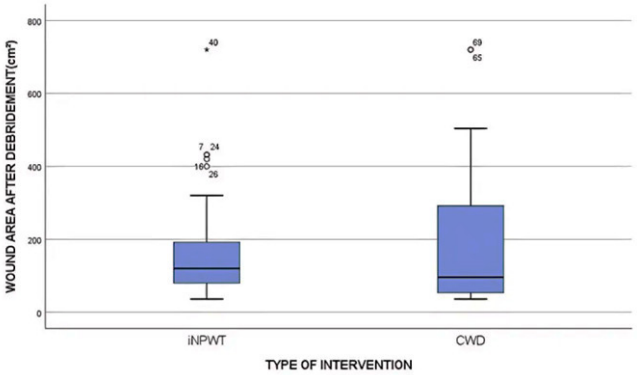

*Figure 1. Distribution of wound area after debridement for iNPWT and CWD patients (box plot showing median, lower and upper quartiles, lower and upper adjacent values and outliers). * Indicates outlier more than 3 IQR above upper quartile.*

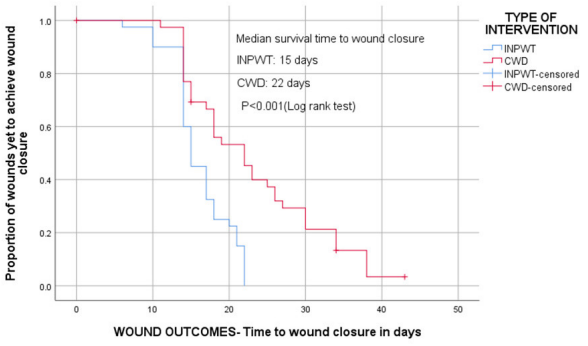

Figure 2. Kaplan-Meier curves showing the time to wound closure by wound dressing techniques. The log-rank test indicated a significant difference in time to wound closure between the two intervention groups.

Table 1. Distribution of participants based on age, sex, education, residence, and occupation concerning the type of intervention (iNPWT and CWT). n=80

Demographic Data	Categories	iNPWT n (%)	CWD n (%)	Total n (%)
Hospital	DRRH	28 (35)	23 (29)	51 (64)
	IRRH	12 (15)	17 (21)	29 (36)
Age (years) Mean (SD)		30.5 (9.7)	28.5 (10.4)	29.5 (10.0)
Sex	Male	16 (20)	16 (20)	32 (40)
	Female	24 (30)	24 (30)	48 (60)
Residence	Rural	22 (28)	20 (25)	42 (53)
	Urban	18 (23)	20 (25)	38 (48)
Education	No formal education	8 (10)	8 (10)	16 (20)
	Primary education	17 (21)	18 (23)	35 (44)
	Secondary education	8 (10)	11 (14)	19 (24)
	Higher education	7 (9)	3 (4)	10 (13)
Occupation	Peasant	18 (23)	18 (23)	36 (45)
	Self-employed	15 (19)	18 (23)	33 (41)
	Employed	2 (3)	3 (4)	5 (6)
	Student	5 (6)	1 (1)	6 (8)
Type of Surgery	Caesarean Section	15 (19)	18 (23)	33 (41)
	Ileostomy/colostomy	4 (5)	4 (5)	8 (10)
	Hysterectomy	9 (11)	3 (4)	12 (15)
	Graham patch	1 (1)	1 (1)	2 (3)
	Other laparotomies	11 (14)	14 (18)	25 (31)
Baseline Wound Size (cm^2) Mean (SD)		97.4 (11.1)	96.6 (78.5)	96.9(73)
BMI Kg/m^2	Normal weight	18 (23)	31 (39)	49 (61)
	Underweight	6 (8)	1 (1)	7 (9)
	Overweight	8 (10)	6 (8)	14 (18)
	Obesity	8 (10)	2 (3)	10 (13)
Alcohol	Yes	1 (1)	8 (10)	9 (11)
	No	39 (49)	32 (40)	71 (89)
Smoking	Current smoker	0 (0)	9 (11)	9(11)
	Former smoker	6 (8)	5 (6)	11(14)
	Never smoked	34 (43)	26 (33)	60 (75)
HIV	Positive	1 (1)	1 (1)	2 (3)
	Negative	39 (49)	39 (49)	78 (98)

Table 2. Cox proportional hazards model indicating the factors associated with time to wound closure

Predictor	HR	[95% CI]	p-value	AHR	AHR [95%CI]	p-value
Type of intervention						
CWD		Ref				
iNPWT	2.717	1.595-4.629	<0.001	2.294	1.184-3.982	0.012
Age groups						
<30		Ref				
30-40	1.433	0.843-2.437	0.183	1.554	0.835-2.893	0.164
>40	1.101	0.535-2.267	0.793	0.644	0.279-1.486	0.302
Type of surgery						
Other laparotomy		Ref				
Caesarean section	0.824	0.484-1.402	0.475	0.613	0.275-1.368	0.232
Ileostomy/colostomy	0.864	0.368-2.031	0.738	0.509	0.140-1.851	0.305
Graham patch	1.007	0.134-7.545	0.995	0.797	0.089-7.102	0.839
Hysterectomy	1.736	0.849-3.550	0.131	1.447	0.404-5.186	0.571
Sex						
Male		Ref				
Female	1.104	0.693-1.759	0.677	0.974	0.557-1.704	0.928
Smoking						
Never smoked		Ref				
Current smoker	0.825	0.450-1.512	0.533	0.410	0.067-2.502	0.334
Former smoker	0.803	0.343-1.878	0.613	0.785	0.174-3.538	0.753
Alcohol						
Yes		Ref				
No	0.447	0.210-0.950	0.036	0.691	0.193-2.478	0.571
BMI						
Normal weight		Ref				
Underweight	2.743	1.182-6.368	0.041	2.102	0.186-2.243	0.102
Overweight	0.796	0.429-1.477	0.469	0.735	0.453-3.789	0.389
Obesity	2.175	1.072-4.414	0.031	1.829	0.311-2.115	0.128

significantly associated with time to wound closure (AHR = 2.294, 95% CI: 1.184-3.982, p = 0.012) (Table 2).

Table 3 shows there were no significant differences between the arms in the occurrences of fever, pus, or death. Pain, however, was more severe in the CWD arm. In neither arm were there any other adverse effects.

Discussion

This study demonstrated significant superiority in reducing the time until wound closure in iNPWT compared to CWD. The benefits of iNPWT have been demonstrated in other studies on different wound types, and this study extended those results to abdominal wounds.[13-15] There was a higher rate of wound closure in the iNPWT arm, and all wounds in iNPWT were secondarily sutured within the study duration. In the CWD arm, the rate of wound closure was slower, and one participant did not achieve wound closure in the follow-up time. It has been reported that iNPWT offers benefits in granulation tissue

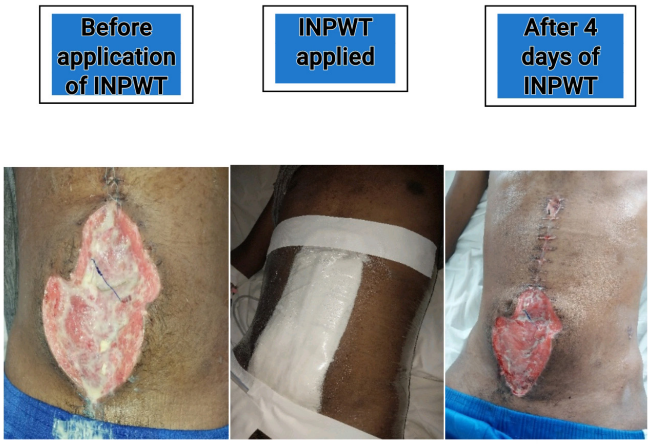

Figure 3. Pre and post-improved negative pressure wound therapy

Table 3. Adverse events including mortality within 42 days, n=80

Variable	All	iNPWT	CWD	p-value
	n (%)	n (%)	n (%)	
Fever				
Yes	39 (49)	23 (29)	16 (20)	0.117
No	41 (51)	17 (21)	24 (30)	
Pus				
Yes	9 (11)	2 (3)	7 (9)	0.154
No	71 (89)	38 (48)	33 (41)	
Pain				
Mild	20 (25)	20 (25)	0 (0)	
Moderate	32 (40)	20 (25)	12 (15)	<0.001
Severe	28 (35)	0 (0)	28 (35)	
Death				
Yes	3 (4)	0 (0)	3 (4)	0.241
No	77 (96)	40 (50)	37 (46)	

production and exudate clearance, which may enhance a stronger foundation for early wound closure.[5,16]

The patients' self-selection into treatment groups is likely to have been a source of bias as the information given before enrolment could have affected their choice. Furthermore, the fact that three patients in the CWD arm died before their wounds were closed raises the possibility of a patient characteristics imbalance between the treatment groups that the baseline data did not adequately capture. These patients may have had worse outcomes because of more severe comorbidities. In contrast to other studies in this area, our endpoint was the time of secondary suture rather than complete wound healing; an experienced surgeon determined when this should be done, which could have introduced potential observer bias. Also, the non-blinded nature of this study could be a source of bias. Thus, randomized studies should be conducted to strengthen the evidence.

We assumed that iNPWT would be accompanied by a higher incidence of adverse events than CWD as in the German DiaFu-RCT,[15] but this was not the case here. Except for the pain due to dressing changes, which was more severe with CWD, there was no significant difference in the occurrence of adverse events between iNPWT and CWD. These findings led us to believe that iNPWT is as safe as CWD when used for gapped abdominal wounds after surgery. The results were similar to that of the SAWHI study, which revealed no significant difference in the incidence of adverse events between NPWT and CWD arms on abdominal wounds.[10]

The findings were inconsistent with those of a study done in four Australian tertiary hospitals, which showed more signs of infections in conventional wound dressing, 9.7% compared to 7.4% in NPWT. Also, more participants in the NPWT arm (4.0%) developed skin blisters compared to standard wound dressing (2.3%).[13] Unlike these results, a randomized controlled trial by Singh et al[14] revealed less occurrence of complications in the NPWT arm compared to CWD.

The severity of pain due to dressing changes in the CWD arm has been demonstrated in other studies;[15,16] this can be explained by the technical effort of removing debris from the wounds, done automatically by iNPWT. We recommend the use of our approach of iNPWT for gapped abdominal wounds after surgery to reduce the pain associated with CWD during dressing changes. The death of participants in the CWD arm was not related to the dressing technique but rather due to other causes.

During our study planning, no comparative study was found reporting the use of iNPWT in gapped abdominal wounds after surgery, which led to limited information on the duration of follow-up and appropriate definition for wound closure. Recurrence of wound dehiscence and other later complications could not be assessed due to the limited follow-up time of this study.

Conclusion

When compared to CWD for the management of gapped abdominal wounds after surgery, iNPWT significantly reduced the time until wound closure and reported pain with no significant difference in the incidence of other adverse events. iNPWT is a safe and effective wound dressing technique in a resource-limited setting to promote swift patient recovery.

We therefore recommend iNPWT for managing gapped abdominal wounds after surgery, as it is both efficient and safe. We also suggest that randomized trials be conducted to compare iNPWT with CWD for more evidence-based data on this topic.

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Conflict of interest: All authors declare to have no conflict of interest.

Patient's consent: Informed consent was obtained from the patients.

References

1. Denys, A., Monbailliu, T., Allaeys, M. et al. Management of abdominal wound dehiscence: update of the literature and meta-analysis. Hernia 2021;25, 449–462. https://doi.org/10.1007/s10029-020-02294-4
2. Akopian G, Nunnery SP, Piangenti J, et al. Outcomes of Conventional Wound Treatment in a Comprehensive Wound Center. American Surgeon 2006;72(4):314-317. https://doi.org/10.1177/000313480607200407
3. Mbunda F, Mchembe MD, Chalya P et al. Experiences with Surgical treatment of chronic lower limb ulcers at a Tertiary hospital in northwestern Tanzania: A prospective review of 300 cases. BMC Dermatol. 2012;12:1–10. https://doi.org/10.1186/1471-5945-12-17
4. Mba UC, Okenwa WO. Experience with the use of improvised negative pressure wound therapy in the management of wounds with exposed bone. Trop Doct. 2020;51(1):6-10. https://doi.org/10.1177/0049475520962745
5. Nyamuryekunge MK, Yango B, Mwanga A, Athar. A Improvised vacuum-assisted closure dressing for enterocutenous fistula, a case report. Int J Surg Case Rep. 2020;77:610–3. https://doi.org/10.1016/j.ijscr.2020.11.049
6. Liu H., Yang, P., Han S., Zhang Y, Zhu H. The application of enhanced recovery after surgery and negative-pressure wound therapy in the perioperative period of elderly patients with colorectal cancer. BMC Surgery 2021;21:332. https://doi.org/10.1186/s12893-021-01331-y
7. Kim JJ, Franczyk MPT, Gottlieb LJ, Song DH. Cost-effective Alternative for Negative-pressure Wound Therapy. Plastic and Reconstructive Surgery - Global Open 2017;5(2):e1211. https://doi.org/10.1097/GOX.0000000000001211
8. Azoury SC, Farrow NE, Hu Q, et al. Management Postoperative abdominal wound infection – epidemiology, risk factors, identification, and. 2023; Chronic Wound Care Management and Research 2015;2:137-148. https://doi.org/10.2147/cwcmr.s62514
9. Chariker ME, Gerstle TL, Morrison CS. An Algorithmic Approach to the Use of Gauze-Based Negative-Pressure Wound Therapy as a Bridge to Closure in Pediatric Extremity Trauma. Plastic and Reconstructive Surgery. 2009;123(5):1510-1520. https://doi.org/10.1097/PRS.0b013e3181a20563
10. Seidel D, Lefering R, Neugebauer EAM. Treatment of subcutaneous abdominal wound healing impairment after surgery without fascial dehiscence by vacuum assisted closureTM (SAWHI-V.A.C.®-study) versus standard conventional wound therapy: Study protocol for a randomized controlled trial. Trials. 2013;14(1):394. https://doi.org/10.1186/1745-6215-14-394
11. Ondieki JG, Khainga SO, Owilla F, Nangole FW. Outcome of foam versus gauze dressings in negative pressure wound therapy for the management of acute traumatic wounds with soft tissue loss at Kenyatta National Hospital. East African Medical Journal. 2012;89(7):230–240. https://www.ajol.info/index.php/eamj/article/download/91518/80996
12. Shah A, Patel S, Jani R. Comparative study in patients treated by negative pressure wound therapy versus conventional wound treatment for abdominal wounds. National Journal of Physiology, Pharmacy and Pharmacology.

2023;13(09):1912-1916.https://doi.org/10.5455/njppp.2023.13.07351202302082023l

13. Gillespie BM, Webster J, Ellwood D, et al. Closed incision negative pressure wound therapy versus standard dressings in obese women undergoing caesarean section: Multicentre parallel-group randomised controlled trial. BMJ. 2021;373:n893. https://doi.org/10.1136/bmj.n893

14. Singh PK, Sethi MK, Mishra TS et al. Comparison of Surgical Site Infection Between Conventional and Negative Pressure Wound Therapy-Assisted Delayed Primary Skin Closure in Grossly Contaminated Emergency Abdominal Surgeries: A Randomized Controlled Trial. J Am Coll Surg. 2022;235(5):S30. https://doi.org/10.1097/01.xcs.0000895876.88100.b8

15. Seidel D, Storck M, Lawall H, et al. Negative pressure wound therapy compared with standard moist wound care on diabetic foot ulcers in real-life clinical practice: Results of the German DiaFu-RCT. BMJ Open. 2020;10(3):e026345. https://doi.org/10.1136/bmjopen-2018-026345

16. Wang N, Li SS, Liu YP,et al. Comparison of negative pressure wound therapy and moist wound care in patients with diabetic foot ulcers: A protocol for systematic review and meta-analysis of randomized controlled trials. Med (United States). 2022;101(31):e29537. https://doi.org/10.1097/MD.0000000000029537

Implementing care for vulnerable infants under 6 months of age and their mothers 'Learning by doing' case study series: South Sudan

Background Many infants are born vulnerable, or become so in the first six months of life, and thus are at an increased risk of poor growth and development, ill health and mortality. To mitigate risks and safeguard future health, comprehensive continuity of person-centred care for at-risk mother–infant pairs is needed, but it remains challenging to deliver this at the required level of quality and at scale. This case study investigates the process of implementing, adapting, normalising and embedding an integrated care pathway approach for the management of small and nutritionally at-risk infants under six months (u6m) and their mothers (the MAMI Care Pathway) in the South Sudan context, to inform sustainable scalability.

Conclusion Guided by different frameworks, the case study painted a rich, nuanced picture of the planning, implementation and adoption of the MAMI Care Pathway approach in the South Sudan implementation. It considered the sustainable scalability of the approach, shared collective learning and made suggestions for strengthening the potential for future scale-up. From the start, implementation of this pilot intended to follow an integrated approach, building upon existing health services. It has generated valuable learning to inform integration but proved difficult to realise in practice due to the limitations of a research study to affect the necessary system changes. Transformative changes in policies and practices led by national authorities would be needed to successfully embed and sustain an integrated approach to care for vulnerable infants and their mothers.

SEE https://www.ennonline.net/sites/default/files/2024-09/MAMI_Case%20Study_South%20Sudan.pdf

River contamination and community health: mining impacts in rural central Kalimantan, Indonesia

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ABSTRACT

Introduction: Rural communities near mining areas face serious environmental health risks due to water contamination and inadequate healthcare infrastructure. Penda Siron Village in Central Kalimantan, Indonesia, exemplifies these challenges, where mining pollution has compromised water quality, while limited access to healthcare exacerbates the community's disease burden. This study examines the intricate relationship between environmental degradation and the health of the community in this mining region.

Method: We used a qualitative study design to collect data through public discussions with village leaders and residents, a review of local health records from 2021 to 2023, and field observations of water sources and sanitation conditions. Thematic analysis identified possible health-environment linkages, patterns of health problems based on healthcare utilisation, and community adaptations.

Results: The study revealed that 85% of villagers were heavily dependent on contaminated water from the river for their daily needs. This resulted in recurring outbreaks of diarrhoea (15 paediatric cases in 2017 - ~27% of the children) and chronic skin infections. The healthcare system combines traditional healing practices with under-resourced modern health services. 30% of the residents initially self-medicate due to financial constraints. Despite some recent corporate health initiatives, systemic gaps persist in the local health system, including a lack of neonatal equipment in community health posts and minimal health insurance coverage for the mine workers and their families. The study found that the presence of Mining-derived heavy metals (Pb, Hg, Cd) in water supply systems which were associated with acute and chronic diseases.

Conclusion: This research highlights the urgent need for comprehensive interventions that address both environmental pollution and healthcare deficiencies in mining regions. Effective solutions must include water quality management, strengthening local health infrastructure, and developing appropriate culturally sensitive policies through multi-stakeholder consultation.

Keywords: mining pollution, waterborne diseases, rural healthcare, environmental health, community engagement, health policy, Indonesia

Introduction

Public health in rural areas faces complex challenges that are shaped by the interplay of geography, environmental factors, and sociocultural factors.[1] Limited access to clean, safe water, dependence on contaminated water sources, and poor hygiene and sanitation practices create unique health burdens across different regions of the world.[2] Globally, 80% of rural health issues are water and sanitation-related, with diarrhoea remaining the second leading cause of death in children under five.[3] In the United States, Appalachian coal mining communities were found to have a 30% higher prevalence of chronic respiratory diseases due to coal dust exposure and contaminated water.[4] Similarly, studies in former East German mining areas revealed increased cases of lung cancer and cardiovascular diseases associated with long-term heavy metal exposure.[5] Southeast Asian mining regions, particularly in Laos and Cambodia, report 40% increases in contact dermatitis and arsenic-related kidney disorders.[6] Indonesia's critical minerals industry poses environmental and health risks due to pollution. Key impacts include an increase in asthma cases, linked to fuel and electricity consumption, as well as global warming resulting from CO_2 emissions and power demand.[7]

Central Kalimantan presents particularly severe environmental health challenges due to uncontrolled urbanisation and industrialisation. These have led to significant water pollution, as evidenced by the mercury levels in the Kahayan River watershed exceeding permissible limits, and lead concentrations in the Pujon River surpassing regulatory standards.[8,9] Such contamination poses a serious hazard to local communities, particularly children living in Artisanal and Small-Scale Gold Mining (ASGM) areas. Studies indicate that these children are particularly vulnerable to mercury exposure, whether through inhalation of toxic vapours or ingestion of contaminated food and water. Multiple exposures can contribute to adverse health outcomes, including stunting.[10]

Penda Siron Village in Laung Tuhup District, Murung Raya Regency, exemplifies these multidimensional health challenges. Located along coal-hauling routes, this community illustrates how environmental and sociocultural factors influence disease patterns. The Laung and Maruwei rivers, although vital for daily life, have become health hazards due to water pollution from upstream mining activities. Although many households are not directly involved in mining, they still rely on these contaminated waters for bathing, washing, and even anal cleansing after defecation. Local health centre records indicate that 65% of patients visit the facility with skin diseases and diarrhoea, while village reports document a 2012 gastroenteritis outbreak affecting 25 residents (~7.4% of the village population).

Previous studies on mining-related health impacts have predominantly focused on macro-level analyses, neglecting local community adaptations to environmental changes and disease patterns. Through this study, we aim to address the existing knowledge gap by examining the environmental and socio-cultural determinants of health in Penda Siron Village. The choice of participatory research is also because we prefer an intervention model that involves multiple stakeholder participation. The research findings will inform decision-makers and assist in the development of evidence-based health policies for mining-affected communities, contributing to the achievement of sustainable development goals for environmental health and community well-being. The research also seeks context-specific solutions that consider both ecological and sociocultural realities of this resource-extraction region.

Method

This study employed qualitative methods to determine the environmental health challenges in Penda Siron Village. Data was collected through a primary Focus Group Discussion (FGD) held in November 2023, with key village stakeholders including the village head, customary leaders, and health post representatives. The research analysis was based on (1) transcripts from public discussions involving village leaders and community representatives, which focused on local perceptions of health problems and the community environmental concerns; (2) observational data from field visits that documented village infrastructure, water sources, and sanitary conditions; of the village and (3) the data from village health records and demographic reports.

Thematic analysis was conducted to identify patterns in community-reported health problems, water utilisation practices, and perceived connections between mining activities and environmental pollution. Health statistics from the Community Health Centre between 2021 and 2023 (a three-year period) were reviewed to determine the relationship between environmental conditions and prevalent diseases. Analysis of health records focused on specific documented events, such as the 2012 gastroenteritis outbreak affecting 25 residents (approximately 7.4% of the village population) and a 2017 diarrhoea cluster involving 15 paediatric cases (approximately 27% of children under

age 7), to correlate with environmental conditions. The study maintained ethical standards by anonymising participant identities and obtaining verbal consent before discussions. The methodology, while respecting local knowledge and concerns, avoids making any speculative claims about pollution sources.

Results

The general findings of this study from Penda Siron Village reveal significant environmental hazards and health problems. Field observations and community discussions revealed that the community was heavily reliant on the Maruwei River for drinking, bathing, and washing. The villagers reported visible changes in water quality since mining operations began in the area. As one female participant in the group discussion stated, "The water turns reddish during rains and smells strange since the mining trucks began passing nearby." This finding was validated with photographic evidence from the field visit, which showed villagers bathing and washing clothes in the visibly turbid, muddy river water. (Figure 1).

Analysis of local health records from the Community Health Centre (2021-2023) identified recurring patterns of water-related illnesses. Most notably, a gastroenteritis outbreak was documented in 2012 that affected 25 residents (~7.4% of the population). The health records show persistent cases of skin infections during the wet seasons. The healthcare infrastructure in the village faces critical limitations, particularly the absence of essential neonatal equipment, such as incubators and oxygen supplies, at the Community Health Sub-Centre (Pustu).

In addition to the documented cases in Table 1, the Focus Group Discussion revealed significant community anxiety regarding potential long-term health impacts from using the river. While specific chronic symptoms were not detailed by the residents, they expressed a strong sense of perceived risk and fear for their future health, linking these concerns directly to the deteriorating water quality.

During the discussion, it emerged that 30% of residents initially practice self-medication using traditional remedies or over-the-counter drugs before seeking formal medical care. Health education efforts include regular counselling sessions by Community Health Centre (Puskesmas) staff and sporadic outreach programs conducted by the Adaro mining company, though these occur irregularly.

Discussion

The environmental health challenges in Penda Siron Village demonstrate the "risk transition" theory,[11] where industrialisation (mining pollution in Maruwei River) creates new environmental hazards while traditional risks (poor sanitation) persist. The villagers' continued use of polluted rivers for bathing, despite skin infections, highlights a critical aspect of the Theory of Planned Behaviour,[12] when 'perceived behavioural control' is effectively zero due to the lack of alternatives, necessity dictates action regardless of personal attitudes or subjective norms. In this case, the absence of other water sources for hygiene makes continued river use unavoidable. risks.

The socio-ecological model helps explain the multidimensional health determinants in this community.[13] At the individual level, high smoking rates and alcohol use reflect limited risk perception. At the interpersonal level, traditional healers influence health decisions through cultural authority. At the community level, the success of Integrated Healthcare Post or Posyandu shows the role

Figure 1a and b.. Condition of the Muara Maruwei River (Source: Author's own photograph)

Table 1. Health conditions associated with contaminated river water use in Penda Siron Village

Health condition	Case characteristics	Time period	Data source
Gastroenteritis	Outbreak affecting 25 residents (~7.4% of the population)	2012	Community Health Centre
Acute diarrhoea	15 paediatric cases - ~27% of the children (cluster)	2017 wet season	Community Health Centre
Chronic dermatitis	Recurrent cases among river users	Annual wet season	Community Health Centre

of peer support in preventive care. At the policy level, the absence of regulations governing mining pollution highlights a significant governance gap. The absence of reported chronic diseases linked to heavy metals may reflect the limited diagnostic capacity of the local health sub-centre rather than a true absence of these conditions.

The reliance on self-medication as a first-line response aligns with findings from other rural communities in developing countries, where accessibility and affordability influence healthcare-seeking behaviour. The positive perception of healthcare providers, regardless of ethnic background, suggests adequate cultural competency in service delivery. However, the irregularity of corporate-sponsored health programs highlights the limitations of public-private partnerships in developing sustainable health promotion programmes.

The coexistence of traditional and modern healthcare practices in Penda Siron is both a challenge and an opportunity in developing effective public health programmes. Traditional healers remain primary care providers and are helpful for non-biomedical illnesses, highlighting the importance of allowing them to coexist in an integrated healthcare system, especially in communities undergoing development. This pattern has been similarly observed in research on Native American communities.[14]

The Community Health Sub-Centres (Pustu) serves as a vital healthcare provider, though their effectiveness is limited due to inadequate infrastructure and equipment. This study highlights the urgent need for integrated interventions that address both environmental hazards and healthcare provision in mining regions through context-specific approaches. A key limitation of this study is the absence of water toxicology analysis. Therefore, the community's perceptions of contamination underscore the urgent need for a formal investigation into heavy metal presence.

Conclusion

This study reveals the serious health consequences of river contamination in Penda Siron Village, where mining activities have compromised water quality, while inadequate healthcare access exacerbates community vulnerabilities. The findings demonstrate how environmental degradation and limited medical infrastructure create interconnected health risks, particularly for waterborne diseases and chronic exposures.

The coexistence of traditional and modern healthcare practices highlights the need for culturally adapted interventions. Future efforts must include government-led water quality testing to verify community concerns about heavy metal contamination.

Ultimately, we recommend the formation of an independent commission, led by government authorities, to conduct a comprehensive environmental health assessment. The financial costs for this investigation and subsequent mitigation programs, including water infrastructure improvement, should be borne by the mining corporations operating in the region.

References

1. Leider JP, Meit M, Mac McCullough J, Resnick B, Dekker D, Natalia Alfonso Y, et al. The State of Rural Public Health: Enduring Needs in a New Decade. Am J Public Health. American Public Health Association Inc.; 2020;110(9):1283. https://doi.org/10.2105/AJPH.2020.305728

2. Hutton G, Chase C. Water Supply, Sanitation, and Hygiene. Disease Control Priorities, Third Edition (Volume 7): Injury Prevention and Environmental Health. The International Bank for Reconstruction and Development / The World Bank; 2017;171–98. https://doi.org/10.1596/978-1-4648-0522-6_CH9

3. Bitew BD, Getachew A, Azanaw J. Diarrhea Prevalence and Associated Factors among Children in Azezo Sub-City, Northwest Ethiopia: A Community-Based Cross-Sectional Study. Am J Trop Med Hyg. American Society of Tropical Medicine and Hygiene; 2023;109(2):429. https://doi.org/10.4269/AJTMH.22-0192

4. Debolt CL, Brizendine C, Tomann MM, Harris DA. Lung Disease in Central Appalachia: It's More than Coal Dust that Drives Disparities. Yale J Biol Med [Internet]. Yale Journal of Biology and Medicine Inc.; 2021 [cited 2025 May 28];94(3):477. https://pmc.ncbi.nlm.nih.gov/articles/PMC8461577/

5. Taeger D, Krahn U, Wiethege T, Ickstadt K, Johnen G, Eisenmenger A, et al. A Study on Lung Cancer Mortality Related to Radon, Quartz, and Arsenic Exposures in German Uranium Miners. J Toxicol Environ Health A. Taylor & Francis Group; 2008;71(13–14):859–65. https://doi.org/10.1080/15287390801987972

6. Seah KY, Lorbriayao B, Phan K, Kim K-W. A case study on regional arsenic sources and its distribution in Mekong River groundwater. APN Science Bulletin. Asia-Pacific Network for Global Change Research; 2023;13(1):296–309. https://doi.org/10.30852/SB.2023.2372

7. Wahyono Y, Sasongko NA, Trench A, Anda M, Hadiyanto H, Aisyah N, et al. Evaluating the impacts of environmental and human health of the critical minerals mining and processing industries in Indonesia using life cycle assessment. Case Studies in Chemical and Environmental Engineering. Elsevier; 2024;10:100944. https://doi.org/10.1016/J.CSCEE.2024.100944

8. Neneng L, Nawan, Adelia A. The Influence of Bioremediation Stages on The Effectiveness of Mercury (Hg) Elimination in Liquid Media. EnviroScienteae. 2023;19(2):96–103.

9. Dewi AK, Harteman E, Ruthena Y. Konsentrasi Merkuri (Hg) dan Timbal (Pb) Dalam Air dan Sedimen Sungai Pujon di Desa Pujon Kabupaten Kapuas. JOURNAL OF TROPICAL FISHERIES. Universitas Palangka Raya; 2024;19(2):07–15. https://doi.org/10.36873/JTF.V19I2.15540

10. Puspita D, Patmasari D, Sella S, Purbayanti D. Review: Risiko Stunting pada Anak yang Tinggal di Area Pertambangan Emas Skala Kecil. Borneo Journal of Medical Laboratory Technology. Universitas Muhammadiyah Palangkaraya; 2020;3(1):161–7. https://doi.org/10.33084/BJMLT.V3I1.1906

11. Cole HVS, Anguelovski I, Connolly JJT, García-Lamarca M, Perez-del-Pulgar C, Shokry G, et al. Adapting the environmental risk transition theory for urban health inequities: An observational study examining complex environmental riskscapes in seven neighborhoods in Global North cities. Soc Sci Med. Pergamon; 2021;277:113907. https://doi.org/10.1016/J.SOCSCIMED.2021.113907

12. Deb D, Schneider P, Dudayev Z, Emon A, Areng SS, Mozumder MMH. Perceptions of Urban Pollution of River Dependent Rural Communities and Their Impact: A Case Study in Bangladesh. Sustainability 2021, Vol 13, Page 13959. Multidisciplinary Digital Publishing Institute; 2021;13(24):13959. https://doi.org/10.3390/SU132413959

13. Palmer R, Smith BJ, Kite J, Phongsavan P. The socio-ecological determinants of help-seeking practices and healthcare access among young men: a systematic review. Health Promot Int. Oxford University Press; 2024;39(2):daae024. https://doi.org/10.1093/HEAPRO/DAAE024

14. Novins DK, Beals J, Moore LA, Manson SM. Use of biomedical services and traditional healing options among American Indians: Sociodemographic correlates, spirituality, and ethnic identity. Med Care. 2004;42(7):670–9. https://doi.org/10.1097/01.MLR.0000129902.29132.A6

Research Article

Iron deficiency in cardiorenal anaemia syndrome in Dodoma, Tanzania

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ABSTRACT

Introduction: Iron deficiency (ID) is common in patients with chronic heart failure (CHF). The convergence of CHF, ID, anaemia, and chronic kidney disease (CKD), termed Cardiorenal Anaemia Iron Deficiency Syndrome (CRAIDS), is associated with high morbidity and mortality according to published data from high-income countries. Despite the increasing occurrence of CHF in low- and middle-income countries, such as Tanzania, there is a paucity of published data. This study aims to unmask CRAIDS among CHF patients attending a tertiary hospital in Dodoma, Tanzania.

Method: This descriptive post hoc secondary analysis utilized data from a previous prospective observational study at Benjamin Mkapa Hospital in Dodoma, Tanzania. A total of 268 adult patients with CHF and varying degrees of CKD were included. ID was defined using serum ferritin and transferrin saturation (TSAT) levels. Data were analysed and presented using descriptive and inferential statistical methods. A 2-sided p-value of ≤ 0.05 indicated statistical significance.

Results: The 268 patients had a mean age of 56.25±14.83 years. There were 154 (57.5%) females. The prevalence of CRAIDS was 32.5% (87/268). Patients with CRAIDS were more likely to have diabetes mellitus (67.8%, p = 0.011), hypertension (62.1%, p = 0.048), New York Association Functional Classification (NYHA) class III/IV (77%, p < 0.001), significant proteinuria (63.2%, p = 0.012), and advanced CKD stages 4/5 (37.9%, p < 0.001). Clinical associations with CRAIDS included diabetes mellitus (AOR 2.10), NYHA III/IV (AOR 2.67), proteinuria (AOR 3.42), and advanced CKD (AOR 5.34).

Conclusion: There is a high burden of CRAIDS among CHF patients in Dodoma, and it is strongly associated with diabetes mellitus, advanced CKD with proteinuria, and poor cardiac function. Early targeted screening and management of ID could improve outcomes in this vulnerable population.

Keywords: cardiorenal anaemia iron deficiency syndrome; chronic heart failure; chronic kidney disease; iron deficiency; Tanzania.

Introduction

Iron is a micronutrient essential for numerous physiological processes, including oxygen transport and cellular metabolism.[1] The lack of iron is associated with impaired cellular metabolic processes and anaemia. Iron deficiency (ID) is common in individuals with chronic heart failure (CHF) and is an independent indicator of poor cardiovascular outcomes.[2] Serum ferritin values <100 µg/L indicate absolute ID in CHF, while serum ferritin levels between 100 and 299 µg/L and transferrin saturation (TSAT) <20% are indicative of functional ID.[3,4] Impaired iron metabolism is reflected in both types, and it is linked to worsening heart failure symptoms, exercise intolerance, and higher hospitalisation and mortality rates.[1,2] ID affects between 21% and 75% of CHF patients worldwide.[6-8] In Europe, ID affects 19% of patients as a functional deficiency and 33% of patients as an absolute deficiency, especially in older people with multimorbidities.[2, 3, 7]

A report from the Netherlands showed an ID of 77.5% of cardiorenal anaemia syndrome (CRAS) patients.[7] According to Tanzanian data, 49% of CHF patients have ID.[6] Most research regarding ID in CRAS patients has been done in high-income countries, with little in Tanzania. The term cardiorenal anaemia iron deficiency syndrome (CRAIDS) was coined to highlight the relationship between ID, anaemia, CHF, and CKD and its strong association with high morbidity and mortality rates.[2,5,7] CRAIDS is defined as a clinical triad of CHF regardless of ejection fraction, CKD with GFR ≤60 mL/min/1.73m^2, and iron deficiency anaemia with haemoglobin of <12 g/dl for females and <13 g/dl for males with features of iron deficiency based on serum ferritin and TSAT.[3–6] Improving patients' outcomes requires an understanding of ID in relation to CRAS in our local setting.[5] The purpose of this research was to close this information gap and support processes that raise patient survival and care quality.

Method

This descriptive post hoc secondary analysis study was carried out by retrieving data of the previous prospective observational study from the Department of Cardiology at Benjamin Mkapa Hospital in Dodoma, Tanzania.[9]

A total of 268 patients who met the inclusion criteria were analysed from the previous ethically cleared study. Statistical Package for Social Sciences (SPSS) Windows version 26 program (IBM SPSS, Chicago IL) was used.

Table 1. Baseline demographic, clinical, and laboratory parameters of study patients

Variables	Numbers (%) or Median (IQR)
Age (years) [x ± SD]	56.25 ± 14.83
Sex	
Female	154 (57.5)
Male	114 (42.5)
Anthropometrics	
Waist circumference, cm	88 (46-118)
Hip circumference, cm	83 (41-109)
Waist-hip ratio (WHR)	1.045 (0.73-2.23)
Blood glucose measurements	
Glycated haemoglobin (HBA1C %)	6.0 (4.1-14.6)
Random blood glucose (RBG), mmol/L	6.6 (4.3-23)
Blood pressure measurements (mmHg)	
Systolic blood pressure (SBP)	133 (98-194)
Diastolic blood pressure (DBP)	76 (59-112)
Baseline median EF, %	49 (10-79)
Iron studies and Red blood indices	
Hb, g/dl	12.1 (4.6-16.6)
Mean corpuscular volume (MCV), fl	83 (64-95.7)
Mean corpuscular haemoglobin (MCH), pg	28 (21-32.3)
C-reactive protein (CRP), mg/L	3.6 (0.06-20.4)
Ferritin, µg/L	148 (6.4-2477)
Iron, µmol/L	59 (19-169)
Total iron binding capacity (TIBC), µmol/L	273 (87-413)
Transferrin saturation (TSAT), %	22.4 (5-49.6)
Lipid profile	
Triglycerides, mmol/L	5.2 (1.2-9.6)
Low density lipoprotein, mmol/L	3.2 (1.03-7.2)
Total cholesterol, mmol/L	5.3 (2.5-9.6)
Kidney functions	
Baseline creatinine, mmol/L	128 (56-351)
Median GFR (mil/min/1.73m2)	47 (15-140)
Median urine protein: creatinine ratio (UPCR), mg/g	35 (0-1300)

Table 2. Clinical profile of patients based on the presence of CRAIDS

Variables	Total, n (%)	CRAS without ID, n (%)	CRAS with ID n (%)	p-value
Age groups				
< 60	156 (58.2)	109 (60.2)	47 (54)	
≥ 60	112 (41.8)	72 (39.8)	40 (46)	0.335
Sex category				
Female	154 (57.5)	104 (57.5)	50 (57.5)	
Male	114 (42.5)	77 (42.5)	37 (42.5)	0.998
DM status				
No	116 (43.3)	88 (48.6)	28 (32.2)	
Yes	152 (56.7)	93 (51.4)	59 (67.8)	0.011
HTN Status				
No	125 (46.6)	92 (50.8)	33 (37.9)	
Yes	143 (53.4)	89 (49.2)	54 (62.1)	0.048
NYHA category				
I/II	118 (44)	98 (54.1)	20 (23)	
III/IV	150 (56)	83 (45.9)	67 (77)	<0.001
CRP category				
< 1.0	44 (16.4)	34 (18.8)	10 (11.5)	
≥ 1.0	224 (83.6)	147 (81.2)	77 (88.5)	0.131
EF %				
≥ 45	167 (62.3)	116 (64.1)	51 (58.6)	
< 45	101 (37.7)	65 (35.9)	36 (41.4)	0.387
UACR, mg/g				
Normal	118 (44)	86 (47.5)	32 (36.8)	
Increased	150 (56)	95 (52.5)	55 (63.2)	0.012
Advanced CKD staging				
≥ 30	221 (82.5)	167 (92.3)	54 (62.1)	
< 30	47 (17.5)	14 (7.7)	33 (37.9)	<0.001
Obesity				
No	103 (38.4)	69 (38.1)	34 (39.1)	
Yes	165 (61.6)	112 (61.9)	53 (60.9)	0.880
Dyslipidemia				
No	103 (38.4)	69 (38.1)	34 (39.1)	
Yes	165 (61.6)	112 (61.9)	53 (60.9)	0.880

* Pearson Chi-squared test.

Descriptive and inferential analyses were performed.

Categorical data were presented as frequencies and percentages. The Pearson Chi-squared test was used to compare the clinical profiles of patients with and without CRAIDS. To identify factors associated with CRAIDS, both univariate and multivariate logistic regression analyses were performed, yielding Crude Odds Ratios (COR) and Adjusted Odds Ratios (AOR) with 95% confidence intervals (CI). For logistic regression, key assumptions include the absence of high multicollinearity among predictor variables and the linearity of the logit for continuous predictors. A 2-sided p-value of ≤ 0.05 was considered statistically significant.

Results

Prevalence of CRAIDS

Out of the 268 patients, 87 (32.5%) had CRAIDS.

Baseline demographic, clinical, and laboratory parameters of study patients: these are shown in Table 1.

Clinical profile of patients based on the presence of CRAIDS

These are shown in Table 2.

Clinical associations with CRAIDS - see Table 3.

In this study, eight potential variables were identified at

Table 3. Clinical Associations with CRAIDS

Variables	Total, n (%)	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age groups					
< 60	156 (58.2)	Ref		Ref	
≥ 60	112 (41.8)	1.288 (0.769-2.159)	0.336	1.373 (0.659-2.858)	0.397
Sex category					
Female	154 (57.5)	Ref		Ref	
Male	114 (42.5)	0.999 (0.596-1.676)	0.998	1.875 (0.884-3.973)	0.101
DM status					
No	116 (43.3)	Ref		Ref	
Yes	152 (56.7)	1.994 (1.167-3.408)	0.012	2.100(1.141-3.860)	0.017
HTN Status					
No	125 (46.6)	Ref		Ref	
Yes	143 (53.4)	1.692 (1.004-2.851)	0.048	1.761(0.0.969-3.202)	0.063
NYHA category					
I/II	44 (16.4)	Ref		Ref	
III/IV	165 (83.6)	3.955 (2.218-7.050)	0.001	2.665 (1.384-5.131)	0.003
CRP category					
< 1.0	167 (62.3)	Ref		Ref	
≥ 1.0	101 (37.7)	1.781 (0.835-3.797)	0.135	1.203 (0.836-3.289)	0.326
UACR, mg/g					
Normal	118 (44)	Ref		Ref	
Increased	150 (56)	2.810 (1.379-5.724)	0.004	3.415 (1.513-7.710)	0.003
CKD staging					
≥ 30	221 (82.5)	Ref		Ref	
< 30	47 (17.5)	7.290 (3.633-14.627)	0.001	5.341 (2.469-11.553)	<0.001

*Univariate and multivariate logistic regression.

baseline as clinical associations and were fitted for univariate analysis, with a p-value ≤0.2 considered statistically significant. Thereafter, multivariate analysis and backwards elimination were performed, and the variables were then reduced to four parameters with statistical significance, with a p-value of less than 0.05. Clinical associates were diabetes mellitus: AOR 2.100 (95% CI, 1.141-3.860; p= 0.017); advanced NYHA functional classes III/IV: AOR 2.665 (95% CI, 1.384-5.131; p=003); proteinuria: AOR 3.415 (95% CI, 1.513-7.710, p=0.003) and advanced CKD stages 4/5: AOR 5.341 (95% CI, 2.469-11.553, p <0.001) were associated with CRAIDS.

Discussion

This study aimed to investigate the burden of CRAIDS among patients with CHF in Dodoma, Tanzania. The observed prevalence was 32.5%, which aligns with data from other low- and middle-income countries.[3,6] A Tanzanian study previously reported iron deficiency (ID) in 49% of CHF patients, while studies from the Netherlands documented even higher ID prevalence up to 77.5% among patients with CRAIDS.[6,7] These higher figures were largely attributed to the advanced age and presence of multiple comorbidities in the studied populations.[2,10–12]

Consistent with previous findings, diabetes mellitus, advanced chronic kidney disease (CKD stages 4/5), proteinuria, and poor cardiac functional status (NYHA classes III/IV) emerged as independent clinical associates of CRAIDS. Chronic inflammation and CKD progression were known to impair iron metabolism and erythropoiesis, then appears to underlie these associations.[2,4] Additionally, the hyperglycaemic state, chronic inflammation, and insulin resistance associated with diabetes mellitus, along with its toxic effects on the heart and kidneys (leading to ischaemic heart disease and diabetic nephrosclerosis), contribute to worsening cardiac and renal functions.[13,14] Iron plays a vital role in multiple metabolic and physiological processes, including the synthesis of myoglobin, haemoglobin, oxidative and respiratory chain enzymes, and in maintaining the contractile strength of cardiac myocytes. Deficiency in iron may therefore exacerbate the progression of this multimorbid syndrome.[13,14] Although, this was a single-centre study, it underscores the need for early screening and targeted intervention of ID among CHF patients, especially those with multimorbid syndrome.

Given that, our facility is a national referral hospital that receives patients from peripheral facilities across Tanzania, the findings may have broader relevance within the country and possibly the East African region. Nevertheless, the relatively small and underrepresented sample limits the generalization of the results. A prospective, multi-centre study is warranted to confirm these findings, and an interventional trial would be valuable to assess the effectiveness of proposed screening and management protocols in this context.

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References

1. Mccullough PA. Anemia of cardiorenal syndrome. Kidney Int Suppl [Internet]. 2021 [cited 2024 Jun10];11:35–45. DOI: https://doi.org/10.1016/j.kisu.2020.12.001
2. Klip IT, Jankowska EA, Enjuanes C, Voors AA, Banasiak W, Bruguera J, et al. The additive burden of iron deficiency in the cardiorenal-anaemia axis: Scope of a problem and its consequences. Eur J Heart Fail. 2014;16(6):655–62. DOI: https://doi.org/10.1002/ejhf.84
3. Tkaczyszyn M, Comín-colet J, Voors AA, Veldhuisen DJ Van, Enjuanes C, Moliner-borja P, et al. Iron deficiency and red cell indices in patients with heart failure. DOI: https://doi.or/:10.1002/ejhf.820
4. Jain D, Desai BN, Rathi RK, Shekhar C, Sahoo PK, Burkule N, et al. Characterization of Iron Deficiency in Patients with Chronic Heart Failure: A Prospective, Multicentric, Observational Study from India. 2020; DOI: https://doi.org/10.4103/JICC.JICC_43_19
5. Macdougall IC, Canaud B, De Francisco ALM, Filippatos G, Ponikowski P, Silverberg D, et al. Beyond the cardiorenal anaemia syndrome: Recognizing the role of iron deficiency. Eur J Heart Fail. 2012;14(8):882–6. DOI: https://doi.org/10.1093/eurjhf/hfs056
6. Makubi A, Hage C, Lwakatare J, Mmbando B, Kisenge P, Lund LH, et al. Prevalence and prognostic implications of anaemia and iron de fi ciency in Tanzanian patients with heart failure. 2014;1–8. DOI: https://doi.org/10.1136/heartjnl-2014-306890'

7. Alnuwaysir RIS, Grote Beverborg N, Hoes MF, Markousis-Mavrogenis G, Gomez KA, van der Wal HH, et al. Additional burden of iron deficiency in heart failure patients beyond the cardio-renal anaemia syndrome: findings from the BIOSTAT-CHF study. Eur J Heart Fail. 2022;24(1):192–204. DOI: https://doi.org/10.1002/ejhf.2393

8. Makubi A, Roberts DJ, Hospital JR. Investigation and treatment for iron deficiency in heart failure : the unmet need in Lower- and Middle-Income Countries. 2017;(May). DOI: https://doi.org/10.1111/bjh.14650'

9. Edwin G, Alphonce B, Meremo A, Meda JR. Prevalence, clinical correlates and outcomes of cardiorenal anemia syndrome among patients with heart failure attending tertiary referral hospital in Dodoma, Tanzania: A protocol of a prospective observational study. PLoS ONE. 2024; 19: 1–54 p. DOI: https://doi.org/10.1371/journal.pone.0292764

10. Alnuwaysir RIS, Beverborg NG, Hoes MF, Markousis-mavrogenis G, Gomez KA, Wal HH Van Der, et al. Additional burden of iron deficiency in heart failure patients beyond the cardio-renal anaemia syndrome : findings from the BIOSTAT-CHF study. 2022. DOI: https://doi.org/10.1002/ejhf.2393'

11. Damman K, Masson S, Lucci D, Gorini M, Urso R, Maggioni AP, et al. Progression of Renal Impairment and Chronic Kidney Disease in Chronic Heart Failure : An Analysis From GISSI-HF. J Card Fail [Internet]. 2017;23(1):2–9. DOI: http://dx.doi.org/10.1016/j.cardfail.2016.09.006'

12. Meremo A, Paget G, Duarte R, Bintabara D, Naicker S. Progression of chronic kidney disease among black patients attending a tertiary hospital in Johannesburg, South Africa. PLoS One [Internet]. 2023;18(2 February):1–17. DOI: http://dx.doi.org/10.1371/journal.pone.0276356

13. Rangaswami J, Bhalla V, Blair JEA, Chang TI, Costa S, Lentine KL, et al. Cardiorenal Syndrome: Classification, Pathophysiology, Diagnosis, and Treatment Strategies: A Scientific Statement From the American Heart Association. Vol. 139, Circulation. 2019. :840–878. DOI: https://doi.org/10.1161/CIR.0000000000000664

14. Iaina A, Silverberg DS, Wexler D. Therapy Insight: congestive heart failure, chronic kidney disease and anemia, the cardio – renal – anemia syndrome. 2005;2(2):95–100. 'DOI: https://doi.org/10.1038/ncpcardio0094

First-Ever Malaria Drug for Infants is Approved

The Africa Centres for Disease Control and Prevention (Africa CDC) has welcomed the approval of the first malaria treatment designed for newborns and infants under five kilograms, calling it a "major step forward".

The new artemether-lumefantrin formulation for children was developed through a partnership between Novartis and the Medicines for Malaria Venture (MMV), under the PAMAfrica consortium, and 8 African countries participated in clinical trials: Burkina Faso, Côte d'Ivoire, Kenya, Malawi, Mozambique, Nigeria, Tanzania, and Uganda.

Children under 5 were often given modified doses of medicines for older children, raising the risk of overdose and toxicity. This new formulation offers a safe, effective, and infant-friendly option, dissolvable in breast milk and with a sweet flavour to ease administration.

https://allafrica.com/view/group/main/main/id/00093769.html?utm_campaign=daily-headlines&utm_medium=email&utm_source=newsletter&utm_content=group-view-link

Research Article

Guerrilla investors: Firm-level innovation and productivity in South Sudan's private pharmaceutical sector

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ABSTRACT

Introduction: Innovation enables firms to thrive under constraints or transform their sectors. This has been little studied in South Sudan's pharmaceutical sector, where it could promote sustainable access to medicines.

Methods: The World Bank's Enterprise Survey 2014 was applied to private pharmaceutical firms between July and September 2021. There were 21 respondents (58% of the registered firms, n = 36). Firm characteristics, major constraints, and firm-level innovation were considered, and productivity was mapped. Percentage comparisons were drawn for firms in South Sudan and sub-Saharan Africa.

Results: Nineteen firms were included in the analysis. The average pharmaceutical firm was 14 years old and had 10 employees. Only 16.7% of pharmaceutical firms offered training to their employees, while political and financial conditions constrained all. Additionally, only 11.1% invested in research and development, and the skilled workforce comprised 53.3% of the workforce. However, pharmaceutical firms innovated to address these constraints: 73.7% had introduced new products or services, 63.2% had partaken in process improvements, and 61.1% recognized products or services as new for their market. 89.5% of pharmaceutical firms increased revenue per worker by US$600-1200, with labour cost accounting for 5% of sales among 88.9% of firms and up to 10% of sales among 5.6% of firms. 40% of pharmaceutical firms reported growth of less than 2%.

Conclusions: Innovation is a key factor in the survival of firms in South Sudan's private pharmaceutical sector. Better sector governance and financial support would enable and help improve the availability of medicines.

Key words: innovation, pharmaceuticals, industrial policy, essential medicines; fragility, South Sudan.

Introduction

Innovation is essential for firm survival in low-income countries (LICs).[1] The Oslo Manual defines innovation as "the implementation of a new or significantly

improved product (goods or services) or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations."[2] Accepted indicators for innovation include research and development (R&D) investments, patents owned or requested, and scientific publications.[3] These metrics are limited in their ability to understand innovation in impoverished settings, where firms innovate under constraints.[4,5] In many settings, small firms and new entrants deploy 'guerrilla tactics'[6] to withstand competition in established markets or uncertainty in evolving markets.

Although Africa represents 1% of global R&D investments and 1% of total patents,[7] 'frugal innovation' – observed among firms that thrive in impoverished settings – is less reliant on R&D and involves customised application of existing technology, low-cost solutions, and design thinking.[4] This presents transformative potential for South Sudan, where the private sector is nascent and public capacity is limited.[8,9]

Unleashing potential among private pharmaceutical firms is essential for the availability of medicines, which is 50.4% in Juba.[10] But the extent of innovation among private pharmaceutical firms remains poorly studied in South Sudan. Locally-situated innovation could indigenize donated technology, where consumables and maintenance costs are often prohibitive.[11]

This article is the first to report innovation among private pharmaceutical firms in South Sudan. It characterizes firms and highlights constraints, comparing averages for the private sector in South Sudan and sub-Saharan Africa. It then examines productivity among the pharmaceutical firms before profiling firm-level innovation.

Method

Study Sample

This study surveyed private, for-profit pharmaceutical firms in South Sudan. A random sample was surveyed through the Pharmaceutical Society of South Sudan. There were 21 respondents, which comprised 58% of all registered private pharmaceutical firms (n = 36) (Personal

Table 1. Characteristics and constraints among firms in South Sudan and sub-Saharan Africa

	Pharmaceutical firms in South Sudan†	Other types of firms in South Sudan‡	Firms in sub-Saharan Africa‡
Basic characteristics			
Age (years), *m*	13.6	4.2	15.1
Size (number of workers), *m*	10.3	12.3	32.1
Purchased fixed assets (% of firms)	57.9	38.1	38.1
Skilled workers (% of all production workers)	53.3	69.8	77.4
Firms with formal training (% of firms)	16.7	17.1	27.5
Foreign ownership (% of firms)	38.9	42.7	16
Challenges reported as "major obstacle" (% of firms)			
Political instability	100	30.4	10.6
Access to finance	100	50	38.2
Corruption	100	40.1	39.1
Connecting telephone	100	N/A	26.8
Electricity	79	58.6	40.6
Transport	84.2	46.2	24.2
Access to land	68.4	7.2	4.2
Inadequately-educated workforce	52.6	19.5	16.3

Source: †Author's own. ‡World Bank (2015).[12]

Note: *m:* mean.

communication). This excludes private, not-for-profit pharmaceutical firms, such as humanitarian or faith-based organisations.

Survey

This study used the World Bank's Enterprise Survey (WBES) 2014[12] via an online survey tool (Qualtrics), between July and September 2021. This comprised 54 questions previously used for studying private firms in South Sudan, allowing for comparison with the private sector in South Sudan and sub-Saharan Africa. It required informed consent and explored ten categories, including workforce, innovation, finance, firm performance, infrastructure, other constraints, other firm characteristics, ownership status, legal and export status, and sectors in which the firm operates. This article presents data on workforce, finance, firm performance, infrastructure, and other constraints concerning innovation.

Outcome

Firms were characterized by factors that impact innovation, and constraints considered with the percentage of firms identifying each as 'major obstacle.' These factors included age, size (number of employees), fixed assets purchased, skillset among employees, formal training offered, and foreign ownership. Major constraints studied included political instability, access to finance, corruption, connecting telephone, electricity, transport, access to land, and an inadequately educated workforce. Percentage comparators were drawn for the private sector in South Sudan and sub-Saharan Africa, based on findings from the WBES 2014.[12]

Table 2. Productivity among private pharmaceutical firms in South Sudan

Firm performance metric	Performance	% of firms
Value-add per worker (US$)	600-1200	89.5
	1200-2400	5.3
	2400-3000	5.3
Cost of labour per unit of sales (%)	0.5	5.6
	5	88.9
	10	5.6
Real annual sales growth (%)	5-10	53.8
	11-15	23.1
	16-20	23.1
Annual employment growth (%)	≤ 2	40
	5-10	30
	10-20	30

Analysis

Three out of 19 respondents included in the analysis omitted one question each: a question on employee training, one on R&D investment, and a question on a product or service that was new to the firm's main market. Descriptive statistics were used for characterisation.

Firm-level innovation was measured as new products or services by the firm, process improvement, R&D, and a product or service new to the firm's market. Firm-level performance was quantified with labour productivity, assessed by value-added per worker, average annual salary or wage, and cost of labour per unit of sale. Financial capital expenditure was assessed by real annual sales growth and annual employment growth.

Results

The average pharmaceutical firm was 14 years old and had 10 employees. This made it older than the average firm in South Sudan and younger than the average for sub-Saharan Africa, but with fewer employees than a firm in South Sudan or sub-Saharan Africa. 57.9% of the pharmaceutical firms purchased fixed assets in the preceding year, compared with 38.1% of all firms in South Sudan and 38.1% for firms in sub-Saharan Africa. The skilled workforce comprised 53.3% of the pharmaceutical firms' workforce, compared with 69.8% for all firms in South Sudan and 77.4% for firms in sub-Saharan Africa. Fewer pharmaceutical firms (16.7%) offered formal training to employees in the preceding year, compared with 17.1% for all firms in South Sudan and 27.5% of firms in sub-Saharan Africa. Foreign ownership was reported by 38.9% of pharmaceutical firms, compared with 42.7% of all firms in South Sudan and 16% of firms in sub-Saharan Africa (Table 1).

These reflected a restrictive business environment, whereby 100% of the pharmaceutical firms reported political instability, access to finance, corruption, and connecting to the telephone as major obstacles. 79% of pharmaceutical firms reported electricity as a major obstacle, compared with 58.6% for all firms in South Sudan and 40.6% in sub-Saharan Africa. Transport was a major obstacle for 84.2% of pharmaceutical firms, 46.2%

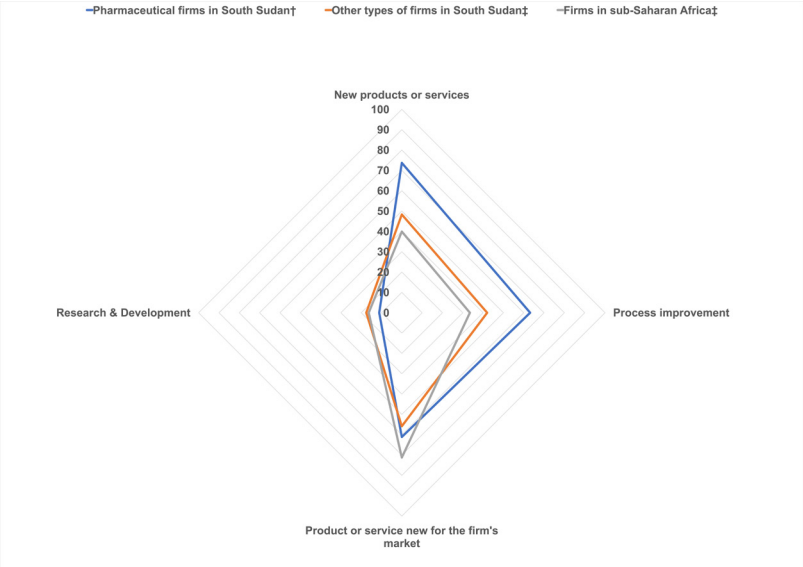

Figure 1. Private pharmaceutical firms innovate under constraints in South Sudan. (Source: †Author's own. ‡World Bank (2015).[12])

of all firms in South Sudan, and 24.2% in sub-Saharan Africa. Access to land was a major obstacle for 68.4% of pharmaceutical firms, 7.2% of all firms in South Sudan, and 4.2% of firms in sub-Saharan Africa. An inadequately educated workforce was a major obstacle for 52.6% of pharmaceutical firms, compared with 19.5% in South Sudan and 16.3% in other countries (Table 1).

These constraints impact performance among private pharmaceutical firms. 89.5% of the pharmaceutical firms added US$600-1200 to revenue per worker, with labour costs accounting for 5% of sales for 88.9% of pharmaceutical firms and up to 10% of sales for 5.6% of pharmaceutical firms. Real sales growth was low among pharmaceutical firms: 53.8% reported 5-10%, 23.1% reported 11-15%, and 23.1% reported 16-20%. Consequently, 40% of pharmaceutical firms reported annual employment growth of less than 2% (Table 2).

These restrictive conditions force firms to innovate. Although only 11.1% of private pharmaceutical firms (blue in Figure 1) invested in R&D in the preceding financial year, compared with 17.5% of other types of firms in South Sudan (orange) and 16.3% of firms in sub-Saharan Africa (grey), 73.7% of the pharmaceutical firms (blue) had introduced new products or services in the preceding year, compared with 48.3% of other types of firms in South Sudan (orange) and 39.9% of firms in sub-Saharan Africa (grey). Similarly, 63.2% of the pharmaceutical firms (blue) partook in process improvement, compared with 42% of other types of firms in South Sudan (orange) and 33.5% of firms in sub-Saharan Africa (grey). 61.1% of pharmaceutical firms (blue) recognized products or services as new to their market, compared with 55.8% of other types of firms in South Sudan (orange) and 71.2% of firms in sub-Saharan Africa (grey) (Figure 1).

Discussion

This study showed that private pharmaceutical firms in South Sudan innovate against constraints. Unfavourable investment conditions have rendered private pharmaceutical firms generally small-sized (<19 employees), less productive, and diminished competencies.[9] These conditions demand 'frugal innovation,' an approach that springs from societal and operational constraints to avail accessible and adaptable solutions.[4,5] They also confirm the lack of cluster scale constraints, sector-based sources of financial capital, bargaining power, and a firm's access to larger markets.[3,7]

While R&D investments, good governance, suitable infrastructure, and talent pool are critical to innovation [13] this study suggests pharmaceutical firms in South Sudan likely partake in 'frugal innovation'[4,5,14] as a means to survival in a hostile investment climate. This approach has been likened to 'guerrilla warfare,' characterised by hit-and-run methods that evade direct competition in a duopoly, as small firms strive for survival under uneven and unfavourable conditions, rather than a classical market entry.[6] In this instance, innovation among private

pharmaceutical firms could also become a viable vehicle for strengthening health systems.[15] Supportive political and business conditions would increase the number of large-sized firms in the pharmaceutical sector, thereby increasing sector-wide potential for harnessing financial power and networks[3] for firm-level productivity.

However, public institutions' reforms have often proven sluggish in fragile and conflict-affected states such as South Sudan.[16] So, context-specific innovation is also instrumental for sustainability when an institutional void exists.[5,14] These insights should inform approaches to the pharmaceutical sector and health systems strengthening in South Sudan and similar settings.

Conclusion

Innovation is a means of survival for firms in South Sudan's private pharmaceutical sector and helps the sector thrive despite constraints. Better governance and financial support would encourage sector sustainability and improve the availability of medicines.

Ethics approval and consent to participate: Ethics approval for this study was granted by the Australian National University (Protocol: 2021/272). Additional approval was obtained from South Sudan's Ministry of Health (Protocol: 32/07/2021 – MOH/RERB/AF/33/2021). Participation was voluntary and anonymous, and no personally-identifying information was collected. Except for the informed consent, respondents could skip questions and submit a partially completed survey. This offered flexibility while preserving anonymity.

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References

1. Gebreeyesus M. Innovation and microenterprises growth in Ethiopia. WIDER Research Paper, No. 2009/51, ISBN 978-92-9230-230-6. 2009, Helsinki: The United Nations University World Institute for Development Economics Research (UNU-WIDER). DOI: https://hdl.handle.net/10419/45080
2. OECD, Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Ed. 2005, Paris: European Commission, pp.46. DOI: https://www.oecd.org/en/publications/oslo-manual_9789264013100-en.html
3. Fu X, Zanello G. Innovation under the radar as a response to constraints: the nature of innovation in Africa. In: Fu X (Ed). Innovation under the Radar: The nature and sources of innovation in Africa. 2020 Nov, New York: Cambridge University Press, pp.65-104. DOI: https://doi.org/10.1017/9781316869482.005
4. Hindochi CN, Antonacci G, Barlow J, Harris M. Defining frugal innovation: a critical review. BMJ Innov. 2021 Oct 5;7:647-656. DOI: https://doi.org/10.1136/bmjinnov-2021-000830
5. Levänen J, Hossain M, Wierenga M. Frugal innovation in the midst of societal and operational pressures. Journal of Cleaner Production. 2022 May 1;347:131308. DOI: https://doi.org/10.1016/j.jclepro.2022.131308
6. Fershtman C. Survival of small firms: guerrilla warfare. Journal of Economics & Management Strategy. 1996;5(1):131-147. Doi: https://doi.org/10.1111/j.1430-9134.1996.00131.x
7. Fu X. Innovation and Growth of African Firms: survival and growth. In: Fu X (Ed). Innovation under the Radar: The Nature and Sources of Innovation in Africa. 2020, New York, NY: Cambridge University Press, pp.125-151. DOI: https://doi.org/10.1017/9781316869482.007
8. Collier, P., Gregory, N., & Ragoussis, A. (2020). Pioneering Firms in Fragile and Conflict-Affected States: Why and How Development Financial Institutions Should Support Them. Journal of Accounting and Finance, 20(3). Doi: https://doi.org/10.33423/jaf.v20i3.3016
9. Dut GM. Private pharmaceutical sector in South Sudan: underdeveloped but essential. South Sudan Medical Journal. 2025: 18(2):78-83 DOI: https://doi.org/10.4314/ssmj.v18i2.5
10. Deng J, Mayai AT, Kayitare E, Ntakirutimana T, Swallehe O, Bizimana T. Assessment of prices, availability and affordability of essential medicines

in Juba County, South Sudan. J Pharm Policy Pract. 2023 Dec 30;16(1):172. Doi: https://doi.org/10.1186/s40545-023-00675-5

11. Malkin RA. Design of health care technologies for the developing world. Annu Rev Biomed Eng. 2007;9:567-87. DOI: https://doi.org/10.1146/annurev.bioeng.9.060906.151913

12. World Bank. Enterprise survey (ES) 2014, Ref. SSD_2014_ES_v01_M. 2015 Oct 7, Washington DC: World Bank. https://www.enterprisesurveys.org/en/data

13. Congressional Budget Office. Research and Development in the Pharmaceutical Industry [Internet]. Updated 2021 April, Washington DC: the US Government. [Cited 19 May 2025] https://www.cbo.gov/publication/57126

14. Bhatti Y, Basu RR, Barron D, Ventresca MJ. Frugal innovation: models, means, methods. 2022, Cambridge, UK: Cambridge University Press, pp.12-14. Doi: https://doi.org/10.1017/9781316986783.004

15. McPake B, Hanson K. Managing the public-private mix to achieve universal health coverage. Lancet. 2016;388:622-30. Doi: https://doi.org/10.1016/S0140-6736(16)00344-5

16. Andrews M, Pritchett L, Woolcock M. Building state capability: evidence, analysis, action. 2019, Oxford: Oxford University Press, pp.29-52. DOI: https://doi.org/10.1093/acprof:oso/9780198747482.003.0003

Resources on wet nursing in emergencies

from UNICEF, IFE Core Group and Save the Children.

Wet Nursing Screening Tool

This screening tool accompanies the UNICEF (2025) Technical and Operational Guidance on Supporting Access to Breastmilk Through Wet Nursing in Emergencies.

The aim is to support frontline professionals in the screening of a prospective wet nurse. This usually requires a screening in which medical history, including infectious disease screening, care duties, and social practices are discussed between the prospective wet nurse and the primary caregiver of the infant receiving the human milk. This screening can be supported between families or facilitated by a health or nutrition professional using a contextualised screening tool such as this. A woman who is a prospective wet nurse may, at any time, decline to continue the screening, in part or entirely. A primary infant caregiver may also opt out of the screening at any time.

See https://iycfehub.org/pdf/Wet-Nursing-Screening-Tool.pdf/

and

Supporting Wet Nursing during Emergencies – provides practical guidance for frontline workers during emergency preparedness and response.

See BACK PAGE and https://www.ennonline.net/sites/default/files/2025-08/Supporting-wet-nursing-during-emergencies-%28ENGLISH%29.pdf

Research Article

Paediatric deaths at Al-Sabbah Children's Hospital, Juba, South Sudan – an audit

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ABSTRACT

Introduction: Paediatric mortality is a pressing public health concern in South Sudan, particularly in tertiary care settings where systemic challenges constrain access to timely and quality healthcare. In response to this, the Momentum Integrated Health Resilience (MIHR), in collaboration with the Association of Gynaecologists and Obstetricians of South Sudan, undertook a paediatric death audit (PDA) at Al-Sabbah Children's Hospital in Juba. This study aimed to describe the experience and the status of PDA implementations and provide recommendations for improvement.

Method: This was a cross-sectional, descriptive study conducted in September 2024. Data were collected using a standardised tool adapted from the United States Agency for International Development Maternal and Child Survival Programme. To obtain the information, focal group discussions were conducted with 13 members from the PDA hospital committee and officials from the Ministry of Health of Central Equatoria State. Another group obtained retrospective data from the available PDA review forms and guidelines.

Results: Based on this assessment, the PDA committee at Al-Sabbah Children's Hospital is functional. The hospital has verifiable PDA guidelines, mainly from the World Health Organisation, standardised death notification and death review forms that capture paediatric death information, and job aids like the International Classification of Diseases-Perinatal Mortality and the International Classification of Diseases-Paediatric Death to support cause-of-death classification. However, it lacked standardised death certificates with a designated section to record the cause of death. The assessment revealed that only a few deaths were reviewed as sampled by the committee chair.

Conclusion: PDA is well implemented in Al-Sabbah Children's Hospital. The assessment recommends replicating the PDA in other national and state hospitals, as well as forming and training PDA committees on the standardised classification of causes of neonatal and paediatric deaths.

Keywords: paediatric death audit (PDA), Al-Sabbah Children's Hospital, South Sudan

Introduction

An audit of paediatric deaths is a systematic review analysing the deaths, particularly those under five years, to identify medical, social, and other factors contributing to mortality.[1] In South Sudan, with its fragile health infrastructure, death audits are critical for improving child survival.[2]

South Sudan records some of the highest under-five mortality rates globally. Contributing factors include malnutrition, infectious diseases (e.g. malaria, pneumonia, and diarrhoea), limited access to quality healthcare, and shortages of trained health personnel.[3] Paediatric death audits (PDA's) provide information about the causes surrounding child deaths and inform interventions.[4]

Unlike maternal and perinatal death audits, auditing child deaths has received much less attention.[6] There are a few published studies on PDAs from low- and middle-income countries (LMICs) as recommended by the World Health Organisation (WHO) in 2018.[5] As part of quality improvement, the Momentum Integrated Health Resilience (MIHR) in South Sudan was joined by the Child Health Department of the National Ministry of Health (MOH), South Sudan Paediatric Association, and WHO to support the implementation of PDA in 2022. This study reported only the PDA assessment conducted in September 2024.

PDA training was conducted over one day in September 2022, utilizing WHO training materials. Twenty-four health care providers, including 15 females and 9 males, attended the training. The attendees included clinical and medical officers, paediatricians, midwives, laboratory technicians, matrons, administrators, and statisticians. PDA monthly reviews were undertaken.

Al-Sabbah Children's Hospital, Juba — our largest and only specialised paediatric referral hospital —provides an opportunity to investigate the patterns and drivers of child mortality in a low-resource setting. This collaborative study, conducted by MIHR and the Association of Gynaecologists and Obstetricians of South Sudan (AGOSS), sought to identify avoidable factors, assess the care quality, and recommend interventions to reduce preventable paediatric deaths.

Method

Al-Sabbah Children's Hospital is a national referral facility for both outpatient and inpatient medical services. This study was a cross-sectional descriptive assessment. It targeted health providers and managers who were members of the PDA committee. Interviews were conducted with health providers on the PDA committee and with the hospital's executive director. The assessment included the review of the PDA tools and job aids available, and other services and mortality data at the hospital. It was conducted by a consultant from AGOSS, using the MIHR PDA assessment tool adapted from the United States Agency for International Development (USAID) Maternal and Child Survival Programme tool.[6] Al-Sabbah Children's Hospital was the only hospital selected for the assessment. This was because it was the only health facility in the country implementing PDA. The aim was to assess the experience, progress, and status of the PDA and the clinical outcomes of its implementation. We describe current national policies and guidelines supporting PDA, identify challenges and adaptations, and provide recommendations for improvements.

The PDA committee in the facility is tasked to systematically review and analyse the under-five deaths to identify causes, contributing factors, and modifiable factors. The ultimate objective is to reduce preventable under-five mortalities and improve the quality of care in the hospital. It comprises professionals involved in child health care. This includes the hospital director as chairperson, the matron, ward in charge, paediatric specialists, general practitioners, pharmacists, laboratory technicians, nutritionists, and data officers, among others. The PDA review process follows a cycle of six steps that starts with the identification and notification of under-5-year-old children's deaths that occurred in the facilities to the audit committee. This is followed by the identification of two members of the PDA committee to collect detailed data on the case using available records, and a death review meeting using the WHO structured audit form, during which the team will analyse the contributing and modifiable factors that led to the death. These steps are followed by others, such as making recommendations and implementing actionable solutions to avoid similar issues in the future, which should also be monitored and evaluated to determine whether improvements occurred.

Data collection and analysis

The study included facility observations and interviews as indicated above. Documentation of the PDA committee, meeting schedules, meeting notes, and reports was checked. Interviews were conducted in English and/or Arabic, but notes were taken in English.

Participants were asked when PDA began and whether it

Table 1. Structure of the assessment

Participants	Number	Data collection method	Data collection tool
PDA committee	17	Focus Group Discussions	Questionnaires
		Review PDA data	Data collection sheet
		Review PDA tools	Direct observations
		Direct observation/verification of data source	
		Historical anecdote	

was part of the hospital's usual quality-of-care activities. They were asked if PDA guidelines were available in the hospital, if activities were coordinated among the committee members, if death notification plans were in place, and if each death was reported to the PDA committee. Enquiries were made about the collection and analysis of paediatric deaths and if the committee made recommendations based on identified modifiable factors, and if action plans were implemented.

Data were collected using a standard tool adapted from the USAID Maternal and Child Survival Programme.[7] The form was adapted using the KoboToolbox online software, which enabled direct data entry.[8] This was checked for completeness and transported into SPSS version 29 for descriptive analysis. No personal identifiers were included. This audit assessment was approved by the Directorate of Reproductive Health, National Ministry of Health, and oral consent was obtained from the respondents. Table 1 summarises the data collection methods and tools used.

Results

Results cover the availability of PDA guidelines, forms, and reporting tools; the organisation and implementation of PDA; the assessment of healthcare workers on PDA; and the PDA cycle.

PDA guidelines, forms, and reporting

The hospital had PDA guidelines, mainly from the WHO, standardised death notification and death review forms that included paediatric death information, and job aids like International Classification of Diseases-Perinatal Mortality (ICD-PM) and International Classification of Diseases-Paediatric Death (ICD-PD), which are international coding classifications of diseases in antepartum, intrapartum, and early neonatal deaths. However, there were no standardised death certificates in the hospital. PDA meetings were supported with a sitting allowance provided by the WHO. Despite limited financial support for implementing death review recommendations, monthly reports were submitted locally to state authorities and made available electronically.

Organisation implementation of PDA

Al-Sabbah Children's Hospital had conducted PDAs for eighteen months before this assessment. The hospital has a functional PDA committee and chairperson. Meetings were attended by the chairperson, health information officer, nurses, nutritionist, pharmacist, laboratory technician, medical officers, and paediatricians, as well as partners from the WHO, United Nations Children's Fund (UNICEF), and MIHR. They discuss how a case was managed, modifiable factors and causes of death, action points, and recommendations, with assigned follow-up responsibilities.

PDA training and supervision

Training to build the PDA committee's capacity was conducted by the hospital administration in collaboration with MIHR and WHO. Unfortunately, PDA training did not include other health facilities within Central Equatoria State.

PDA Cycle

Identifying and notifying death

Authorities are routinely notified of neonatal and paediatric deaths within the hospital, but this doesn't include those occurring within the communities. Deaths are identified from the emergency care register, the outpatient department, the emergency department, the paediatric admission register, and the clinical files.

Collecting information

Information for a death review is compiled from the

case notes, charts, registers, and death notification forms. Medical records and registers do not capture all the necessary information due to poor documentation, lost files, and some records being taken by the patient's guardians.

Not all the paediatric deaths were selected for review. The chairperson and secretary of the PDA committee examined all files and selected those for review based on suspected clinical mismanagement.

Data analysis

The hospital has a standard form for paediatric death review, but does not use international classification systems. Modifiable factors were analysed using the 3-delay model (i.e., the delay at the hospital) and root cause analysis. No data on neonatal and paediatric death trends, audited deaths, recommended changes, or frequency of death audit meetings were displayed.

Tables 2 and 3 show PDA using an electronic digital tool (Comcare application)—an electronic tool used by the MIHR-USAID project for data savings and analysis.

Recommendations and implementing changes

These are based on the identified modifiable factors contributing to death. These include a lack of medical supplies, poor enumeration of healthcare workers, delayed referral of critical cases, power shortages, and a shortage of healthcare workers in the hospital.

Members were designated to follow up on recommendations based on their responsibilities. Other recommendations were assigned to the hospital CEO or administrators. The hospital has a process for reporting to the PDA committee on the progress of recommended actions. However, implementation challenges include issues such as unpaid salaries for months, a lack of financial resources, difficulty in reaching supporting partners like UNICEF, competing priorities, inadequate communication, weak referral systems, and a lack of community engagement.

Positive changes based on mortality audit recommendations

According to participants, introducing PDA significantly reduced mortality at this paediatric referral centre over the past 1.5 years. However, improvements are needed in areas like record-keeping, patient assessment, investigation, and treatment. PDA has also led to improvements in hospital ward organisation, enhanced patient attendance, regular clinical rounds, triage training, instruction of new interns, daily meetings, and clinical note documentation.

Table 2. Number of deaths recorded by health facility staff using digital death notifications, April-September (2024)

Type of Death by Period	Female	Male	Total death notifications
Child death (12 to 59 months)	77	104	181
Early neonatal death (0 to 7 day of life)	21	27	48
Late neonatal (8 to 28 days of life)	2	2	4
Post-neonatal (29 days to less than one year)	38	49	87
Total	138	182	320

Source: MIHR monthly death audit report-2024

Table 3. Timeline

Timeline between admission and death	Female	Male	Total audited deaths
Over 7 days	0	2	2
Before 3 hours	0	1	1
Less than 7 days	1	1	2
6-12 hours	0	2	2
3-6 hours	2	2	4
12-24 hours	4	3	7
24-48 hours	5	3	8
Total	12	14	26

Source: MIHR monthly death audit report-2024

Discussion

This assessment was conducted to describe the experience and status of PDA implementation at Al-Sabah Children's Hospital and to provide recommendations for improvement.

A supportive policy for PDA helps implementation, but does not ensure translation into practice. South Sudan has yet to release a ministerial order on the implementation of PDA at the community, facility, county, and state levels. Al-Sabbah Hospital is the only facility in South Sudan that uses PDA. Most PDA implementation efforts are led by partners such as MIHR, WHO, and UNICEF. Hence, health care workers and some managers believe that PDA is a partner-led intervention that delays ownership countrywide.

Despite the lack of national guidelines for PDA implementation, WHO tools were successfully used to conduct neonatal and paediatric mortality audits at the hospital. This was because review meetings were led by qualified medical cadres, such as paediatricians, who were fully informed about the process.[9]

The PDA process is well embedded in the hospital. However, the state and national health level authorities lag behind.

The survey found that partners and hospital administrators initiated most capacity-building and skills-transfer activities. This could be due to a lack of resources or leadership.[10] Prevailing principles dictate that country health authorities assume full responsibility for the quality of care, including PDA, and utilize review results and recommendations to improve healthcare quality and policymaking.[11,12] This study also indicated that all neonatal and paediatric fatalities in the hospital are notified, unlike maternal and perinatal deaths. Community engagement remains inadequate.

Despite improvements in hospital recording, gathering information from registers and patient files remains difficult due to poor documentation. Irregular salary payments may demotivate staff, as noted in our previous study.[10] The study also indicated that ICD-PM and ICD-PD are not used to standardise causes of death, and mortality audit statistics are not displayed anywhere within the facility.[13] Modifiable factors contributing to newborn and paediatric fatalities, precise and actionable suggestions, and designated personnel to follow up on recommended activities were clearly described in all of the evaluated death audit forms.

Most of the PDA committee's suggested changes were not adopted. This could be linked to insufficient financial resources. The Abuja Declaration states that health should receive at least 15% of the country's annual budget.[14]

All assessed death review documents demonstrated good confidentiality. However, having a formal code of conduct that states that individual staff names should not be included in meeting discussions, and no names should be included in audit documents.[15] Although PDA committee members should sign a document underlying this practice, no such form exists in the facility.

Supportive policy and political environment

South Sudan lacks a law or ministerial order to institutionalise and implement PDA, with Al-Sabbah Hospital being the only facility practising it. Partners like MIHR, WHO, and UNICEF have been largely responsible, giving the impression that PDA is a partner-led initiative.

The lack of coordination among different levels of health structures (National, States, and Counties), irregularities in government salaries, inadequate resources, and the MOH's commitment to governance hinder effective implementation of PDA.

To address these challenges, the MOH should prioritise the signing of pending health policy documents (the Child Health Survival Strategy) and coordinate monthly PDA review meetings and the submission of reports.

Lessons learned

- Systematic data collection arising from a standardised approach to PDA reviews has the potential to generate the first official database development on under-five mortality in South Sudan.
- Initiating and setting up PDA is a process that requires collective efforts from all child health partners.
- Involvement of health authorities at the MOH to ensure a nationwide set-up of PDA.
- Committed and dedicated health care providers ensure the sustainability of PDA.
- Adequate financial resources are needed to address identified gaps.
- While PDA is meant to improve the quality of care for children, awareness and community engagement are necessary to enhance sustainability.

Obstacles to implementing PDA

- Lack of financial resources for implementation of death review recommendations, lack of community engagement, and lack of MOH support.
- Patients disappear from the hospital because of financial constraints or a perception of poor services.
- Lack of qualified human resources, especially nurses.
- Lack of essential laboratory investigation.
- Late referrals from lower-level health facilities.
- Lack of resuscitation equipment and essential medical consumables.
- Lack of reliable sources of oxygen.

- With the expansion of Juba city, the hospital facilities have not kept pace with the increasing influx of patients

Conclusion

Although not officially endorsed by state and national health authorities, PDA is well implemented at Al-Sabbah Children's Hospital. The assessment recommends replicating PDA in other national and state hospitals, and forming and training PDA committees to standardise the classification of neonatal and paediatric causes of death. Adequate funding is crucial.

The study recommends:

1. Development and dissemination of PDA national guidelines.
2. Expand PDA to health facilities across the country.
3. Refresh training for facility PDA committees with emphasis on ICD-MM, ICD-PM, display of mortality data, and code of conduct.
4. Engagement of Boma health workers in reporting and collecting information on deaths in the community.
5. Increase budget allocation for health in general and Maternal, Neonatal and Child Health (MNCH) to ensure staff motivation, purchase of essential medicines, and resources.
6. Explore potential linkages between PDA and Maternal and Prenatal Death Surveillance Response (MPDSR) reviews in facilities that only implement MPDSR, ensuring PDA also occurs.
7. PDA activities are funded by activities, but there is a need for the MOH or the hospital to take ownership.

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References

1. Duke T, Irimu G, Were W. New WHO guidelines on paediatric mortality and morbidity auditing. Archives of Disease in Childhood. BMJ Publishing Group; 2019;104:831–2.
2. Mugo N, Zwi AB, Botfield JR, Steiner C. Maternal and Child Health in South Sudan: Priorities for the Post-2015 Agenda. Sage Open. 2015 Jun 19;5(2).
3. Integrating severe acute malnutrition into the management of childhood diseases at community level in South Sudan. 2013. Available from: www.malariaconsortium.org/resourcespublications/add-type/learning-papers
4. Gijzen S, L'Hoir MP, Boere-Boonekamp MM, Need A. Stakeholders' opinions on the implementation of Child Death Review in the Netherlands. BMC Res Notes. 2016 Apr 21;9(1).
5. Duke T, Irimu G, Were W. New WHO guidelines on paediatric mortality and morbidity auditing. Archives of Disease in Childhood. BMJ Publishing Group; 2019;104:831–2.
6. Survival Program C. Maternal and Perinatal Death Surveillance and Response Capacity-Building Materials: MDSR module Facilitator's Guide. Available from: www.mcsprogram.org
7. Maternal and Perinatal Death Surveillance and Response Capacity-Building Materials: MDSR module Facilitator's Guide. Available from: www.mcsprogram.org
8. Kumar Poloju K. New Method Of Data Collection Using The Kobo Toolbox 1. Article in The Journal of Positive Psychology. 2022;6(4):1527-1535 Available from: https://www.researchgate.net/publication/359992761
9. Shaw K, Kenyon S, Pease A, Spry J, Routledge G, Garstang JJ. Child death review: Understanding variations in practice using normalisation process theory. BMJ Paediatr Open. 2025 May 27;9(1).
10. Malel ZJ, Lueth GD, Ayuel MM, Singba ND. Quality of care in South Sudan and its associated factors, a facility-based cross-sectional study in public health facilities in Yambio County, Western Equatoria State. BMC Health Serv Res. 2024 Dec 1;24(1).
11. Mgawadere F, Kana T, Van Den Broek N. Measuring maternal mortality: A systematic review of methods used to obtain estimates of the Maternal Mortality Ratio (MMR) in low- and middle-income countries. Vol. 121, British Medical Bulletin. Oxford University Press; 2017. p. 121–34.
12. Rowe LA, Brillant B, Cleveland E, Dahn BT, Ramanadhan S, Podesta M, et al. Building capacity in health facility management: guiding principles

for skills transfer in Liberia. 2010. Available from: http://www.human-resources-health.com/content/8/1/5

13. Gaikwad HS, Nagpal K, Ahuja P, Mittal P. Utility of ICD-PM Classification in Assigning Cause of Death in Stillbirths in a Tertiary Care Hospital in North India. Journal of South Asian Federation of Obstetrics and Gynaecology. Jaypee Brothers Medical Publishers (P) Ltd; 2024;16: 471–5.

14. Nahad Sadr-Azodi A, Marisol Rodríguez M. Following the 2001 Abuja Declaration of committing 15 percent government expenditure on health, is Africa making progress towards universal health coverage? 2018.

15. Country M, Leadership G. Strategies For Deploying Pediatric Death Audit To Improve Quality Of Care Momentum Country And Global Leadership Momentum-Strategies For Deploying Pediatric Death Audit To Improve Quality Of Care 2. 2024.

Communities Act Against Hunger and Malnutrition

In neighbouring South Sudan, Bol Ayak, a community social worker and volunteer is assuming local heroism for the children in the communities of Ombaci Payam in the restive Yei River State. Once a week, Ayak volunteers to travel over 160 kilometres by motorbike to Juba Teaching Hospital, the capital of South Sudan. Here, he can meet health workers and share the progress report of children in his community.

A recent study showed that only 18 of Yei River County's 40 health facilities are functional. However, they lack some basic services such as drugs, personnel and bed capacity to handle the needs of its people who are mostly displaced by war.

At Juba Teaching Hospital, health workers rely on Ayak's report to determine the supplies needed by the children. Ayak then takes the medicine, food rations, and recommendations back to the community. "I usually receive around 20 mothers daily at my home as early as 5:30 a.m., waiting in my compound for attendance," he said.

The model is simple. After receiving the cases, mothers and other community members mobilise for fuel to support his movement to the city hospital for the treatment and food rations.

"The community members always contribute some fuel for me to put in my bike to ride every Monday to go to Juba Teaching Hospital to secure this food stuff for their babies. I am not being paid, but it's just the love for children and the experience I have that gives me the strength to carry on this task."

Beyond the medicine and food supplies, he is mobilising communities to build capacity to manage feeding patterns for children in the community through backyard gardening. "The mothers are now adapting to backyard vegetable gardens to improve the quality of meals especially for children," he said.

https://allafrica.com/stories/202509090069.html?utm_campaign=daily-headlines&utm_medium=email&utm_source=newsletter&utm_content=aans-view-link

Prevalence of anaemia among pregnant women attending the antenatal clinic at Bor State Referral Hospital

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ABSTRACT

Introduction: Anaemia is a condition in which the number of red blood cells or the haemoglobin concentration within them is lower than normal, leading to insufficient oxygen being delivered to organs and tissues. It mainly affects women and children and is a public health concern affecting particularly people in low- and middle-income countries (LMICs). The most common causes of anaemia in pregnancy are iron deficiency and haemoglobinopathy. In 2019, the WHO estimated the prevalence of anaemia in pregnant women in South Sudan to be 40%. The objectives of this study were to determine the prevalence of anaemia among pregnant women attending the antenatal clinic (ANC) at Bor State Hospital and the associated risks for anaemia.

Method: A cross-sectional hospital-based study was conducted in the ANC between August 17 and September 23, 2022. The haemoglobin level of each participant was measured by the researcher using the HemoCue Hb 301 device. A structured questionnaire was used to collect demographic details, clinical characteristics, and data related to risk factors.

Results: A total of 384 pregnant women attending the ANC were enrolled. The prevalence of anaemia using the WHO definition was 45.3% (95% Confidence Interval 40.3% - 50.3%). 25% with anaemia had severe or very severe anaemia, 43% had moderate anaemia, and 33% had mild anaemia, based on the WHO/CDC classification. The clinical characteristics associated with anaemia in pregnancy were teenage pregnancy, grand-multigravidity, and being underweight (BMI). The risk factors found to be significantly associated were 'diet containing meat less than three times in one week', bleeding related to obstetric complications within the previous two years, malaria within one year, and birth interval less than three years.

Conclusion: Anaemia is a significant problem found in 45.3% of pregnant women in Bor, which is very high compared to data available from other East African countries. The study identified risk factors and patient characteristics associated with anaemia, which require validation in further research. All stakeholders should be involved in preventing, identifying, and managing anaemia in pregnancy.

Keywords: anaemia in pregnancy, iron deficiency anaemia, risk factors, predictors, prevention strategy

Introduction

The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) define anaemia differently depending on age, sex, and pregnancy status. Anaemia in pregnancy is defined as haemoglobin of less than 11g/dL throughout pregnancy.[1] This may be further divided into mild (10-10.9g/dL), moderate (7-9.9g/dL), and severe anaemia (<7g/dL).[2]

In 2015, the WHO estimated that globally, 36.6% (32.4 million) pregnant women were anaemic. Southeast Asia and Africa share 48.7% and 46.3% respectively, of the anaemia burden.[3,4] A Lancet series (2013) on maternal and child undernutrition reported that 37% (32 million) of pregnant women aged 15–49 years were affected by anaemia, with sub-Saharan Africa carrying the highest burden at 56%.[4]

Anaemia in pregnancy has serious consequences for the mother and the baby: premature births, low birth weight, foetal cognitive impairment, and death.[5] South Sudan has one of the highest maternal mortality ratios at 1,223 per 100,000 live births.[6] Globally, approximately 23% of maternal deaths are caused indirectly by anaemia, with the majority of deaths occurring in low and middle-income countries (LMICs).[7] Most deaths occur during delivery and postpartum. Anaemia aggravates the sequelae of postpartum haemorrhage and predisposes to puerperal infection, both of which are leading causes of mortality in LMICs.

A contributor to anaemia in South Sudan is malaria, and the whole population of Bor is vulnerable.

Data on prevalence and determinants of anaemia during pregnancy in South Sudan are scarce. Therefore, this study aimed to address this issue.

Method

The research proposal was approved by Jonglei Health Sciences Institute, Research Ethics Board, and access to the antenatal clinic (ANC), Bor State Referral Hospital (BSRH) was granted.

A cross-sectional study was designed to determine the prevalence of anaemia in pregnancy, using the WHO definition of <11 g/dL, among women who attended ANC. The colorimetric method to estimate haemoglobin used the HemoCue Hb 301 device (Angelholm, Sweden). HemoCue Hb 301 machine estimates haemoglobin using the hemiglobincyanide method, using two wavelengths 506 and 880 nm for spectrometric analysis. It has a sensitivity of 75%-91% and a specificity of 88%-100%. [8]

Bor State Referral Hospital is a public hospital in Jonglei State and one of two teaching hospitals in greater Jonglei. It is the state's major referral centre, serving 11 counties and a population of over 1 million. It receives patients from neighbouring states, the Lake State, the Pibor administrative area, and a few foreigners. The hospital handles about 1,000 deliveries annually. At the ANC, on average, 30 women are seen each day, each from Monday through Friday.

The sample size for this study was determined by the available statistics in the country in 2022. Data from the World Bank estimates in 2019 found that the prevalence of anaemia among pregnant women in South Sudan was 40%.[9] The sample size in our study was determined, with a possible 5% error and a 95% CI, as 369 (adjusted to 385 to account for possible wastage of sampling kits).

The study variables were the prevalence of anaemia (< 11 g/dL) and the assessment of risk factors and clinical characteristics for anaemia, determined by administering a structured questionnaire after a face-to-face interview with the women.

Results

A total of 384 pregnant women attending ANC between August 17 and September 23, 2022, were randomly selected. Table 1 shows the socio-demographic details.

Prevalence of anaemia

Table 2 shows that the prevalence of anaemia was 45.3% (95% Confidence Limits: 40.3% - 50.3%).

The pregnant women found with anaemia were categorized into mild (10-11 g/dL), moderate (7- 9.9 g/dL), severe (< 7 g/dL), and very severe (< 4 g/dL). (Table 3).

Clinical characteristics of pregnant women and prevalence of anaemia

The prevalence of anaemia in pregnant women with any of four clinical characteristics namely teenage pregnancy, trimester of pregnancy, multi-parity and underweight, as assessed by body mass index (BMI) of less than 18.5 were evaluated (Table 4); 52.7% of those aged 15-19 years, 59.7% of grand multigravida women and 67.5% of underweight women were anaemic. There was an association with the second trimester, as it is physiologically common at this stage.

Table 1. Demographic details of study population N=384

Variable	n (%)
Age (years)	
15-19	74 (19.3)
20-34	201 (52.3)
35-45	109 (28.4)
Parity	
Primigravida	129 (33.6)
Multigravida	178 (46.4)
Grand multigravida	77 (20.1)
Occupation	
Farmers	120 (31.3)
Hairdressers	32 (8.3)
Fish sellers	89 (23.2)
Housewives	143 (37.2)
Marital status	
Married	350 (91.2)
Widowed	34 (8.8)
Trimester at time of study	
First	178 (46.4)
Second	151 (39.3)
Third	55 (14.3)

Table 2. Prevalence of anaemia in pregnant women attending the ANC clinic

Key Variable	Anaemia	95 % Confidence Intervals	
	n (%)	LL	UL
Anaemia	174 (45.3)	40.3%	50.3%

Table 3. Severity of anaemia

Variable	n (%)
Mild anaemia (10-10.9 g/dL)	57 (33)
Moderate anaemia (7.1-9.9 g/dL)	74 (43)
Severe anaemia (4.1-7 g/dL)	38 (22)
Very severe anaemia (<4 g/dL)	5 (3)

As shown in Table 4, when the test for significance using the prevalence ratio was used, teenage pregnancy, grand multigravida, and underweight (BMI) were significantly associated with anaemia. The first trimester of pregnancy was not significantly associated with anaemia. The second trimester of pregnancy was significantly associated with anaemia, as there are physiological changes leading to haemodilution.

Risk factors and prevalence of anaemia

Five risk factors for anaemia were considered, namely, diet (meat less than thrice weekly), excessive bleeding within the last two years, consuming iron supplements for less than 120 days, having had malaria within the year, and a birth interval of less than three years (Table 5 and bivariate analysis for significance).

There were no vegetarians; all consumed some form of meat. Two hundred (52.1%) women had a history of unusual or excessive bleeding within the last two years. Of which none had bleeding haemorrhoids but 49 (28.2%) complained of menorrhagia, 23 (13.2%) gave a history of a miscarriage and 56 (32.2%) of antepartum or postpartum haemorrhage within two years before current pregnancy; 134 (34.9%) had not had any iron supplements during the current pregnancy and 251 (65.4%) had less than 120 days of iron supplements. At least one malaria attack was experienced by 233 (60.7%) in the previous year. Out of the women who had had malaria, 27 women (11.6%) had had five or more episodes of malaria in the previous year. 129 women were pregnant for the first time (primigravida). Of the remaining 255 women, 200 (78.4%) had a birth interval of less than 3 years between the current and previous pregnancies.

Discussion

Prevalence of anaemia in pregnant women

This is the only reported study from South Sudan to have assessed the prevalence of anaemia in pregnancy using haemoglobin assessment. The prevalence of anaemia was high at 45.3% (95% Confidence Interval: 40.3 – 50.3). The WHO considers anaemia a severe public health problem if the prevalence is >/= 40%.[2] A study of pregnant women from South Sudan in a refugee/returnee camp in Western Ethiopia found the prevalence of anaemia to be 36%.[10]

The WHO/World Bank estimates of anaemia in pregnancy in South Sudan in 2019 were 40 %,[9] which is very close to our finding. However, a recent review[11] quotes the prevalence of anaemia in pregnancy in South Sudan at 60-61% but does not refer precisely to the population sources. The prevalence of anaemia among pregnant women in East African countries ranges from 23.36% in Rwanda to 57.10% in Tanzania.[12]

Risk factors for anaemia in pregnancy

The study also examined predictors and risk factors that may lead to anaemia in pregnancy. The predictors and risk factors were those already known to cause anaemia. A study in Ghana found that low education level, number of pregnancies, and number of children a woman had were significant determinants of anaemia during pregnancy.[13]

Teenage pregnancy, low BMI, and grand multiparity were found to be associated with anaemia in this study.

Since its independence in 2011, South Sudan has struggled economically, leading to food shortages among other calamities. Recent reports by the UN state that 7.7 million people face food scarcity, which is nearly 50% of the population.[14] Reasons contributing to this are climate change and the recent war in neighbouring Sudan.[15] Many children and women are adversely affected by this, giving rise to malnutrition and probably anaemia. This study found that low BMI and a low-iron diet predict anaemia in pregnancy.

Teenagers are generally prone to anaemia because their growth spurt increases iron requirements.[16] Also, South Sudan has one of the highest rates of child marriage, with more than half the girls being married off at or before 18 years of age.[17]

Table 4. Clinical characteristics associated with anaemia in pregnancy

Characteristic	Prevalence	Prevalence Ratio
Teenage pregnancy	52.7%	1.2
First trimester	44.9%	0.98
Second trimester	49.7%	1.17
Grand multi gravida	59.7%	1.43
Under weight (BMI)	67.5%	1.9

Excessive bleeding within the previous two years, having a diet low in iron and its enhancers (meat), attacks of malaria in the previous year, and a birth interval of less than three years were included in the study and found to be significantly associated with anaemia. All these conditions increase the demand for iron.

South Sudan has a very high burden of malaria, with the 2019 Integrated Disease Surveillance and Response report of the WHO stating that 66.8% of outpatient morbidity and 50% of mortality are due to malaria.[18]

This study found that teenage pregnancy, multiparity, and low weight (BMI) were predictors of anaemia with low dietary iron intake, excessive bleeding within two years, malaria within one year, and a birth interval of less than three years to be significantly associated with anaemia in pregnancy.

Conclusion

The study was a preliminary investigation to estimate the prevalence of anaemia in pregnancy and identify significant risk factors. The World Health Assembly has set a goal of reducing anaemia in pregnancy by 50% between 2012 and 2025. With limited data on whether South Sudan is on track to reach this goal, this study in Bor in 2022 aimed to determine the prevalence and risk factors.

The prevalence of anaemia in pregnancy in this study of 45.3% is higher than previous estimates. In a resource-constrained environment such as South Sudan, routine haemoglobin testing is not performed in ANC clinics. The risk factors identified as statistically significant in this study should be considered predictors of anaemia. Midwives and other healthcare providers in ANCs should be aware of these predictors and provide targeted testing and treatment with iron (120-180 mg of elemental iron per day).

Table 5. Risk factors for anaemia in pregnancy

Risk factors	Prevalence	Prevalence ratio	95% CI		Prevalence
			LL	UL	
Dietary habit*	61.3%	1.75	1.4	2.17	<0.0001
Bleeding within two years	64%	2.56	1.96	3.36	<0.0001
No iron or less than 120 days of iron supplements	51%	1.47	1.13	1.92	0.0021
Malaria in the previous year	67.4%	5.98	3.79	9.45	<0.0001
Birth interval <3 years	51.5%	3.54	1.84	6.81	<0.0001

References

1. World Health Organization. Iron deficiency anaemia assessment, prevention and control: A guide for programme managers. Geneva: World Health Organization 2001;132.
2. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. World Health Organization 2011. https://iris.who.int/handle/10665/85839
3. UNICEF and World Health Organization. Progress on sanitation and drinking water: 2015 update and MDG assessment. 2015: World Health Organization. https://www.who.int/publications/i/item/9789241509145
4. Stevens GA, Finucane MM, De-Regil LM et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. The Lancet Global Health. 2013 Jul 1;1(1):e16-25.
5. Georgieff MK. Iron deficiency in pregnancy. Am J Obstet Gynecol. 2020 Oct;223(4):516-524. httpps://doi.org/10.1016/j.ajog.2020.03.006 Epub 2020 Mar 14.
6. iAHO Integrated African Health Observatory, World Health Organization Maternal Mortality Regional analytical fact sheet. 2023 https://www.developmentaid.org/api/frontend/cms/file/2025/02/iAHO_Maternal_Mortality_Regional_Factsheet.pdf
7. Black RE, Victora CG, Walker SP et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 2013;382:427–51. https://doi.org/10.1016/S0140-6736(13)60937-X.
8. Fothergill A, Crider KS, Johnson CB, Raj MP, Guetterman HM, Bose B, Rose CE, Qi YP, Williams JL, Kuriyan R, Bonam W, Finkelstein JL. Comparison of Anemia Screening Methods Using Paired Venous Samples in Women of Reproductive Age in Southern India. J Nutr. 2023 Jan 14;152(12):2978-2992. doi: 10.1093/jn/nxac218. PMID: 36130238; PMCID: PMC9840000.
9. World Bank. Development indicators. South Sudan- Prevalence of Anaemia among pregnant women https://tradingeconomics.com/south-sudan/prevalence-of-anaemia-among-pregnant-women-percent-wb-data.html
10. Alemayehu A, Gedefaw L, Yemane T, Asres Y. Prevalence, Severity, and Determinant Factors of Anaemia among Pregnant Women in South Sudanese Refugees, Pugnido, Western Ethiopia. Anaemia. 2016;2016:9817358. https://doi.org/10.1155/2016/9817358. Epub 2016 Dec 12.
11. Elioba JLR, David WN, Margret AH et al Anaemia in Pregnancy in South Sudan: Challenges, Interventions, and Pathways to Improved Maternal Health Outcomes https://academicstrive.com/OJGOMC/OJGOMC180052.pdf
12. Liyew AM, Tesema GA, Alamneh TS et al. Prevalence and determinants of anaemia among pregnant women in East Africa; A multi-level analysis of recent Demographic and Health Surveys. PLoS One. 2021 Apr 27;16(4):e0250560. https://doi.org/10.1371/journal.pone.0250560
13. Tettegah E, Hormenu T and Ebu-Enyan NI. Risk factors associated with anaemia among pregnant women in the Adaklu District, Ghana. Front. Glob. Womens Health 2024;4:1140867. https://doi.org/10.3389/fgwh.2023.1140867
14. UN news, Global perspective, human stories. Famine stalks two counties in South Sudan as fragile peace is threatened https://news.un.org/en/story/2025/06/1164311#
15. World Food Program, South Sudan Recent Conflict & Growing Hunger. https://www.wfpusa.org/place/south-sudan/
16. Shaka MF, Wondimagegne YA. Anemia, a moderate public health concern among adolescents in South Ethiopia. PLoS One. 2018 Jul 17;13(7):e0191467. doi: 10.1371/journal.pone.0191467. PMID: 30016373; PMCID: PMC6049899.
17. Unicef, Child marriage: a threat to the lives and future of girls in South Sudan. https://www.unicef.org/southsudan/lets-change-picture
18. WHO Knowledge management series for health. Malaria in South Sudan, the past present and future. https://www.afro.who.int/sites/default/files/2025-03/Knowledge%20Management%20Series%20for%20Health_Malaria%20in%20South%20Sudan_%20Past%20Present%20and%20Future.pdf

Research Article

The impact of dietary compliance on diabetic foot ulcer healing: A cross-sectional study

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ABSTRACT

Introduction: Diabetic foot ulcers (DFUs) are a major complication of diabetes mellitus and are influenced by various factors, including dietary behavior. Proper diet adherence is essential for glycemic control and tissue regeneration, yet its role in ulcer healing remains underexplored.

Method: This cross-sectional study involved 100 type 2 diabetes mellitus patients with DFUs receiving home-based care in a community setting. Dietary compliance was measured using a structured questionnaire based on the 3J principle (meal timing, type, and portion). Ulcer healing was evaluated using the Wagner grading system. Data were analyzed using chi-square and logistic regression tests with SPSS 25.0.

Results: Among patients with high dietary compliance, 73.3% showed significant ulcer healing, compared with 42.5% in the low-compliance group ($p = 0.008$). Dietary compliance was a significant predictor of ulcer healing (OR = 3.18; 95% CI = 1.41–7.15).

Conclusion: Higher dietary compliance was associated with better short-term healing of diabetic ulcers. While integrating nutrition education into home care services may be a valuable component of DFU management, our findings cannot confirm its independent effect, and further prospective research is warranted to determine causality and underlying mechanisms.

Keywords: diabetic foot, diet therapy, wound healing, patient compliance, diabetes mellitus

Introduction

Diabetes mellitus is a chronic and progressive metabolic disorder affecting over 537 million adults globally, and its complications place significant burdens on individuals and healthcare systems.[1] One of the most serious complications is diabetic foot ulcers (DFUs), which are associated with prolonged healing times,[2] infection, amputation, and increased mortality risk.[3] Impaired wound healing in diabetes is multifactorial, involving hyperglycemia-induced neuropathy, vascular insufficiency, and compromised immune response.[4]

Effective DFU management requires a multifaceted approach, with glycaemia control playing a central role.[5] Dietary compliance is a key modifiable factor that affects glucose levels and the physiological environment for wound healing.[6] However, most existing studies have focused on clinical interventions such as debridement and topical agents, while the specific influence of dietary adherence on DFU healing remains underexplored, particularly in non-hospital settings.[7]

This gap is particularly critical in low-resource settings, where access to specialized care is limited. There is a lack of research examining how structured dietary adherence influences DFU outcomes within home care models that involve family participation and community-based health services. This study offers a novel contribution by evaluating the impact of dietary compliance, as measured by the 3J principles (timing, portion, and type of food), on DFU healing among people living with diabetes receiving community-based home care in Indonesia. The integration of wound monitoring, nutrition education, and spiritual support in the home setting provides a holistic and contextually relevant model of care.

The concept of dietary compliance in this study is guided by the Indonesian Ministry of Health's "3J" principle, which emphasizes Jadwal (meal timing), Jumlah (portion size), and Jenis (food type). These components are critical for maintaining glycemic control and optimizing nutrient intake, making them a suitable framework for assessing dietary behavior in diabetic patients. The findings aim to inform more effective dietary interventions within home care frameworks to accelerate ulcer healing in diabetic patients.

Method

Study design and setting

This study employed a cross-sectional analytical design conducted between January and July 2024 in the community service area of a hospital in Central Java, Indonesia. The research was embedded within an ongoing community-based home care wound management program for patients with type 2 diabetes mellitus.

Study population and sample

The study population consisted of patients diagnosed with type 2 diabetes mellitus and diabetic foot ulcers (DFUs) who were receiving home-based wound care. Inclusion criteria included: (1) age ≥18 years, (2) presence of a DFU classified as Wagner grade 1 or 2, (3) undergoing regular home visits for wound care, and (4) consent to participate. Patients with severe cognitive impairment or active infection requiring hospitalization were excluded. The minimum sample size was calculated using the formula for a cross-sectional study, where Z = 1.96 (95% confidence level), p = 0.5 (estimated proportion of dietary compliance due to lack of prior data), and d = 0.1 (10% precision). The calculated minimum sample size was 96 participants. Considering potential non-response, we recruited 100 participants. A total of 100 participants were selected using purposive sampling, ensuring variability in dietary adherence levels and ulcer status. The complete participant recruitment process is illustrated in Figure 1.

Data collection instruments

Dietary Compliance Questionnaire: A structured and validated instrument, adapted from the Indonesian Ministry of Health's 3J principle—Jadwal (Meal timing), Jumlah (Portion), and Jenis (Food type)—was used to assess dietary compliance. Responses were scored on a

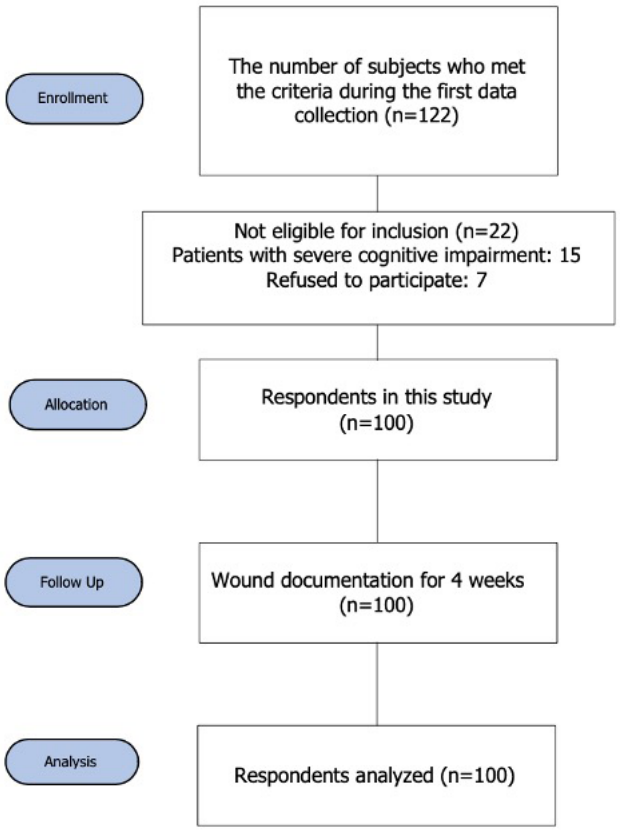

Figure 1. Flow diagram for participant assignment in this study

4-point Likert scale (1 = never, 4 = always), with total scores ranging from 12 to 48. In the absence of validated cut-off points for the 3J compliance scale, participants were categorized into high dietary compliance (>median) and low compliance (≤median). The median score of 36 was the most frequent value in the distribution, resulting in slightly unequal group sizes (60% vs. 40%). The dietary compliance questionnaire consisted of 12 items covering: (1) Jadwal – eating at consistent times to maintain glucose stability; (2) Jumlah – controlling portions, particularly of carbohydrates; and (3) Jenis – choosing foods with low glycaemic index, adequate fiber, and balanced macronutrients, including lean proteins and healthy fats. Validity was assessed using Pearson correlation, with all item-total correlations greater than 0.3 considered acceptable. The instrument showed good internal consistency (Cronbach's alpha = 0.82). We note that dietary compliance was self-reported and thus may be subject to recall bias.

Wound healing assessment: DFU healing status was assessed using the Wagner classification during routine home visits by trained nurses. Healing was defined as either a reduction in Wagner grade or complete epithelialization.

Demographic data: Age, sex, duration of diabetes, educational level, and comorbidities were recorded. Comorbidities were recorded as a binary variable (yes/no), based on the presence of at least one diagnosed chronic condition as noted in medical records. These included hypertension, dyslipidaemia, peripheral arterial disease, chronic kidney disease, and other metabolic or cardiovascular conditions.

Data collection procedures

Nurses trained in diabetic wound care and health education visited participants at home twice per week. At each visit, they conducted wound assessments, reinforced dietary education, and monitored compliance behaviours. Wound status was documented weekly for a period of four weeks. The 4-week follow-up period was chosen because it aligns with the routine evaluation cycle in our home care wound management program and reflects the short-term healing potential typically expected for Wagner grade 1 and 2 ulcers. Data on lower limb amputation (major or minor), hospital admission, or death were not systematically collected, as the study's primary focus was short-term healing progression; however, we acknowledge that including these outcomes in future research would provide a more comprehensive assessment of patient recovery.

Statistical analysis

Data were analysed using SPSS version 25.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Chi-square tests were performed to examine associations between dietary compliance and wound healing outcomes. Logistic regression was used to determine whether dietary compliance independently predicted wound healing, controlling for potential confounders. A p-value <0.05 was considered statistically significant.

Table 1. Demographic and clinical characteristics of participants (N = 100)

Variable	Category	n (%)
Age	<60 years	56 (56.0)
	≥60 years	44 (44.0)
Sex	Male	38 (38.0)
	Female	62 (62.0)
Duration of diabetes	<5 years	26 (26.0)
	≥5 years	74 (74.0)
Education level	≤Elementary School	63 (63.0)
	>Elementary School	37 (37.0)
Comorbidities	Yes	48 (48.0)
	No	52 (52.0)

Table 2. Clinical and demographic characteristics by dietary compliance group

Characteristic	High compliance n (%) N=60	Low compliance n (%) N=40
Wagner Grade		
Grade 1	38 (63.3%)	20 (50.0%)
Grade 2	22 (36.7%)	20 (50.0%)
Educational Level		
≤ Elementary School	34 (56.7%)	29 (72.5%)
> Elementary School	26 (43.3%)	11 (27.5%)
Presence of comorbidity		
Yes	26 (43.3%)	22 (55.0%)
No	34 (56.7%)	18 (45.0%)

Ethical approval

Ethical approval was obtained on January 5, 2024, from a university-based health research ethics committee in Indonesia (Ref. No. 043.6/II.3.AU/F/KEPK/I/2024), in compliance with the World Health Organization (WHO) 2011 standards and the Council for International Organizations of Medical Sciences (CIOMS) 2016 guidelines.

Results

A total of 100 participants with type 2 diabetes mellitus and diabetic foot ulcers were included in the study. The mean age of participants was 58.4 ± 9.1 years; 62% were female and 38% were male. The majority of participants (74%) had lived with diabetes for more than five years, and 63% had no formal education beyond the elementary level, as shown in Table 1. Out of the total participants, 60 individuals (60%) were categorized as having high dietary compliance, while 40 individuals (40%) demonstrated low compliance based on their scores on the 3J dietary adherence questionnaire. Participants in the high-compliance group were more consistent in meal timing (≥3 scheduled meals/day), adhered to recommended carbohydrate portions, and chose low-glycaemic index foods more frequently compared to the low-compliance group.

The distribution patterns in Table 2 suggest that participants with higher dietary compliance tended to present with less severe ulcer grades, as reflected by a greater proportion in Wagner grade 1 compared to those with low compliance. This finding may indicate that consistent adherence to dietary recommendations could be associated with better ulcer status or earlier stage presentation. In Table 3, among those with high dietary compliance, 44 participants (73.3%) showed significant wound healing (i.e., improvement by at least one Wagner grade or complete epithelialization), compared to only 17 participants (42.5%) in the low dietary compliance group. The difference in healing rate between the two groups was statistically significant ($\chi^2 = 9.61$; $p = 0.002$).

Logistic regression analysis was conducted to evaluate whether dietary compliance independently predicted wound healing after adjusting for age, sex, diabetes duration, and comorbidities. High dietary compliance was found to be a significant predictor of wound healing (Odds Ratio [OR] = 3.18; 95% Confidence Interval [CI]: 1.41–7.15; $p = 0.005$), shown in Table 4.

Table 3. Distribution of wound healing outcomes by dietary compliance

Dietary Compliance	Healed n (%)	Not healed n (%)	Total n
High (n = 60)	44 (73.3)	16 (26.7)	60
Low (n = 40)	17 (42.5)	23 (57.5)	40
Total	61 (61.0)	39 (39.0)	100

Table 4. Logistic regression analysis: predictors of wound healing

Variable	OR	95% CI	p-value
High dietary compliance	3.18	1.41 – 7.15	0.005
Age ≥60 years	0.89	0.41 – 1.94	0.77
Female	1.27	0.59 – 2.75	0.54
Diabetes ≥5 years	0.92	0.39 – 2.18	0.85
Comorbidities present	0.71	0.32 – 1.56	0.39

Discussion

This study observed a statistically significant association between dietary compliance and wound healing among patients with diabetic foot ulcers (DFUs) receiving community-based home care. Participants with higher dietary compliance demonstrated a 73.3% healing rate compared to 42.5% in the lower compliance group. While multivariate analysis indicated that dietary adherence was an independent predictor of ulcer healing (OR = 3.18; $p = 0.005$), these findings should be interpreted cautiously due to the cross-sectional nature of the study and the limited follow-up period. Interestingly, the composite binary variable "comorbidity present/absent" was not a significant predictor of healing. This may reflect the heterogeneity of underlying conditions or the limitations of using a simplified binary measure. A similar observation was reported by Tehan et al. (2022), who also found that nutritional supplementation influenced early DFU healing while traditional risk factors did not show a significant impact in their population.[8]

The results are consistent with previous research indicating that nutritional status plays a critical role in tissue repair and glycaemic control.[9] Proper dietary practices such as consuming low-glycaemic index foods, maintaining balanced macronutrient intake, and adhering

to regular meal schedules are associated with better blood glucose regulation, which may create a more favourable physiological environment for wound healing.[10] Bechara et al. (2021) have similarly emphasized the association between nutrient intake and reduced risk of foot ulceration in diabetes. However, because of the study design, we cannot confirm a direct causal relationship between dietary compliance and ulcer healing; unmeasured confounders or reverse causation may also play a role.[11]

In low-resource contexts such as Indonesia, integrating structured dietary education into home care services may offer a practical approach to support patient self-management and potentially improve healing outcomes.[4,12] Nonetheless, further longitudinal or interventional studies are required to confirm whether improving dietary compliance directly accelerates healing and to explore the underlying mechanisms. Although current clinical guidelines often emphasize pharmacologic and topical interventions, fewer studies have examined the direct impact of dietary behaviours on DFU outcomes. Our findings contribute to the limited existing literature, suggesting that dietary compliance may be a modifiable and important factor. However, while dietary education was reinforced in both groups during home visits, significant differences in healing remained, indicating that education alone may not be sufficient without sustained adherence. In low-resource contexts, such as Indonesia, integrating structured dietary education into home care may be a valuable component of DFU management; however, further research is needed to confirm its independent effect. In the context of Indonesian healthcare, where access to specialist care may be limited, integrating dietary education within home care services provides a practical and sustainable model.[13,14] Empowering patients and families to implement the 3J dietary principles (timing, portion, and food type) allows for more active engagement in self-care and can reduce dependency on hospital-based treatment.[9,13]

In this study, age, sex, and comorbidities were not significant predictors of healing, which may reflect the homogeneity of the sample or context-specific influences. Other studies have reported mixed results on these variables, suggesting that their effects may be modulated by factors such as socioeconomic status, access to care, and patient engagement in self-management.[3,14] Possible mechanisms for our findings include: (a) high dietary compliance as a proxy for other positive health behaviours such as adherence to medication, smoking cessation, or ulcer offloading; (b) absence of malnutrition among high-compliance patients; and (c) better glycaemic control. Unfortunately, we did not collect detailed data on Body Mass Index (BMI), smoking status, ulcer infection status, vascular insufficiency, or HbA1c, which could help clarify these mechanisms. Future research should incorporate these variables in a prospective design to better explain the observed associations.

Study Limitations

This study used a cross-sectional design, which limits the ability to infer causality between dietary compliance and wound healing. Additionally, dietary compliance was self-reported, which may be subject to recall bias. We also note that there was a noticeable, although statistically non-significant, difference in baseline ulcer severity (Wagner grade) between the high- and low-dietary compliance groups. This imbalance may have influenced healing outcomes and should be considered when interpreting the findings. Furthermore, the use of a non-random sampling method may affect the generalizability of the results. Future studies with longitudinal designs and objective dietary assessments are recommended.

Conclusion

This study found that higher dietary compliance was significantly associated with better wound healing outcomes in patients with diabetic foot ulcers receiving home-based care. Adherence to dietary principles—especially consistent meal timing, appropriate portion sizes, and healthier food choices—was linked with improved short-term healing rates. While integrating structured nutritional education into community health and home care programs may be a valuable component of diabetic foot ulcer management, our findings cannot confirm its independent effect. Further prospective and interventional research is needed to establish causality, clarify mechanisms, and determine the most effective strategies to improve dietary adherence and ulcer healing outcomes.

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References

1. Magliano DJ, Boyko EJ, IDF Diabetes Atlas 10th edition scientific committee. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021. (IDF Diabetes Atlas). Available from: http://www.ncbi.nlm.nih.gov/books/NBK581934/
2. Lipsky BA, Berendt AR, Cornia PB, Pile JC, Peters EJG, Armstrong DG, et al. 2012 Infectious Diseases Society of America Clinical Practice Guideline for the Diagnosis and Treatment of Diabetic Foot Infectionsa. Clinical Infectious Diseases. 2012 June 15;54(12):e132–73.
3. Akkus G, Sert M. Diabetic foot ulcers: A devastating complication of diabetes mellitus continues non-stop in spite of new medical treatment modalities. World J Diabetes. 2022 Dec 15;13(12):1106–21.
4. Lee SH, Kim SH, Kim KB, Kim HS, Lee YK. Factors Influencing Wound Healing in Diabetic Foot Patients. Medicina. 2024 May;60(5):723.
5. Manisha, Niharika, Gaur P, Goel R, Lata K, Mishra R. Understanding Diabetic Wounds: A Review of Mechanisms, Pathophysiology, and Multimodal Management Strategies. Current Reviews in Clinical and Experimental Pharmacology. 2025 Aug 1;20(3):207–28.
6. Ramos-Lopez O, Milagro FI, Riezu-Boj JI, Martinez JA. Epigenetic signatures underlying inflammation: an interplay of nutrition, physical activity, metabolic diseases, and environmental factors for personalized nutrition. Inflamm Res. 2021 Jan 1;70(1):29–49.
7. Zamanifard M, Nasiri M, Yarahmadi F, Zonoori S, Razani O, Salajegheh Z, et al. Healing of diabetic foot ulcer with topical and oral administrations of herbal products: A systematic review and meta-analysis of randomized controlled trials. International Wound Journal. 2024;21(2):e14760.
8. Tehan PE, Burrows T, Hawes MB, Linton C, Norbury K, Peterson B, et al. Factors influencing diabetes-related foot ulcer healing in Australian adults: A prospective cohort study. Diabetic Medicine. 2023;40(1):e14951.
9. Ju M, Kim Y, Seo KW. Role of nutrition in wound healing and nutritional recommendations for promotion of wound healing: a narrative review. Ann Clin Nutr Metab. 2023 Dec 1;15(3):67–71.
10. Tsereteli N, Vallat R, Fernandez-Tajes J, Delahanty LM, Ordovas JM, Drew DA, et al. Impact of insufficient sleep on dysregulated blood glucose control under standardised meal conditions. Diabetologia. 2022 Feb 1;65(2):356–65.
11. Bechara N, Gunton JE, Flood V, Hng TM, McGloin C. Associations between Nutrients and Foot Ulceration in Diabetes: A Systematic Review. Nutrients. 2021 Aug;13(8):2576.
12. Pancheva R, Zhelyazkova D, Ahmed F, Gillon-Keren M, Usheva N, Bocheva Y, et al. Dietary Intake and Adherence to the Recommendations for Healthy Eating in Patients With Type 1 Diabetes: A Narrative Review. Front Nutr. 2021 Dec 16;8. Available from: https://www.frontiersin.org/journals/nutrition/articles/10.3389/fnut.2021.782670/full
13. Clemente-Suárez VJ, Peris-Ramos HC, Redondo-Flórez L, Beltrán-Velasco AI, Martín-Rodríguez A, David-Fernandez S, et al. Personalizing Nutrition Strategies: Bridging Research and Public Health. Journal of Personalized Medicine. 2024 Mar;14(3):305.
14. Natesan V, Kim SJ. Diabetic Nephropathy – a Review of Risk Factors, Progression, Mechanism, and Dietary Management. Biomol Ther (Seoul). 2021 July 1;29(4):365–72.

Review Article

Personal determinants of gender-based violence: a review of intimate partner violence in South Sudan

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ABSTRACT

Intimate partner violence is an important health concern and a human rights violation in South Sudan. It is a major form of gender-based violence with serious consequences such as physical injuries, psychological distress, and loss of employability. This study identified personal determinants that perpetuate intimate partner violence in South Sudan. The study focused on the individual factors in the context of Haise's Social Ecological Model. Literature from South Sudan and relevant contexts was used to provide factual bases for the study. The personal factors identified that influence intimate partner violence include alcohol abuse, young age, witnessing violence in childhood, and having been a victim of child abuse. Intimate partner violence is an important health problem to address to achieve equal gender relations. This is only possible when the root causes or violence determinants are identified, understood, and addressed using evidence-based strategies.

Keywords: South Sudan, sexual violence, intimate partner violence, ecological model.

Introduction

Gender-based violence (GBV) is defined as any act of violence that is inflicted upon an individual because of his or her gender or sexual orientation.[1] It includes different forms of violence, such as physical, sexual, or psychological, and harmful practices, such as child marriage, female genital cutting, sex trafficking, selective abortion, and honour killings.[2]

Intimate partner violence is defined as a pattern of abusive behaviour in an intimate relationship, including marriage, where one person uses to gain or maintain power and control over the other person.[1] Thirty-five percent of women suffer intimate-partner violence (IPV) in their lifetime worldwide.[2–4] Intimate partner violence is the major form of gender-based violence around the globe. However, the estimates for the prevalence of different forms of IPV vary by country, with some countries having lower rates of violence compared to others. Annually, it is estimated that 20-69% of women are physically assaulted, while intimate partners sexually violate between 6% and 47%.[5] IPV is rooted

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in gender inequality in male-controlled relationships that make women dependent on their intimate partners.[3] IPV is historically accepted as a normal act of enforcing discipline, and is considered a private family affair that does not need the involvement of a third party.[3] Fortunately, there is a growing international acknowledgement that IPV is an important public health issue and a human rights violation that needs to be addressed.[5,4,6]

Although it receives less emphasis, IPV is the most prevalent form of gender-based violence in South Sudan.[7,8–10] Studies estimate that 47% of women are physically assaulted, 13% are sexually abused, while 40% experience psychological violence. Gender inequality is the main driver of violence, but it is also reported that long-standing conflict in the country has contributed significantly to the increased occurrence of IPV.[8,9]

While there is growing advocacy against IPV, cultural practices continue to frustrate efforts to tackle IPV as a national health problem and a human rights abuse that needs external intervention. This way, women in South Sudan suffer IPV at the hands of their husbands without adequate protection from a third party or the law.[7]

Physical violence is the most dominant form of IPV that affects women in intimate relationships in South Sudan. It is estimated that 90% of men beat their wives for reasons such as insults, refusal to cook, sex denial, or child care neglect.[11] South Sudanese cultures condone and accept acts of violence as a way of ensuring discipline in the family.[11] Because of age-old cultural subjugation, women accept an inferior status in society, as 68% women agree that women deserve to be beaten by men for any reason.[7] These forms of physical violence include blows with fists, dragging, kicking, and beating with sticks. Ill-health consequences that result from physical violence include pain, body wounds, fractures, as well as psychological trauma.[7,10,12–14] At the family level, physical violence negatively impacts incomes because ill health puts a burden on finances and reduces labour as working hands decrease due to complications of physical injuries. It may also impede economic growth and development as the vast majority of women subjected to physical violence no longer perform their tasks to the utmost best because of injuries, psychological trauma, and resultant loss of employability.[7,10,11] Violence against women results in the loss of 1.8 million working days per year, as survivors of violence are unable to engage in regular economic productivity. The economic costs of survivor services are as high as US$1.2 million in out-of-pocket expenses, thereby exacerbating the impoverishing effects on the already impoverished population of South Sudan.[15]

Physical violence also results in severe consequences to pregnant women whose husbands engage in physical abuse.[16] In 2017, it was reported that 7% of women lost pregnancies due to violence in intimate relationships in South Sudan. This is because trauma affects the viability of the foetus, resulting in loss of pregnancy.[16]

Sexual violence in a marital context includes rape, sexual harassment, and sexual assault. Rape in a marital context is unreported in South Sudan because it is usually considered a bedroom affair that does not warrant discussion or description whatsoever.[7,8,10] Sexual violence is under-reported due to high levels of stigma and shame attached to it. It is the survivor that carries stigma and shame, while the perpetrator retains unchecked social standing because cultural norms do not consider it a serious offence.[17]

Another form of IPV is emotional violence, in which women experience psychological harm because of abusive words or rude behaviours displayed by spouses. Women are psychologically tormented with insults, humiliation in front of others, intentional intimidation, threats with weapons, and severe restriction from friends and strangers.[7,8–10] This results in mental personality disorders that impact women's quality of life and length of life. Mental disorders like chronic stress and worries lead to depression, resulting in health complications such as hypertension.[11]

This study sought to answer the question: What are the factors influencing IPV and effective interventions in South Sudan? The answer to this question helps in deciding effective strategies for IPV prevention in South Sudan.

Method

This research is a literature review that combines both published peer-reviewed articles and grey literature (i.e., that is not published through the usual academic processes). The search engines used to ascertain articles included PubMed/Medline, VU library, Google Scholar, and the Ministry of Health websites to obtain relevant IPV literature in South Sudan and other relevant contexts. Articles published in the last ten years (2010 – 2019) in the English language were preferred as there is little change in attitudes, beliefs, and cultural norms related to IPV in South Sudan over this period.

The Heise's Integrated Ecological Framework (Figure 1) was chosen for this review since it is more relevant for the analysis of IPV in the context of South Sudan. However, the focus has been on the analysis of individual factors: age,

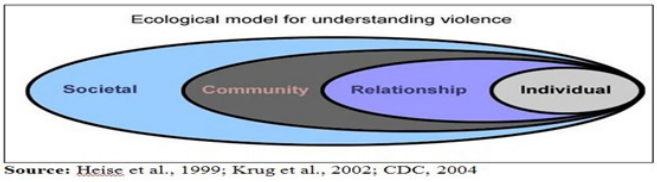

Figure 1. The Social Ecological Model.[18]

family history of violence, victim of child abuse, alcohol, refugee, or internally displaced person. The remaining factors, such as interpersonal, community, policies and society, were not included.[20]

Results

The first level of the framework explored the individual factors. The highlighted factors focused on age, family history of violence, victim of child abuse, alcohol abuse, and refugee or internally displaced person. These individual factors are known to contribute to IPV.

Age

In South Sudan, the marital age difference was found to be associated with IPV in relationships.[8] Women older than 34 years were less at risk of violence compared to younger women.[19] Additionally, young girls forced into marriages were more at risk of violence from their husbands.[8]

A WHO multi-country study also established that an age difference is a predictive factor for IPV among women in intimate partner relationships. IPV was more likely when a woman was younger than her partner by more than five years.[20] Women who were 15 years old or younger were four times more at risk of violence compared to women who were more than 15 years old.[21]

A systematic review of IPV in low- and middle-income countries also found that young women below the age of 20 years were more at risk of IPV than older women.[22] IPV was also associated with women who had been married for more than five years compared to women whose marital durations were less than five years.[21]

Looking at the types of violence perpetrated in relation to age, a multi-country research in low- and middle-income countries found that emotional IPV was less likely associated with women below 19 years old, while physical and sexual violence were associated with women aged between 25-29 and 30-34, respectively.[21] Generally, the risks of IPV decreased with increasing age of men compared to men who were younger than 34 years old, in urban Tanzania.[23] Additionally, increasing age was also associated with reduced risks of forced sexual violence, resulting in lower odds of unwanted sex.[24]

Family history of violence

Violence at the family level was reported to be rampant in South Sudan since almost every adult in an intimate partner relationship had witnessed it first-hand.[25] Several studies indicate that the history of violence in the family was strongly associated with IPV.[2,20,26] There was evidence that violence was high among couples who, in their childhood, witnessed their father abusing their mother.[2,20,26] Since the outbreak of war, 24.4% of children reported that they witnessed killings in their communities. Additionally, children admitted that they saw their fathers hitting their mothers in the household, resulting in severe physical IPV.[25]

The WHO multi-country study indicated that IPV was highest where couples admitted that both their mothers and grandmothers experienced IPV.[20] It is important, however, to note that IPV also occurred even though partners were not aware whether their parents experienced violence in the past.[20] Girls who witnessed violence in childhood and boys who witnessed someone being physically abused during their childhood were more likely to be abused or to engage in violence in intimate partner relationships compared to their counterparts who did not undergo the same experiences.[20]

Victim of child abuse

Corporal punishment of children was banned through provisions enshrined in the national constitution of South Sudan, but the implementation of these laws faced challenges.[19] The victims of childhood physical violence were more likely to perpetuate physical violence on their children in their families.[19] Boys and girls in the households were found to be victimised equally in their childhood, and mothers were more likely to inflict physical violence on children compared to fathers.[19] Childhood victims of physical violence were more likely to inflict physical and psychological harm on their spouses later in life.[19] Studies also found that much of child abuse happens in the household.[10,14] It was also found that boys sustained severe injuries from being hit with objects by parents in the household than girls.[25]

In Uganda, the major forms of child abuse were physical and emotional violence, as children were beaten and insulted with abusive words. Schools also abused children physically, as well as sexually, as some teachers were found to defile young girls in exchange for higher grades.[27]

Children with a history of physical, sexual, or emotional abuse were more likely to experience or engage in IPV in their families.[28]

Some multi-country studies recognized that children who had experienced violence in their lives were likely to be abused or inflict violence later in their families compared to children who had a childhood free from violence.[2,20] Young girls who experienced different kinds of physical, sexual, or emotional violence were more likely to experience IPV from their spouses compared to women who were not abused in their childhood.[20]

A study in Ethiopia found that women whose spouses were beaten during childhood by someone were more likely to experience IPV than women whose husbands were never physically abused by someone in childhood.[29] Although not all boys who were abused during their childhood became perpetrators of violence, some of them engaged in IPV.[20]

Alcohol abuse

In South Sudan, men were found to be more likely to drink alcohol and inflict social harm or IPV against women. Men above the age of 25 years were more likely to abuse alcohol, resulting in physical and sexual IPV compared to men below the age of 25 years.[30] The unemployed were more at risk of excessive alcohol consumption with resulting mental disorders like depression and IPV, compared to men who were employed.[30] Additionally, a study in the South Sudanese refugee settings in Uganda concluded that excessive drinking of alcohol was associated with sexual IPV, including rape.[27]

The WHO multi-country study found that women in relationships where men drank alcohol were at increased risk of IPV compared to women in relationships where neither of the couple drank alcohol.[31] Additionally, men who drank alcohol were more likely to inflict IPV compared to women who drank alcohol.[20] A systematic review of gender norms in low- and middle-income countries also confirmed that women in intimate relationships with husbands who drank alcohol were at higher risks of IPV compared to women in relationships where the husbands did not drink alcohol.[21]

A study in conflict-ridden communities of northern Uganda stated that 30% of women who experienced IPV reported that their husbands were intoxicated with alcohol.[27] Also, in a study conducted in the Sudan, men who abused alcohol were more likely to engage in physical, sexual, and emotional violence against their wives compared to men who did not abuse alcohol.[32]

Refugee or internally displaced person

A recent study about internally displaced persons (IDP) camps in South Sudan found that IPV was high among young women.[31] The study also established that women were more at risk of sexual IPV (35.2%) compared to physical IPV (30.4%) in the IDP settings in Juba.[31]

A multi-country study in refugee camps found that men in the refugee camps were more likely to have forced sex with their wives compared to men in the general population.[33] Women in the refugee and IDP camps were at a higher risk of emotional IPV compared to women in the general population.[13] Additionally, men in the IDP camps were more likely to inflict physical IPV on their wives.[13]

Discussion

This literature review shows that IPV is the leading cause of gender-based violence in South Sudan, confirming the global trends where 1 in 3 women (35%) experiences violence at the hands of their husbands. Additionally, it was noted that a study in South Sudan's IDP camps indicates that sexual violence against women was higher than other forms of IPV. This is contrary to nationwide IPV trends, where physical and emotional IPV are consistently the main forms of IPV. This finding could partly be because there is more sensitization about sexual violence in the IDP camps and partly because of improved recording and reporting of IPV incidents in the camps compared to the situation in the general population, where women are conditioned to silence by cultural norms as a way of avoiding gossip and stigma.

At the individual level of the ecological framework, child abuse is an important factor that needs to be addressed to avoid creating aggressive masculinities and loss of empathy in children. Parents should be counselled and trained on parenting programmes through group training, to avoid harsh punishment of children. This aggressive upbringing of children hardens male-dominant masculinities that are associated with IPV. It also perpetuates the cycle of violence from parents to children. Improved parenting reduces the family history of violence, which is also a significant factor influencing IPV.

Mitigation of alcohol consumption through health facility-based counselling is an effective strategy of persuading alcohol addicts to reduce or give up drinking. Alcohol consumption perpetuates all forms of IPV and also contributes to household poverty, which is also a potential cause of parental conflict and IPV.

There is a need to strengthen health facility-based counselling programmes for couples to reduce the levels of couples' frustration and sexual violence that are seen to be high. Women from IDP and refugee camps also face IPV from men returning from war with militarised masculinities. This requires advocacy and political commitment to peace building, accountability, and good governance, including the provision of economic opportunities to ex-combatants and holding perpetrators of IPV to account.

Conclusion

IPV in South Sudan is predominantly driven by personal determinants rooted in personal histories, age, and educational disparities between couples. Early childhood exposure to violence sets the precedent for the perpetuation of domestic violence. Additionally, alcohol abuse not only spurs violence, but also has a profound effect on family savings – resulting in frustration that feeds the cycle of violence. Women's low educational capacity is a risk factor for violence as it diminishes their capacity to negotiate and communicate in intimate relationships and reinforces economic dependence and vulnerability. Any interventions aimed at alleviating the vices of IPV should also address the IPV personal factors identified in this paper.

References

1. Krug EG, Dahlberg LL, Mercy JA, Zwi AB, Lozano R. World report on violence and health Edited by. World Heal Organ Geneva. 2002.
2. Krantz G, Garcia-moreno C. Violence against women. J Epidemiol Community Health. 2005;(August 2004):818–21.
3. Harvey A, Garcia-Moreno C, Butchart A. Primary prevention of intimate-partner violence and sexual violence : Background paper for WHO expert meeting. Geneva World Heal Organ. 2007;1–38.
4. Partners H. User Guide: How to Support a Survivor of Gender-based Violence when there is no GBV actor in your area. 2012.
5. Ashraf N, Bau N, Nunn N, Voena A. Bride price and female education. Journal of Political Economy. 2020 Feb 1;128(2):591-641. Bride Price and Female Education | Journal of Political Economy: Vol 128, No 2
6. García-Moreno C, Stöckl H. Protection of sexual and reproductive health rights: Addressing violence against women. Int J Gynecol Obstet. 2009;106(2):144–7.
7. Deng D, Willems R. Sexual and gender-based violence (SGBV) in Unity State, South Sudan. University for Peace UPEACE Centre The Hague, the South Sudan Law Society (SSLS) and PAX: March. 2016 Mar:4. sgbv-in-unity-state-policy-brief.pdf
8. Ministry of Health NB of S. South Sudan Household Health Survey, 2010. Vol. 91. 2013.
9. Jervase A, Tahir H, Modi JK, Almobarak AO, Mital D, Ahmed MH. HIV / AIDS in South Sudan past, present, and future : a model of resilience in a challenging context. J Public Heal Emerg. 2018;(December):2–6.
10. Salman SMA. The new state of South Sudan and the hydro-politics of the Nile Basi. Water Int. 2011;36(2):154–66.
11. Stern OM. Gender, Conflict and International Humanitarian Law: A critique of the'principle of distinction'. Routledge; 2018 Jul 27.
12. Rolandsen ØH, Glomnes HM, Manoeli S, Nicolaisen F. A year of South Sudan's third civil war. Int Area Stud Rev. 2015;18(1):87–104.
13. Tol WA, Stavrou V, Greene MC, Mergenthaler C, Van Ommeren M MC. Sexual and gender-based violence in areas of armed conflict: a systematic review of mental health and psychosocial support interventions. Confl Health. 2013;7(1).
14. Gurman TA, Trappler RM, Acosta A, McCray PA, Cooper CM, Goodsmith L. "By seeing with our own eyes, it can remain in our mind": Qualitative evaluation findings suggest the ability of participatory video to reduce gender-based violence in conflict-affected settings. Health Educ Res. 2014;29(4):690–701.
15. Elmusharaf, K., Scriver, S., Chadha, M., Ballantine, C., Sabir, M., Raghavendra, S., Duvvury, N., Kennedy, J., Grant-Vest, S. and Edopu, P., 2019. Economic and social costs of violence against women in South Sudan: technical report. Economic and social costs of violence against women in South Sudan: Technical report
16. West G. A mixed methods assessment of barriers

to maternal , newborn and child health in. Reprod Health. 2017;1–13.

17. Eyobo MB, Bepo E, Lako RL, Wani G, Julla AI, Remijo CD, et al. Malaria indicator survey 2009, South Sudan: baseline results at household level. Malar J. 2014;13(1):45.

18. Terry MS. Applying the Social Ecological Model to Violence against Women with Disabilities. J Women's Heal Care. 2014;3(6).

19. Ndoromo O, Österman K, Björkqvist K. Low Intensity Intimate Partner Aggression as a Mediating Factor for the Intergenerational Transmission of Physical Punishment of Children in South Sudan. Eurasian Journal of Medical Investigation. 2018;2(4):183-9. Low Intensity Intimate Partner Aggression as a Mediating Factor for the Intergenerational Transmission of Physical Punishment of Children in South Sudan-35220.pdf

20. Jansen HA, Garcia-Moreno C, Devries K, Heise L, Kiss L, Abramsky T, et al. What factors are associated with recent intimate partner violence? findings from the WHO multi-country study on women's health and domestic violence. BMC Public Health. 2011;11(1).

21. Semahegn, A., Torpey, K., Manu, A., Assefa, N., Tesfaye, G. and Ankomah, A., 2019. Are interventions focused on gender-norms effective in preventing domestic violence against women in low and lower-middle income countries? A systematic review and meta-analysis. Reproductive health, 16(1):93.

22. Ho U, Valladares E, Pen R, Lars A. Violence against pregnant women : prevalence and characteristics . A population-based study in Nicaragua. BJOG An Int J Obstet Gynaecol. 2005; (September): 112:1243–8.

23. Hill C. Associations between peer network gender norms and the perpetration of intimate partner violence among urban Tanzanian men: A multilevel analysis. Matern Child Health J. 2019;19(4):427–36.

24. Lindsay Stark, Khudejha Asghar, Gary Yu, Caroline Bora, Asham Assazenew Baysa KLF. Prevalence and associated risk factors of violence against conflict – affected female adolescents : a multi – country, cross – sectional study. J Glob Health. 2017;7(1).

25. Ndoromo O, Österman, Karin KB. Domestic Violence as a Risk Factor for Children Ending up Sleeping in the Streets of Post-War South Sudan. Journal of Child & Adolescent Behavior. 2017.

26. Fulu E, Jewkes R, Roselli T, Garcia-Moreno C. Prevalence of and factors associated with male perpetration of intimate partner violence: Findings from the UN multi-country cross-sectional study on men and violence in Asia and the Pacific. Lancet Glob Heal. 2013;1(4):e187–207. Available from: http://dx.doi.org/10.1016/S2214-109X(13)70074-3

27. Gottschalk N. Uganda : early marriage as a form of sexual violence. Forced Migr Rev. 2016;

28. Annan J, Brier M. The risk of return : Intimate partner violence in Northern Uganda's armed conflict. Soc Sci Med. 2010;70:152–9.

29. Abeya SG, Afework MF, Yalew AW. Intimate partner violence against women in western Ethiopia: prevalence, patterns, and associated factors. BMC Public Health. 2011;

30. Lien L, Hauff E, Martinez P, Eide AH, Swarts L, Ayazi T. Alcohol use in South Sudan in relation to social factors, mental distress and traumatic events. BMC Public Health. 2016;1–7.

31. Ali AA, Yassin K, Omer R. Domestic violence against women in Eastern Sudan. BMC Public Health. 2014;4–8.

32. Wachter K, Horn R, Friis E, Falb K, Ward L, Apio C, Wanjiku S, Puffer E. Drivers of intimate partner violence against women in three refugee camps. Violence Against Women. 2018 Mar;24(3):286-306. https://doi.org/10.1177/1077801216689163

33. Murphy M, Bingenheimer JB, Ovince J, Ellsberg M, Contreras-Urbina M. The effects of conflict and displacement on violence against adolescent girls in South Sudan: the case of adolescent girls in the Protection of Civilian sites in Juba. Sexual and reproductive health matters. 2019 Jan 1;27(1):181-91. https://doi.org/10.1080/26410397.2019.1601965

Review Article

Misdiagnosing Muslims: The hidden risk of using the CAGE questionnaire in some Islamic contexts

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ABSTRACT

The CAGE questionnaire is widely used for screening alcohol use disorders but may yield misleading results in practicing Muslim communities, where alcohol is religiously prohibited and culturally stigmatized. The four questions focus on **C**utting down, **A**nnoyance by criticism, **G**uilty feeling, and **E**ye-openers, giving the acronym "CAGE". Feelings of guilt or the desire to abstain may reflect religious conviction rather than pathological use, risking false-positive diagnoses. This paper explores the cultural limitations of the CAGE among practicing Muslims and highlights the ethical and clinical consequences of its uncritical application. It calls for greater cultural sensitivity in alcohol screening and recommends the use of alternative tools or locally validated instruments in Muslim-majority settings.

Keywords: alcohol screening, transcultural psychiatry, Islamic culture, CAGE questionnaire, substance use disorders.

Introduction

The CAGE questionnaire is a widely used screening tool for identifying individuals with potential alcohol problems. It consists of four yes/no questions that assess an individual's experience with alcohol: feeling the need to **C**ut down, being **A**nnoyed by criticism, feeling **G**uilty, and requiring a morning drink to steady nerves, "**E**ye-opener", giving the acronym "CAGE".[1] Its brevity and ease of administration have led to its widespread use in both clinical and primary care settings, particularly in Western contexts where moderate drinking is culturally accepted.[2]

However, the universal application of the CAGE, especially in Islamic cultural contexts, raises serious concerns. In Muslim-majority societies where alcohol consumption is strictly prohibited and socially stigmatized, the assumptions embedded in the CAGE become problematic. Applying this tool without cultural adaptation risks misclassification and ethical missteps.

Religious guilt vs. clinical impairment

The CAGE questionnaire relies heavily on subjective emotional responses, guilt, social criticism, and desire to change behaviour, which may not accurately reflect alcohol dependence in Islamic contexts. For instance, a devout Muslim who consumes alcohol once may answer "yes" to three of the four CAGE questions, not due to dependence, but due to guilt and social disapproval rooted in religious values.[3,4] The cultural and religious condemnation of alcohol in Islam is well-established, with explicit prohibitions in the Qur'an and Hadith.[5,6] This creates a high likelihood of false positives. Some studies among the Muslim population showed that religious beliefs significantly influenced their self-reports of guilt and regret related to alcohol use, even in the absence of problematic drinking patterns.[3,4,7] The result is a distorted clinical picture, where moral or spiritual distress is mistaken for addiction.

Why this matters now

In a Malaysian study, Muslim participants scored highest on the CAGE item assessing guilt after drinking, despite reporting the lowest alcohol consumption among all groups.[4] Moreover, the authors have encountered, in their clinical practice, numerous cases of Muslim men who, during a stressful period, consumed alcohol on a single or very few occasions and subsequently experienced deep regret. When screened using the CAGE, he answered "yes" to feeling guilty, being criticized, and wanting to stop. Despite no evidence of continued or compulsive use, the CAGE score would suggest a high risk of alcohol dependence. This can lead to inappropriate labeling or unnecessary intervention.

The second item, being annoyed by criticism, also becomes culturally biased. In conservative Islamic societies, even rare drinking behaviour can draw harsh social criticism, leading respondents to endorse this item despite having no internal struggle with alcohol.[3,4,7] Similarly, the desire to "cut down" might simply reflect an individual's wish to remain religiously compliant, rather than an indication of impaired control.[4]

Only the fourth question, needing an "eye-opener", relies more on physiological dependence. This item may be less vulnerable to cultural context, though research indicates that it is often infrequently endorsed and, on its own, lacks sufficient sensitivity to reliably identify alcohol use disorder.[8]

Tool design and cross-cultural validity

The original development of the CAGE did not consider the values and norms of Muslim-majority populations. Like many psychiatric screening instruments, it was normed on Western populations where moderate alcohol use is often seen as socially acceptable.[9,10] In contrast, in conservative Islamic cultures, the threshold for guilt or criticism is much lower, making emotional responses unreliable indicators of substance use disorders.[4]

Moreover, the broader issue lies in the uncritical export of Western-developed tools into non-Western settings. This raises questions about the cultural validity of the instrument. Without adaptation or proper validation, the CAGE risks undermining the diagnostic process and damaging trust in mental health services.[9,10]

Clinical and ethical ramifications

The misapplication of culturally insensitive screening tools like the CAGE questionnaire carries not only diagnostic risks but also significant ethical concerns. In mental health settings where trust and rapport are critical, a false positive result due to culturally driven guilt can erode the therapeutic alliance. Patients who are wrongly labeled with alcohol use disorders may face social stigma, legal consequences, or loss of employment opportunities, particularly in Muslim-majority societies where alcohol use may be criminalized or morally condemned. This risk is compounded in community mental health programs and primary care systems where mental health professionals may rely heavily on screening tools without the time or training to interpret results in light of cultural nuance.

From an ethical perspective, the principle of non-maleficence is compromised when clinicians apply tools that carry a high potential for harm through misclassification, such as causing unwarranted stigma, damaging the patient's reputation, straining family or community relationships, or prompting unnecessary interventions and referrals. Similarly, the principle of respect for persons is undermined if patients are not assessed in ways that honour their cultural and religious contexts. The lack of adaptation or disclaimers surrounding the use of CAGE in these settings reflects a broader issue in psychiatric practice, the assumption that tools developed in Western, secular contexts are universally valid. Rectifying this requires greater awareness, culturally sensitive training, and systematic evaluation of existing tools across diverse populations.

Better alternatives exist

In light of these limitations, clinicians working in Muslim contexts should be cautious when using the CAGE. In any cultural context, they should avoid labelling an individual with an alcohol use disorder based solely on a positive CAGE score. One useful alternative is the Alcohol Use Disorders Identification Test (AUDIT), which emphasizes behavioural patterns such as frequency and quantity of consumption rather than emotional responses.[11] The AUDIT has demonstrated better cross-cultural reliability and is less likely to produce false positives due to guilt alone.[12,13] Several studies reinforce the validity and reliability of the AUDIT across different cultural and linguistic contexts, and among diverse populations in various countries.[3,13,14] A longer-term solution would involve developing culturally sensitive screening tools tailored to Islamic societies. These tools could incorporate distinctions between religious guilt and psychological distress, focusing more on observable behaviour than on feelings shaped by moral doctrine.[11] Including items that explore the source of guilt (religious versus behavioural) could substantially improve specificity.

A call to action

The CAGE questionnaire, while used widely in Western contexts, has inherent limitations that make it an insufficient stand-alone screening tool even in the populations it was designed for,[15] and it poses an even greater risk of misdiagnosis when applied in practicing Muslim communities. Its reliance on feelings of guilt, social criticism, and the desire to cut down aligns poorly with the realities of alcohol use in societies where drinking is both religiously forbidden and socially condemned. This mismatch can lead to false positives, inappropriate interventions, and a loss of trust in psychiatric care.

We call for a reassessment of culturally inappropriate screening practices and urge the development of tools that respect the values and lived experiences of a significant portion of practicing Muslims. Until such tools are developed, clinicians and other healthcare staff should receive appropriate training to interpret CAGE results with extreme caution or consider avoiding its use altogether in these settings.

Author Contributions

Both authors meet the ICMJE criteria for authorship. AIA conceived the initial idea for the commentary. Both AIA and SH contributed to the development of the concept, drafting, and critical revision of the manuscript. They both approved the final version and agreed to be accountable for all aspects of the work.

Conflict of interest: None.

References

1. Ewing JA. Detecting alcoholism: The CAGE questionnaire. JAMA. 1984;252(14):1905-7.
2. Bisschop JM, de Jonge HJM, Brunsveld-Reinders AH, van de Mheen DH, Mathijssen JJP, Rozema AD. Screening instruments to detect problematic alcohol use among adults in hospitals and their diagnostic test accuracy: A systematic review. Drug Alcohol Rev. 2025 Feb;44(2):505-531.
3. Al Mousawi A. Alcohol use disorder identification test use in Muslim countries. Int J Prev Treat Subst Use Disord. 2015;1(3-4):18-37.
4. Indran SK. Usefulness of the "CAGE" in Malaysia. Singapore Med J. 1995 Apr;36(2):194-6. PMID: 7676267.
5. Tamimi Arab P. Can Muslims drink? Rumi vodka, Persianate ideals, and the anthropology of Islam. Comp Stud Soc Hist. 2022;64(2):263-299. doi:10.1017/S001041752200007X.
6. Tarighat-Esfanjani A, Namazi N. Erratum to: nutritional concepts and frequency of foodstuffs mentioned in the Holy Quran. J Relig Health. 2016;55(3):820. doi: 10.1007/s10943-014-9990-4.
7. Lankarani KB, Afshari R. Alcohol consumption in Iran. Lancet. 2014;384(9958):1927–1928. doi: 10.1016/S0140-6736(14)62279-0.
8. Volk RJ et al. Item bias in the CAGE screening test for alcohol use disorders. J Gen Intern Med. 1997;12(12):763-9.
9. CAGE questionnaire allows doctors to avoid focusing on specifics of drinking. BMJ. 1998 Jun 13;316(7147):1827. doi:10.1136/bmj.316.7147.1827.
10. Alageel S, Alomair N. Muslims perceptions of safe alcohol use: a qualitative study in the Gulf Council Cooperation countries. Harm Reduct J. 2024 Sep 10;21(1):167. doi: 10.1186/s12954-024-01087-7.
11. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use

Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction. 1993;88(6):791-804.

12. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. AUDIT: The Alcohol Use Disorders Identification Test: Guidelines for use in primary care. Geneva: World Health Organization; 2001.

13. Almarri TSK, Oei TPS, Amir T. Validation of the Alcohol Use Identification Test in a prison sample living in the Arabian Gulf region. Subst Use Misuse. 2009;44(14):2001-13. doi:10.3109/10826080902848533.

14. Hallit J, Salameh P, Haddad C, Sacre H, Soufia M, Akel M, Obeid S, Hallit R, Hallit S. Validation of the AUDIT scale and factors associated with alcohol use disorder in adolescents: results of a National Lebanese Study. BMC Pediatr. 2020 May 11;20(1):205.

15. National Institute on Alcohol Abuse and Alcoholism. Screen and assess: use quick, effective methods [Internet]. Bethesda (MD): National Institute on Alcohol Abuse and Alcoholism; [cited 2025 Aug 11]. Available from: https://www.niaaa.nih.gov/health-professionals-communities/core-resource-on-alcohol/screen-and-assess-use-quick-effective-methods

Adapting food assistance during crisis in Sudan

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Conclusion: Our experience implementing both central kitchen and food basket models in White Nile and Gedarif states demonstrates that flexible, localised food assistance can effectively reach displaced populations in highly fluid and resource-limited environments. A key takeaway is that context matters; central kitchens are best suited for acute displacement scenarios with limited cooking infrastructure, while food baskets are more effective in chronic displacement settings where families are organised and capable of preparing meals themselves.

A major driver of success was the strong collaboration with local implementing partners, whose community trust, cultural awareness, and operational agility enabled efficient delivery under extremely challenging conditions. However, local partners are often themselves experiencing the crisis and the impact of this on service provision must be further explored. The programme also faced notable challenges, including price fluctuations, population mobility, and coordination gaps among field actors. SAMA plans to continue its food assistance programmes in White Nile and Gedarif states and has recently expanded operations to El Fasher, North Darfur, where displaced populations are facing acute hunger due to the ongoing siege of the city.

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Review Article

Impact of healthcare worker training on paediatric tuberculosis detection and reporting: A systematic review

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ABSTRACT

Paediatric tuberculosis (TB) is often underdiagnosed in low- and middle-income countries (LMICs) due to limited healthcare worker (HCW) capacity. This review assesses the impact of HCW training on improving paediatric TB detection and notification. A systematic search of international databases from January 2020 to April 2025 identified studies on HCW training related to paediatric TB diagnosis, notification, and HCW knowledge or confidence. Nine studies from LMICs (Kenya, Indonesia, Egypt, China, South Africa) met the criteria. Training formats included workshops and digital platforms, with most improving HCWs' knowledge and confidence. Five studies showed a 35-60% increase in paediatric TB detection, while four showed improved notification, particularly with training, supervision, and TB register use. Barriers included poor internet access, staff turnover, and a lack of mentorship. Digital platforms showed promise but required adaptation. HCW training improves paediatric TB outcomes in LMICs, especially when incorporating interactive content, supervision, and practical tools. Ongoing paediatric TB training should be integrated into national TB programs.

Keywords: paediatric tuberculosis; healthcare workers; training; detection; reporting.

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Introduction

Tuberculosis (TB) is a major global health issue, affecting an estimated 10.6 million people in 2022, including 1.1 million children under 15 years.[1] Paediatric TB represents a significant burden, especially in high-incidence, low- and middle-income countries (LMICs). However, its detection and management lag behind that of adult TB.[2-5]

Diagnosing TB in children is challenging due to non-specific symptoms, paucibacillary disease, and frequent smear-negative results, leading to under-diagnosis, delayed treatment, and preventable morbidity and mortality.[3,4,6-8] Missed cases disrupt surveillance and hinder national TB control efforts.

In LMICs, healthcare workers (HCWs) outside TB programs often lack adequate knowledge and confidence in diagnostic algorithms, contributing to misdiagnosis

and under-reporting.[3,6-9] Better training is needed to improve early detection and reporting of paediatric TB.[2,5]

While traditional training methods like workshops and mentoring are common, digital platforms and blended learning approaches are becoming more popular, helping overcome logistical barriers. For example, Indonesia's Plataran Sehat platform supports ongoing TB management training for primary healthcare workers. Despite these efforts, evidence on their impact is fragmented.[10-16]

Although reviews on general TB detection exist, few focus on healthcare worker training for paediatric TB diagnosis and notification. This review aims to assess the impact of various training interventions (offline, online, or blended) on paediatric TB outcomes and identify key training types, delivery modes, and implementation challenges.

Method

We included studies assessing HCWs training interventions aimed at improving paediatric TB diagnosis and reporting. Participants included general practitioners, nurses, midwives, and community health workers. Eligible interventions involved structured programs (workshops, mentoring, e-learning, or blended formats). We considered RCTs, quasi-experimental designs, cohort studies, and before-and-after studies reporting on outcomes related to diagnosis, notification, or intermediate outcomes (knowledge, confidence, and skills). Only English-language studies published between January 2020 and June 2025 were eligible.

We searched PubMed, Scopus, Web of Science, Embase, and Cochrane Library using keywords related to TB, paediatrics, HCW training, and diagnostic outcomes. Reference lists of relevant studies were screened. Two independent reviewers screened titles and abstracts, followed by a review of the full texts. Disagreements will be resolved by consensus or a third reviewer.

Data extraction focused on study characteristics, training formats, and outcomes (diagnosis, notification, knowledge, confidence, barriers/facilitators). Two reviewers independently extracted data and assessed study quality using Cochrane RoB2 for RCTs and ROBINS-I for non-randomized studies. We grouped studies by intervention type and delivery mode, with thematic analysis of barriers and facilitators.

Results

Out of 121 records identified, 79 remained after removing duplicates. After excluding 27 studies, 9 were included (Figure 1).

The studies, conducted in LMICs (Kenya, Indonesia, Libya, Egypt, South Africa, Brazil), involved quasi-experimental (3), RCTs (2), before-after studies (2), one systematic review, and one qualitative study. Training formats included workshops (5), e-learning (2), and blended (2), with durations from 3 days to several weeks (Table 1).

Seven studies evaluated paediatric TB diagnosis, with five showing a 35%-60% improvement in detection.[11,12,14,15,16] Amare et al. (2023) reported a pooled relative risk of 1.60 (95% CI: 1.53–1.66) following training.[13] Several studies have also shown an increased use of standardized diagnostic algorithms.[6,14]

Six studies assessed the impact of training on TB case notification, with four showing improved paediatric TB reporting to national systems. Key enablers included post-training supervision, TB registers, and mobile tools.[11,13,15,16] In Kenya, training enhanced the use of TBData4Action, leading to improved data-driven responses.[17]

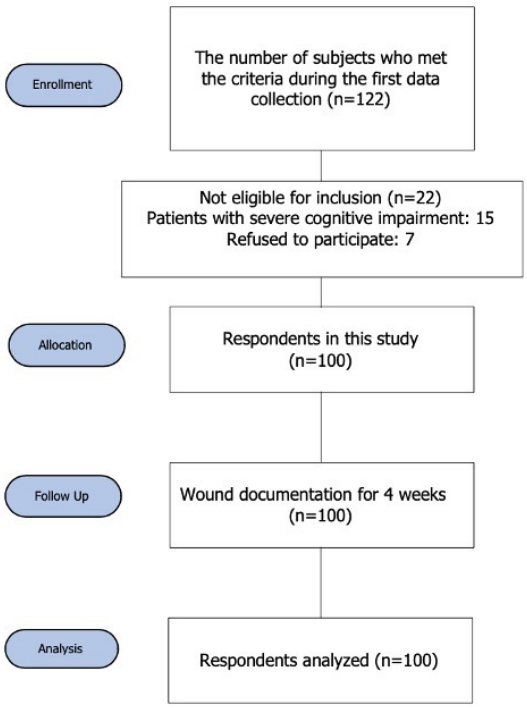

Figure 1. Flow diagram

Table 1. Characteristics of included studies

Author (Year)	Country	Study Design	Participants	Training Type	Key Outcomes
Angala et al. (2022) [16]	Kenya	Quasi-experimental	TB coordinators (n=331)	In-person workshops + field practicals	↑ Notification, ↑ Data use, ↓ Training cost
Elbahloul et al. (2023) [15]	Libya	Quasi-experimental	Nurses (n=100)	Educational module	↑ Knowledge, attitude, practice at 6 months
Madzinga et al. (2022) [14]	South Africa	Qualitative	HCWs (n=24)	TB management training (unspecified)	Barriers to IPC and implementation
Amare et al. (2023) [13]	Multi-country	Systematic review + meta-analysis	Multiple studies	Mixed (varied)	RR = 1.60 for TB case detection
Elgazzar et al. (2023) [12]	Egypt	Quasi-experimental	Nurses (n=36)	Structured educational program	↑ Practice, ↑ Self-efficacy
Sianturi et al. (2023) [10]	Indonesia	Interventional study	TB instructors (n=60)	OCB-based training	↑ Competence (p=0.001)
Russo et al. (2024) [6]	Brazil	Scoping review	Not specified	N/A	Missed diagnosis opportunities in children
Chan et al. (2025) [5]	Indonesia	Qualitative	Physicians (n=15)	No formal training	Barriers to notification (private sector)
Wang et al (2021) [11]	China	Quasi-experimental	N=757	E-learning programs for TB	↑ TB knowledge, key facilitators: content quality, barriers: content difficulty, relevance, and hardware limitations

Six studies reported improvements in HCWs' knowledge and confidence in paediatric TB management post-training.[6,10-14,17] Elbahloul et al. (2023) observed a 40-point knowledge increase, lasting up to six months reported a 40-point knowledge increase, lasting up to six months,[15] while Elgazzar et al. (2023) observed improved self-efficacy in nurses.[12] Long-term retention and behaviour change were inconsistently evaluated.

Five studies identified barriers and facilitators.[10-12,14,16] Barriers included staff turnover, time constraints, poor internet, and lack of post-training support, while facilitators included strong leadership, integration into child health modules, and localized mentorship. Chan et al. (2023) noted gaps in private sector reporting and the need for policy-driven support.[5]

Discussion

This review underscores the importance of HCWs training in improving pediatric TB detection and notification, addressing a significant gap in global TB control. Nine studies showed that training, whether via workshops, blended formats, or digital platforms, consistently improved HCWs' knowledge, confidence, and TB outcomes.[5,6,10-13,15,16]

Our findings align with global evidence that enhancing HCWs competencies is critical for addressing pediatric TB under-diagnosis and underreporting, particularly in resource-limited settings. Notably, several studies reported substantial improvements in TB detection rates after targeted training, with Amare et al. reporting a 60% increase.[12,13,15]

Outcomes varied due to differences in training methods, duration, and local factors like pre-existing skills and available diagnostic tools. However, interventions with post-training mentorship or supervision were more successful in translating knowledge into

practice,[6,10,12,13,15,16] emphasizing the need for ongoing support to sustain improvements.[10,11,13]

Digital and blended training models showed promise, particularly in Indonesia and Kenya,[10,16] but challenges like poor internet access and low digital literacy remain. Success depends on offline support and continuous technical assistance.[10,11,13,16]

While all studies showed immediate improvements in HCW knowledge and confidence, few assessed long-term outcomes. Only Elbahloul et al.[15] evaluated impact beyond six months, highlighting the need for longitudinal research to explore the sustainability of training effects.

For national TB programs, integrating paediatric TB training into continuous professional development and ensuring ongoing supervision are crucial to closing the paediatric TB reporting gap. Monitoring training outputs and case detection rates will help refine programmes.[5,6,15]

This review's strengths include a comprehensive search strategy and robust evaluation, though limitations include study heterogeneity and short-term focus. Future research should compare training models, assess cost-effectiveness, and investigate impacts on treatment outcomes. Qualitative studies, like those by Chan et al.[5] and Madzinga et al,[14] could provide valuable insights into the sustainability of these interventions.

Conclusion

This systematic review highlights the positive impact of healthcare worker training on paediatric tuberculosis detection and notification in low- and middle-income countries. The training methods most effective in improving HCWs' knowledge and clinical practices incorporated interactive content, supervision, and practical tools. Future research should focus on long-term sustainability, cost-effectiveness, and the role of structural and behavioural factors in enhancing training uptake and outcomes.

References

1. WHO. 2024 Global tuberculosis report [Internet]. 25 November 2024. 2024. 1–50 p. Available from: https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2024
2. Basile FW, Nabeta P, Ruhwald M, Song R. Pediatric Tuberculosis Diagnostics: Present and Future. J Pediatric Infect Dis Soc. 2022;11(Suppl 3):S85–93.
3. Linn AR, Dubois MM, Steenhoff AP. Under-Reporting of Tuberculosis Disease among Children and Adolescents in Low and Middle-Income Countries: A Systematic Review. Trop Med Infect Dis. 2023 May;8(6).
4. Mane SS, Shrotriya P. Current Epidemiology of Pediatric Tuberculosis. Indian J Pediatr. 2024 Jul;91(7):711–6.
5. Chan S, Ahmed IA, Hamzah H. Addressing barriers in paediatric tuberculosis reporting: A qualitative study of private healthcare providers' perspectives. South Sudan Med J. 2025;18(1):19–23.
6. Russo DO, Jimenez ALL, Diniz LMO, Cardoso CA, Romanelli RM de C. Missed opportunities in the prevention and diagnosis of pediatric tuberculosis: a scoping review. J Pediatr (Rio J). 2024;100(4):343–9.
7. Tesfaye SH, Mulat Tebeje T, Sisay D, Belete M, Kifle Y, Feleke A, et al. Estimating childhood tuberculosis incidence and under-reporting in Gedeo Zone, Ethiopia: a Bayesian hidden Markov model. IJID. 2025;15:100673. Available from: https://doi.org/10.1016/j.ijregi.2025.100673
8. Moore BK, Graham SM, Nandakumar S, Doyle J, Maloney SA. Pediatric Tuberculosis: A Review of Evidence-Based Best Practices for Clinicians and Health Care Providers. Pathogens. 2024;13(6).
9. UNICEF. Pediatric tuberculosis with a focus on indonesia. Unicef. 2022;1–51.
10. Sianturi E, Situmorang B, Simaremare A. Competency of Tuberculosis Instructor after Training with Citizenship Behavior-Based Organizational Training Management. Open Access Maced J Med Sci. 2023;11(E):5–12.
11. Wang ZY, Zhang LJ, Liu YH, Jiang WX, Jia JY, Tang SL, et al. The effectiveness of E-learning in continuing medical education for tuberculosis health workers: a quasi-experiment from China. Infect Dis Poverty. 2021;10(1):1–11. Available from: https://doi.org/10.1186/s40249-021-00855-y

12. Elgazzar S, Labib Elkashif M, Elbqry M, Elmansy F. Improving nurses' knowledge, practice, and self-efficacy regarding caring patients with tuberculosis: A quasi-experimental design. Iran J Nurs Midwifery Res. 2023;28(3):235–43.

13. Amare D, Getahun FA, Mengesha EW, Dessie G, Shiferaw MB, Dires TA, et al. Effectiveness of healthcare workers and volunteers training on improving tuberculosis case detection: A systematic review and meta-analysis. PLoS One. 2023;18(3):1–13. Available from: http://dx.doi.org/10.1371/journal.pone.0271825

14. Madzinga D, Tshitangano TG, Raliphaswa NS, Razwiedani L. Healthcare Workers' Perception of Measures to Reduce the Risk of New Tuberculosis Infections: A Qualitative Study Report. Nurs Reports. 2022;12(4):873–83.

15. Elbahloul M, Ali K, Alghennai S. Effectiveness of Health Education Intervention in Improving Knowledge, Attitude, and Practices Regarding Tuberculosis Among Nurses Working in Tuberculosis Centers in Libya. Alq J Med App Sci. 2023;6(1):230–9. Available from: https://journal.utripoli.edu.ly/index.php/Alqalam/indexeISSN2707-7179

16. Angala P, Dlodlo RA, Wanjala S, Mamo G, Mugambi-Nyaboga L, Onyango Okoth E, et al. TB training in Kenya: building capacity for care and prevention. Public Heal Action. 2022;12(1):40–7.

Consolidated guidelines for the prevention, diagnosis and treatment of postpartum haemorrhage

The World Health Organization has released new guidelines on the prevention and treatment of PPH.

Guidance Highlights:

- WHO's updated definition of PPH
- Recommendations for prevention, diagnosis, treatment, and care
- Implementation strategies: training, supplies, monitoring, and community engagement
- Key interventions: oxytocin, heat-stable carbetocin, tranexamic acid, and treatment bundles

These recommendations provide clear, evidence-based direction to help health providers deliver timely, effective, client-centered care to women everywhere. Adoption of these guidelines can save lives, improve quality of care, and advance maternal health equity.

https://iris.who.int/server/api/core/bitstreams/88bf11a5-93b6-4d6b-bdaa-856b46c8ed3c/content?utm_source=AlignMNH&utm_campaign=d73dfcb8f5-EMAIL_ALIGNMNH_World_PPH_Day_2025&utm_medium=email&utm_term=0_69a16bace3-d73dfcb8f5-1312240574

Lupus nephritis overlap syndrome in a male with albinism: A case report

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ABSTRACT

Systemic lupus erythematosus (SLE) and antineutrophil cytoplasmic antibody (ANCA)-associated vasculitis (AAV) are distinct autoimmune disorders that rarely coexist. Their co-occurrence, known as SLE/AAV overlap syndrome, represents a clinically significant entity characterized by combined serological and histopathological features of both conditions. It is most commonly reported in females, with limited data on male patients. We describe a case of SLE/AAV overlap syndrome in a 38-year-old male with albinism who presented with progressive polyarthritis, generalized oedema, oliguria, and constitutional symptoms. Laboratory findings included elevated serum creatinine (170 µmol/L), nephrotic-range proteinuria (2.0 g/day), positive antinuclear antibodies (ANA: 4000 IU/mL), anti-dsDNA (800 IU/mL), P-ANCA (50.74 IU/mL), and low complement levels (C3 and C4). Urinalysis revealed RBC casts and dysmorphic red blood cells. Renal biopsy confirmed a dual diagnosis of lupus nephritis (class III + V) and crescentic glomerulonephritis with full-house immunofluorescence and ANCA positivity. The patient was treated with intravenous methylprednisolone pulses followed by low-dose cyclophosphamide (Euro-Lupus protocol). Upon clinical improvement, he was transitioned to oral mycophenolate mofetil, hydroxychloroquine, and enalapril. Within two months, he showed significant clinical and laboratory improvement with normalization of renal function (serum creatinine 73 µmol/L), reduction in proteinuria (to 298 mg/day), and a decrease in disease activity (SLEDAI-2K score of 2). This case emphasises the need for a high clinical suspicion in atypical autoimmune presentations. Early renal biopsy and prompt immunosuppressive therapy are crucial for favourable outcomes.

Keywords: lupus nephritis; antineutrophil cytoplasmic antibody-associated vasculitis; overlap syndrome; male patient; albinism; Tanzania

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Introduction

Systemic lupus erythematosus (SLE) and antineutrophil cytoplasmic antibody (ANCA)-associated vasculitis (AAV) are two distinct autoimmune conditions and rarely occur together.[1-3] Their coexistence can result in potentially fatal complications, especially rapidly progressive glomerulonephritis (RPGN).[4-6] This disease entity, known as Lupus Nephritis–AAV Overlap Syndrome,

was initially defined in 2008.[6,7] It exhibits overlapping presentations in terms of clinical, pathological, and serological findings.[8-10] The pathogenesis of overlap syndrome remains elusive.[1] However, the hallmark characteristic discovery is crescentic glomerulonephritis, which results in haematuria, renal vasculitis, and progressive renal dysfunction.[6,9,11,12] With mortality rates as high as 20%, early diagnosis and treatment are essential.[2] The majority of documented cases are in females, frequently with microscopic polyangiitis (MPA) and P-ANCA positivity, and most of these cases showed remarkable clinical improvements despite the different treatment options.[3,7,10,12] There are limited documented data regarding this syndrome, especially in males, in our setting. We present a rare case of a 38-year-old male with albinism and polyarthritis and deteriorating renal function. Overlap syndrome with full-house nephropathy and ANCA positivity was confirmed by kidney biopsy. This is the first reported case of a male in our region. The patient was diagnosed early and responded well to treatment. This case underscores the importance of recognizing atypical presentations. Prompt intervention can significantly improve outcomes.

Case presentation

A 38-year-old male with albinism arrived at the emergency room for assessment of three months of progressive diffuse symmetrical joint pain, two weeks of body swelling, and decreased urine output. The metatarsal joints, both ankles, and knees were the first affected with dull aching, pain, and limited ranges of motion. Later, the wrists and metacarpal joints were also involved. The affected joints were red and swollen. He had sporadic episodes of low-grade fever, numbness in his lower extremities, generalized weakness, and easy fatigue. Later, he observed increasing oedema in the lower limbs, abdomen, and morning face puffiness, with symptoms of dyspepsia. He noted a 7kg weight loss. He also reported a history of chest pain and a dry nocturnal cough. There were no skin lesions apart from his albinism, as shown in Figure 1, and no haematuria.

Before admission, he had been treated at another facility with prednisolone, ibuprofen, captopril, and furosemide for his arthropathy and assumed heart failure and had not benefited. There was no history of diabetes mellitus or hypertension. He had never smoked or drunk alcohol. Upon physical examination, he was alert (Glasgow coma score of 15/15), with a heart rate of 112 beats per minute and blood pressure of 118/63 mmHg. He was pale with moderate leg oedema grade 2+, moderate ascites, and facial puffiness. A pericardial friction rub was heard with an elevated jugular venous pressure (at 13 cm H_2O), on musculoskeletal examination revealed swollen tender multiple joints and warm, in keeping with inflammatory arthritis. Strabismus (esotropia) was noted, which is often associated with albinism. Urine output was 250mls in 24 hours, and body weight was 47kg. These features suggested a systemic autoimmune disease, most likely SLE, with differentials of mixed connective tissue disease (MCTD) and rheumatoid arthritis. The investigations performed are presented in Table.

Other nuclear antigen profiles, including anti-SSA and anti-SSB antibodies, were unavailable. Urine analysis showed blood 2+ and protein 3+. Urine microscopy showed red blood cell (RBC) casts and dysmorphic RBCs. Other laboratory tests: haemoglobin 8.84 g/dL, leucocytes 4.9x109 cells/µL, platelet count 193 x109 cells/µL, direct Coomb's test negative, ESR 140 in the first hour, and CRP 4.9 mg/dL. Liver chemistry and coagulation indices were within normal limits. Serological tests for HIV and hepatitis B/ C were nonreactive. Serum complements, C3 was 0.6 mg/dL (reference range 0.9–1.8 mg/dL) and C4 was 0.07 mg/dL (reference range 0.1–0.4 mg/dL).

Figure 1a and 1b. Face and legs of patient without abnormal skin lesions except for albinism. (CREDIT: Gidion Edwin. Photographs taken during index admission after consent).

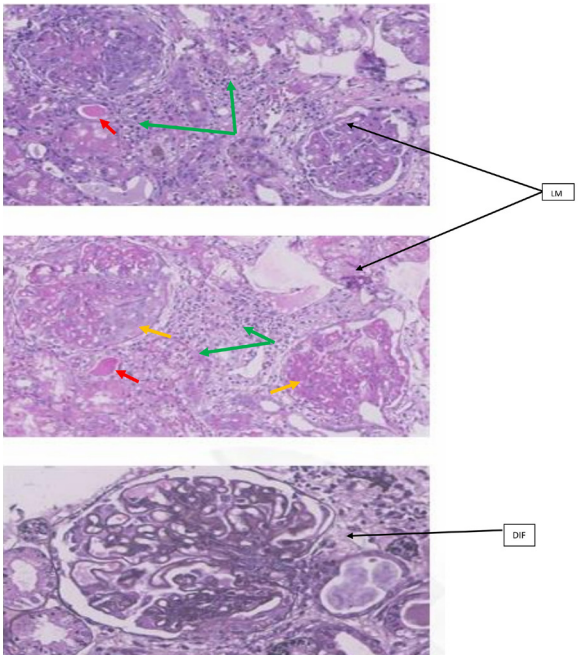

Figure 2. Original renal biopsy showing histopathological findings (LM: light microscopy. DIF: direct immunofluorescence). Yellow arrow: globally sclerosed glomeruli with fibrous crescent. Red arrow: granular casts. Green arrow: lymphocytic interstitial inflammation. (CREDIT: MHL Tanzania report processed at METROPOLIS Mumbai, May 2025)

Table 1. Investigation results

S. No	Test/parameter	Result	Reference
1.	Serum creatinine, µmol/l	170	62-112
2.	Blood urea nitrogen, mg/dl	21.9	2.8-7.9
3.	Uric acid, µmol/l	526	200-415
4.	Serum sodium, mEq/l	137	135-146
5.	Serum potassium, mEq/l	4.99	3.5-5.1
6.	Serum albumin, g/l	29.5	35-50
7.	24 hours urine protein, mg/day	2016	< 15
8.	Glycated haemoglobin,%	5.2	4.8-5.7
9.	Antinuclear antibodies, IU/ml	4000	0-40
10.	Anti-Ds DNA, IU/ml	800	0-20
11.	Anti-CCP, IU/ml	5.7	0-20
12.	Rheumatoid factor (qualitative)	Non-reactive	
13.	P-ANCA, IU/ml	50.74	0-20
14.	Anti-Sm IGG, IU/ml	400	0-20

Chest radiography revealed features of pulmonary oedema with left-sided mild pleural effusion. A 12-lead electrocardiogram showed sinus tachycardia, but otherwise normal findings, and a two-dimensional transthoracic echocardiogram demonstrated mild to moderate pericardial effusion with good diastolic and systolic functions. Cultures (blood and urine) and tuberculosis screen (sputum for GeneXpert and serum adenosine deaminase, ADA was 27 IU/L) were negative. Renal ultrasound scan showed normal-sized kidneys without hydronephrosis.

Thereafter, the patient was kept on intravenous methylprednisolone 500 mg for three days and other supportive medical therapy, including intravenous paracetamol, injectable pantoprazole, and cough syrup, while a kidney biopsy was arranged urgently. On day 3, serum creatinine was 127 µmol/l with marked clinical resolution of admitting symptoms. The kidney biopsy under light microscopy showed focal and diffuse sclerosing GN with overlying fibrous crescents, 20 glomeruli, and most were enlarged, hypercellular with diffuse capillary wall thickening, subendothelial spikes, and increased mesangial and endocapillary cellularity. Five cellular crescents were seen with focal duplication of capillary walls. The interstitium and tubules showed foci of tubular atrophy and interstitial fibrosis involving 5-10% of the sampled cortex. A few granular casts were seen, and mild lymphocytic interstitial inflammation. The blood vessels showed mild intimal thickening. The renal light microscopy (LM) findings were in keeping with combined membranous class V with focal proliferative class III lupus nephritis (LN) activity index 4/24 and chronicity index 2/12, of which six crescents were seen, with five cellular and one fibrous. There were focal (2/22) glomerulosclerosis and mild interstitial fibrosis and tubular atrophy (IFTA, 10%). Direct immunofluorescence (DIF) showed granular mesangiocapillary deposits of IgG (þ2), IgA (þ1), IgM (þ1), C3 (þ3), C4 (þ1), C1q (þ2), fibrinogen (negative), Kappa (þ2), and Lambda (þ3), as shown in Figure 2. This full-house immunofluorescence positivity raised the possibility of LN.

Based on these clinical and pathological findings, a diagnosis of SLE/AAV overlap syndrome was made. This patient's clinical presentation supported the AAV diagnosis, as evidenced by the presence of necrotizing GN and ANCA positivity. He also fulfilled the American College of Rheumatology criteria for SLE, namely presence of arthritis, serositis (pericarditis), vasculitis, anaemia, renal involvement and low C3/C4. The patient

was started on oral prednisolone 50 mg daily before going on intravenous low-dose cyclophosphamide 500 mg/m2 at 0 and 2 weeks only (Euro-Plus protocol). Then the regimen was changed due to marked clinical improvement to oral mycophenolate mofetil 1 gm twice daily, enalapril 5 mg daily, and hydroxychloroquine 200 mg daily as maintenance therapy. After two months of therapy, there was significant improvement characterised by normalisation of serum creatinine to 73 µmol/l, ESR 13, and C3/C4. Urine analysis and sedimentation showed blood 1+ and protein 1+, and RBC casts with few RBC cells, respectively, while 24-hour urine protein was 298 mg/day. The patient reported the complete resolution of his admitting symptoms, and he gained his body weight from 54 kg to 56.4 kg. His current SLEDAI-2K score is 2.

Discussion

SLE/AAV overlap syndrome is an exceptionally rare autoimmune clinical entity, first described in 2008, characterized by overlapping clinical, serological, and histopathological features of both systemic lupus erythematosus and ANCA-associated vasculitis.[1,6] We report a case of a 38-year-old male with albinism who presented with polyarthritis, serositis, non-nephrotic-range proteinuria, and constitutional symptoms, eventually diagnosed as LN-AAV overlap with full-house nephropathy and ANCA positivity.

This clinical picture aligns with the dual pathology seen in overlap syndrome, notably the presence of both necrotizing glomerulonephritis and full-house immune complex deposition. Crescentic GN, red cell casts, and ANCA positivity supported the vasculitic component, while high ANA, anti-dsDNA, and low complement levels favoured LN. The renal biopsy confirmed class V (membranous) and class III (focal proliferative) LN with crescents, a hallmark finding in overlap syndrome. Although overlap syndrome is more common in women, this case highlights its potential occurrence in males, particularly in underreported regions.

Diagnosis and management of overlap syndrome were based on clinical presentation and immunopathological profile, which then suggests ANCA positivity with full-house nephropathy.[7,12,13] The literature suggests MPO-ANCA and P-ANCA are more frequently associated with overlap cases;[1,4,6] this was consistent in our case (P-ANCA titer 50.74 IU/ml). Most reported cases were treated with immunosuppressants and showed remarkable clinical remission,[3,7,13] like our case, despite its rarity in males.

Our case responded well to initial methylprednisolone pulses followed by cyclophosphamide (Euro-Lupus protocol) and transitioned to mycophenolate mofetil for maintenance, with rapid resolution of symptoms within weeks and normalisation of renal function, while 24-hour urine protein reduced from 2016 mg/day to 298 mg/day within three weeks. Early diagnosis and prompt immunosuppressive therapy are essential, given the high risk of rapidly progressive glomerulonephritis and mortality rates up to 20%. The management approach of our case followed previous documented cases.[2-6,9,11] Furthermore, comparative case reviews indicate variable presentations—ranging from cutaneous lesions to pulmonary haemorrhage, but renal involvement remains a consistent hallmark.

Given the rarity, especially among males in our setting, this case adds to the growing but limited body of knowledge. It emphasizes the importance of renal biopsy in atypical lupus presentations with unexplained renal decline and ANCA positivity. Nevertheless, treatment remains individualized, often combining lupus and vasculitis protocols with careful monitoring for relapses and complications.[6,7] Our patient showed complete resolution of symptoms following medications; therefore, repeating the renal biopsy is unnecessary.

Our case underscores the clinical relevance of recognizing SLE/AAV overlap early to optimize treatment outcomes. Further multicentre studies are needed to standardize diagnostic criteria, treatment protocols, and long-term outcomes for this rare but serious overlap syndrome.

Conclusion

This case illustrates a rare presentation of SLE/AAV overlap syndrome in a male patient, emphasizing the need for high clinical suspicion in atypical autoimmune presentations. Early renal biopsy and prompt immunosuppressive therapy are crucial for favourable outcomes. This report contributes to the limited literature on male cases and highlights the importance of recognizing overlap syndromes in diverse populations.

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Conflict of interest: None.

Funding: Nil.

Authors' contributions: G.E.: Conceptualization, writing original draft, writing reviews, and editing. B.A: Writing reviews and editing. S.M.: supervision, writing reviews, and editing. A.M: Supervision, writing reviews, and editing.

References

1. Farah RI, Shahin NA, Alawneh M, Adwan M. Rapidly progressive glomerulonephritis due to systemic lupus erythematosus and ANCA-associated vasculitis overlap. 2020;3–6. DOI: https://orcid.org/0000-0003-1638-9017
2. Martínez CM. Anca-positive vasculitis with full-house nephropathy, an unusual association: a case report and review of literature. C r | r c. 2021;285–90. DOI: https://doi.org/10.1590/21758239-JBN-2020-0134
3. Itikyala S, Pattanaik D, Raza S. Case Report Systemic Lupus Erythematosus (SLE) and Antineutrophil Cytoplasmic Antibody-Associated Vasculitis (AAV) Overlap Syndrome: Case Report and Review of the Literature. 2019;2019:2–6. DOI: https://doi.org/10.1155/2019/5013904
4. Itikyala S, Pattanaik D, Raza S. Case Report Systemic Lupus Erythematosus (SLE) and Antineutrophil Cytoplasmic Antibody-Associated Vasculitis (AAV) Overlap Syndrome: Case Report and Review of the Literature. 2019;2019:2–6. DOI: https://doi.org/10.1155/2019/5013904
5. Kato K, Kawamura T, Terashima R, Tsuchiya Y, Takahashi Y, Kasai K, et al. Case Report A Case of Systemic Lupus Erythematosus / Antineutrophil Cytoplasmic Antibody-Associated Vasculitis Overlap Syndrome with Dissociated Pathological and Immunological Findings. 2020;2020:1–7. DOI: https://doi.org/10.1155/2020/5698708
6. Hounoki H, Shinoda K, Matsui A, Okumura M, Yamaguchi S, Kakeshita K, et al. Case Report A Case of Systemic Lupus Erythematosus and Antineutrophil Cytoplasmic Antibodies-Associated Vasculitis Overlap Syndrome. 2021;2021. DOI: https://doi.org/10.1155/2021/6690658
7. Chiu C, Ho M, Laniyati S, Nuntana H, Yuan K Der. The 2024 APLAR Consensus on the Management of Lupus Nephritis. 2025;1–18. DOI: https://doi.org/10.1111/1756-185X.70021
8. Curtiss P, Liebman T, Khorolsky C, Brinster N. Systemic lupus erythematosus and antineutrophil cytoplasmic antibody e associated vasculitis : An emerging overlap syndrome with cutaneous manifestations. JAAD Case Reports [Internet]. 2018;4(5):493–6. Available from: https://doi.org/10.1016/j.jdcr.2018.01.021
9. Glomerulonephritis P, Jarrot P andre, Chiche L, Hervier B, Daniel L, Vuiblet V, et al. Systemic Lupus Erythematosus and Antineutrophil Cytoplasmic Antibody-Associated Vasculitis Overlap Syndrome in Patients With Biopsy-. 2016;95(22):1–11.
10. Pan L, Ping M, Jing L, Wang H, Xu M, Rui S. Immunological pathogenesis and treatment of systemic lupus erythematosus. World J Pediatr [Internet]. 2020;16(1):19–30. Available from: DOI: https://doi.org/10.1007/s12519-019-00229-3
11. Dardik G, Krieger A, Rao MK, Stokes MB, Wooden B, Bomback AS. A Case Report and Literature Review of ANCA-Associated Vasculitis and Lupus Nephritis Overlap : Lessons in Management. 2025;168–75. DOI: https://doi.org/10.1159/000543014
12. Ashraf A, Daloya J, Rana V, Ahmed A, Kaell A. Diagnosing and Managing Clinically Silent Lupus Nephritis and Anti-neutrophil Cytoplasmic Antibody-Associated Vasculitis Overlap Syndrome : A Clinical Challange Case Presentation. 2022;14(4). DOI: https://doi.org/10.7759/cureus.24624
13. Rossi GM, Vaglio A. New Treatment Regimens, New Drugs, and New Treatment Goals for Lupus Nephritis. 2025;1–11. DOI: https://doi.org/10.3390/jcm14020584

Case Report

Rare isolation of *Pseudomonas mendocina* from a postoperative wound in a diabetic patient: A case report

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ABSTRACT

Pseudomonas mendocina is a rare, Gram-negative, environmental organism that infrequently causes human infections, usually acting as an opportunistic pathogen in immunocompromised hosts. We present the case of a 47-year-old man with type 2 diabetes mellitus who developed a postoperative wound infection following surgical fixation of a distal tibial and fibular fracture. After an initially uneventful recovery, he presented on the eighth postoperative day with signs of localized infection. Microbiological examination of the purulent discharge identified *P. mendocina* using the VITEK2 automated system and confirmed the result with MALDI-TOF MS. The isolate was susceptible to a range of antibiotics, including cefepime, gentamicin, and ciprofloxacin. Targeted antimicrobial therapy combined with surgical debridement and musculocutaneous flap coverage resulted in complete clinical resolution. This case highlights the clinical significance of P. mendocina as an opportunistic pathogen in orthopaedic surgical site infections, especially in immunocompromised patients. Timely and accurate microbiological identification, along with appropriate targeted therapy, is crucial for favourable outcomes. Increased clinical awareness of rare environmental pathogens is vital when dealing with persistent postoperative infections, particularly in diabetic patients with open or contaminated wounds.

Keywords: diabetes mellitus, type 2, *pseudomonas* infections, *Pseudomonas mendocina*, surgical wound infection, India

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Introduction

Pseudomonas mendocina is a motile, aerobic, Gram-negative bacillus rarely implicated in human disease. Typically isolated from soil and water, it has emerged as an opportunistic pathogen, with approximately 22 human infections reported worldwide since the first case in Argentina in 1992.[1,2] Clinical presentations include endocarditis, meningitis, bacteraemia, and soft tissue infections, primarily in immunocompromised individuals.[1] Unlike *P. aeruginosa*, *P. mendocina* often exhibits susceptibility to third-generation cephalosporins.[2] We report a rare case of *P. mendocina* isolated from a postoperative wound in a diabetic patient,

emphasizing accurate microbiological identification and its therapeutic implications in musculoskeletal infections.

Case Presentation

Presentation

A 47-year-old male presented to Justice K.S. Hegde Charitable Hospital, Mangalore, India, with pain, an open wound, and visible deformity over the left lower limb following a road traffic accident. The pain was acute, sharp, localized, non-progressive, and non-radiating, worsening with movement and relieved by immobilization and analgesics. The patient was haemodynamically stable and well-oriented, with no systemic abnormalities on examination. He had a known history of type 2 diabetes mellitus, managed with oral hypoglycaemic agents. Local examination revealed a 3 × 1 cm laceration over the medial aspect of the left ankle, with diffuse swelling, active bleeding, and exposed bone. Palpation confirmed tenderness over the anterior joint line, crepitus, and abnormal bony mobility, indicating a fracture. Range of motion at the ankle was severely limited due to pain. A neurovascular assessment confirmed intact distal pulses and preserved sensation, suggesting no immediate vascular or neural compromise.

Laboratory and imaging investigations

Initial laboratory investigations indicated leucocytosis, with a white blood cell (WBC) count of 12,250 cells/mm³. Differential leucocyte counts revealed neutrophilia (80.3%), with lymphocytes at 16.0%, monocytes at 3.6%, eosinophils at 0.0%, and basophils at 0.1%. The erythrocyte sedimentation rate (ESR) was elevated at 18 mm/hour. Based on clinical and radiological findings, the patient had a comminuted fracture of the distal one-third of the left tibial shaft, classified as a Gustilo-Anderson Type III B open fracture.

Surgical management

The patient underwent surgical management under spinal anaesthesia, with open reduction and internal fixation (ORIF) of the left distal fibula. Postoperative radiographs confirmed satisfactory anatomical alignment of fracture fragments with appropriate implant placement (Figure 1). The procedure was well tolerated, and the immediate postoperative period was uneventful. Wound evaluations were performed on postoperative days (POD) 3, 6, and 8. The patient received intravenous ceftriaxone 1 g twice daily, metronidazole 500mg (in 100 mL) thrice daily, and gentamicin 80 mg twice daily for five days postoperatively. Antibiotics were then discontinued. However, by POD 8, the surgical site showed signs of inflammation, including erythema, swelling, and seropurulent discharge. Considering the purulent nature of the wound and the patient's comorbid diabetes, blood cultures were obtained to rule out systemic involvement. The negative blood culture results indicated a localized infection. A deep pus sample was collected aseptically from within the wound cavity using sterile aspiration, avoiding superficial contamination, and sent for microbiological culture and antibiotic susceptibility testing. However, we appreciate that additional confirmation of the pathogen might have been obtained if multiple intraoperative deep tissue samples had been taken during wound debridement and musculocutaneous flap coverage.

Microbiological evaluation

Pus samples were collected aseptically and inoculated onto 5% sheep blood agar, MacConkey agar, and nutrient agar (HiMedia, Mumbai, India) using the streak plate method. The plates were incubated at 37 °C for 24 to 48 hours. On blood agar, non-haemolytic colonies appeared grayish to white. MacConkey agar showed pale, irregular, non-lactose fermenting colonies, while nutrient agar revealed smooth, grayish, non-pigmented colonies without diffusible

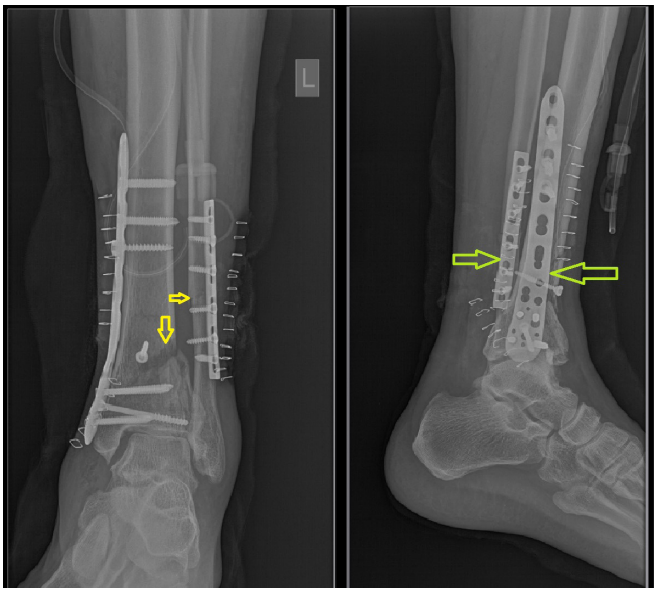

Figure 1. Anteroposterior and lateral radiographs of the left ankle demonstrating a comminuted fracture of the distal one-third shafts of the tibia and fibula, along with the postoperative status following open reduction and internal fixation (ORIF) of the distal fibula, showing satisfactory anatomical alignment and proper implant placement.

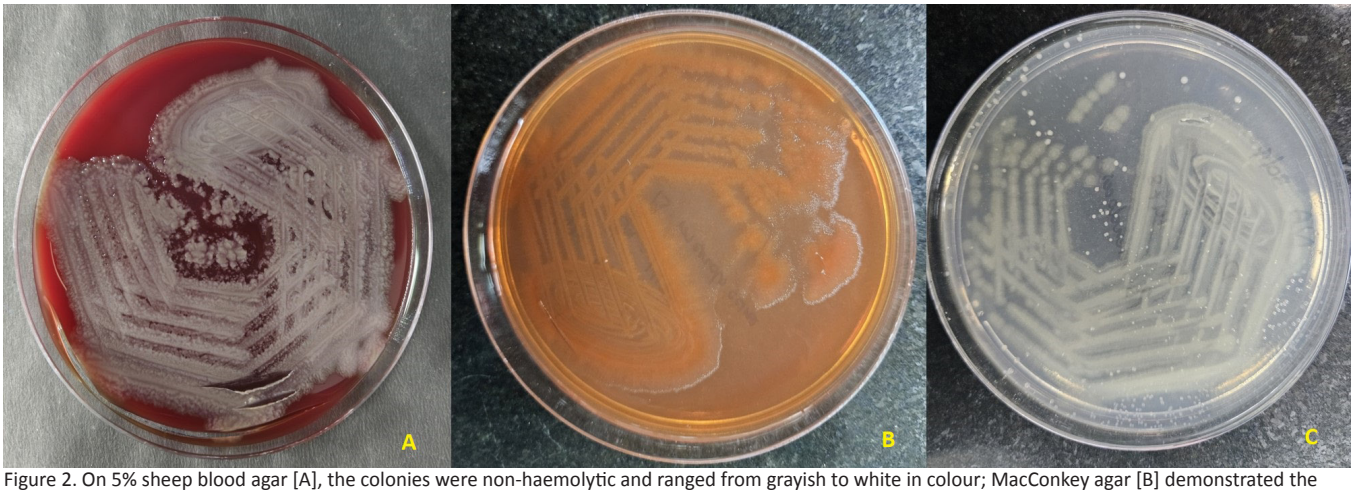

Figure 2. On 5% sheep blood agar [A], the colonies were non-haemolytic and ranged from grayish to white in colour; MacConkey agar [B] demonstrated the growth of pale, irregular, non-lactose fermenting colonies; and nutrient agar [C] showed smooth, grayish, non-pigmented colonies without any diffusible pigment.

pigment (Figure 2). Gram staining showed gram-negative bacilli. Preliminary biochemical tests were catalase and oxidase-positive. The isolate hydrolysed arginine but did not decarboxylate lysine or ornithine.

The organism was identified as *P. mendocina* using both the VITEK2 Compact System (BioMérieux, Marcy L'Étoile, France) with the Gram-negative identification card and the Matrix-Assisted Laser Desorption/Ionization-Time of Flight Mass Spectrometry (MALDI-TOF MS; BioMérieux, France). Antimicrobial susceptibility testing was performed using the VITEK2 system, and the minimum inhibitory concentrations (MICs) were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guidelines.[3] The isolate was found to be sensitive to the following antibiotics, with corresponding MIC values: piperacillin/tazobactam (≤4 µg/ml), ceftazidime (2 µg/mL), cefoperazone/sulbactam (≤8 µg/ml), cefepime (0.5 µg/ml), imipenem (1 µg/ml), meropenem (≤0.25 µg/ml), amikacin (2 µg/ml), gentamicin (≤1 µg/ml), ciprofloxacin (≤0.06 µg/ml), levofloxacin (≤0.12 µg/ml), trimethoprim/sulfamethoxazole (≤20 µg/ml).

The clinical presentation of an open, contaminated Gustilo–Anderson Type III B fracture with purulent discharge and delayed signs of infection required consideration of several potential pathogens and clinical scenarios. Common organisms implicated in post-orthopaedic surgical site infections, such as *Staphylococcus aureus* (including MRSA), coagulase-negative staphylococci, and Enterococcus species, were considered. In Gram-negative infections, organisms like *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and *Enterobacter* species were highly likely candidates.[4] The possibility of polymicrobial infections and, in rare instances, the contribution of anaerobes (e.g., *Clostridium*, *Bacteroides* species) was kept in mind due to the open nature of the fracture.[5] Fungal infections were also a consideration, especially in immunocompromised patients with delayed or atypical clinical courses.[6] Ultimately, targeted microbiological culture and sensitivity testing confirmed *Pseudomonas mendocina* as the causative pathogen, facilitating targeted therapy and reinforcing the importance of thorough microbiological evaluation for optimal clinical outcomes.

Antibiotic and Surgical Management with Clinical Outcome

In view of the microbiological findings and based on the antibiotic susceptibility profile, the patient underwent left ankle wound debridement followed by musculocutaneous flap coverage. Intravenous cefepime 1 g twice daily and gentamicin 80 mg twice daily were initiated. Daily inspection of the wound and flap site was performed on postoperative days 3, 6, and 8, revealing progressive wound healing. The patient demonstrated steady symptomatic improvement, and the intravenous antibiotics were discontinued after 10 days of administration. Upon discharge, the patient was prescribed oral ciprofloxacin 500 mg twice daily for 14 days and advised to follow up in the outpatient department (OPD) after one week. At the follow-up visit, the patient exhibited no clinical signs of wound site infection, and the surgical site was clean with no discharge, indicating successful postoperative wound healing. No further long-term follow-up was performed as

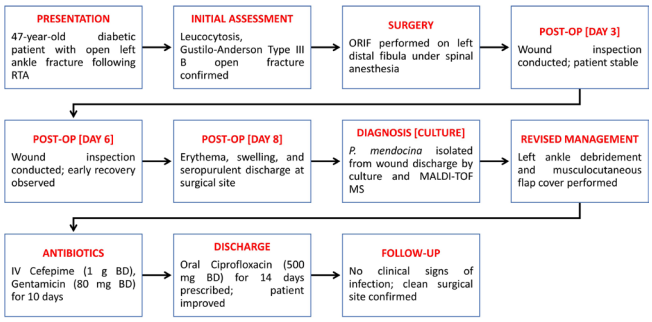

Figure 3. Timeline of clinical milestones, interventions, and outcomes in a patient with *Pseudomonas mendocina* post-operative wound infection.

the patient did not return for subsequent scheduled visits. Given the retained metal-work, prolonged antibiotic therapy was considered before discharge to reduce the risk of recurrence, as is generally recommended. The clinical timeline of diagnosis, interventions, and outcomes is summarized in Figure 3.

Discussion

This case contributes to the limited but growing evidence of *P. mendocina* as an opportunistic pathogen capable of causing human infections, especially in trauma-exposed patients.[7] Traditionally regarded as an environmental organism with low pathogenic potential, *P. mendocina* has increasingly been implicated in severe clinical syndromes, including soft tissue and musculoskeletal infections.[8] This case is particularly notable as it reports *P. mendocina* from a deep surgical site infection (SSI) following an open distal tibial fracture—a setting where *Pseudomonas aeruginosa* is more commonly encountered.[9] A deep pus sample was collected aseptically from within the wound cavity before debridement, avoiding superficial contamination. However, it would have been advisable to have taken multiple intraoperative deep tissue samples during wound debridement and musculocutaneous flap coverage. The patient's type 2 diabetes mellitus and environmental exposure after trauma likely facilitated microbial entry and persistence, consistent with similar infections caused by soil- and water-borne pseudomonads.[1,10]

Accurate identification of rare, non-fermenting Gram-negative bacilli is crucial to prevent misclassification. Conventional phenotypic methods often fail to differentiate *P. mendocina* from closely related pseudomonads. The combined use of automated systems such as VITEK2 and MALDI-TOF MS enabled precise species-level identification and guided early, targeted treatment, in line with modern diagnostic recommendations for orthopaedic infections.[11] Antimicrobial susceptibility testing revealed sensitivity to cephalosporins, aminoglycosides, and fluoroquinolones, consistent with recent reports highlighting the generally favourable susceptibility profile of *P. mendocina*, which contrasts with the multidrug resistance often seen in *P. aeruginosa*.[2]

Open fractures are particularly susceptible to SSIs due to direct environmental contamination, soft tissue damage, and the presence of implants. The isolation of *P. mendocina* in this context underscores the relevance of atypical environmental pathogens in post-traumatic infections. Studies have emphasized the role of microbial burden in infection severity and healing outcomes, even in immunocompetent hosts.[12,13] Biofilm formation, common among non-fermenting Gram-negative rods, likely contributes to infection persistence and highlights the need for timely surgical and antimicrobial intervention.[14,15]

The emerging role of *P. mendocina* in orthopaedic SSIs—especially in open fractures with environmental exposure and comorbidities—demands greater clinical awareness. Its distinct susceptibility profile requires accurate species identification for effective management. Continued documentation and surveillance of *P. mendocina* infections are essential to elucidate resistance trends and optimize patient outcomes in this evolving clinical landscape. No further long-term follow-up was possible due to patient'sfailure to attend for review visits. Prolonged antibiotic therapy is frequently recommendedwhere orthopaedic metal implants remain and to help reduce the risk of late recurrence.

Conclusion

This case highlights *P. mendocina* as a rare but emerging pathogen in post-traumatic musculoskeletal infections. Its detection in an open fracture surgical site emphasizes the need to consider environmental organisms in high-risk orthopaedic patients. Prompt diagnosis and targeted therapy are vital for optimal outcomes and preventing complications.

Ethical approval: Written informed consent for publication was obtained from the patient. This case report was conducted in accordance with the ethical guidelines of K S Hegde Medical Academy, Nitte (Deemed to be University) and was determined by the K S Hegde Medical Academy Institutional Ethics Committee (IEC) to not require full IEC review.

Authors contributions: A.A.A and V.K.K contributed to the study's conception and design. Material preparation, data collection, analysis, interpretation, validation, literature search, and manuscript writing were performed by A.A.A, B.J. The first draft of the manuscript was written, edited, and reviewed by A.A.A, V.K.K. All authors contributed to the article and approved the submitted version.

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References

1. Vo T, Maisuradze N, Maglakelidze D, et al. Pseudomonas mendocina urinary tract infection: a case report and literature review. Cureus. 2022;14(3):e23583. https://doi.org/10.7759/cureus.23583
2. Aman M, Fomda BA, Roohi S, Qadri U, Wani SJ, Majid U, Dar RA. Pseudomonas mendocinabacteremia: a case study from Indian subcontinent. Indian J Med Microbiol. 2025;55:100827. https://doi.org/10.1016/j.ijmmb.2025.100827
3. Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing. 34th ed. CLSI supplement M100. Wayne, PA: CLSI; 2024.
4. Motififard M, Teimouri M, Shirani K, Hatami S, Yadegari M. Prevalence of Bacterial surgical site infection in traumatic patients undergoing orthopedic surgeries: a cross-sectional study. Int J Burns Trauma. 2021;11(3):191-196.
5. Singh C, Sood A, Bala K, Tandup C, Ray P, Angrup A. Anaerobic infections in patients admitted in various surgical units of a tertiary care hospital of north India: neglected but important. Iran J Microbiol. 2021;13(3):274-281. https://doi.org/10.18502/ijm.v13i3.6387
6. Prakash PY. Fungal surgical site infections. Int Wound J. 2016 Jun;13(3):428. https://doi.org/10.1111/iwj.12302
7. Gani M, Rao S, Miller M, Scoular S. Pseudomonas mendocina Bacteremia: A Case Study and Review of Literature. Am J Case Rep. 2019;20:453-458. https://doi.org/10.12659/AJCR.914360
8. Ioannou P, Vougiouklakis G. A Systematic Review of Human Infections by Pseudomonas mendocina. Trop Med Infect Dis. 2020;5(2):71. https://doi.org/10.3390/tropicalmed5020071
9. Yang Y, Zhang L, Wang J, Chen Z, Tong L, Wang Z, et al. Proportions of Pseudomonas aeruginosa and Antimicrobial-Resistant P. aeruginosa Among Patients With Surgical Site Infections in China: A Systematic Review and Meta-analysis. Open Forum Infect Dis. 2024;11(2):ofad647. https://doi.org/10.1093/ofid/ofad647.
10. Nagendra L, Boro H, Mannar V. Bacterial infections in diabetes [Internet]. In: Feingold KR, Ahmed SF, Anawalt B, et al., editors. Endotext. South Dartmouth (MA): MDText.com, Inc.; 2000– [updated 2022 Apr 5; cited 2025 May 30]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK579762/
11. Kar M, Dubey A, Sahu C, Patel S. Pseudomonas mendocina meningitis in a postoperative patient: A case report and review of literature. J Clin Diagn Res. 2023;17(5):DD03–DD06. https://doi.org/10.7860/JCDR/2023/61792.17859
12. Liu H, Xing H, Zhang G, Wei A, Chang Z. Risk factors for surgical site infections after orthopaedic surgery: A meta-analysis and systematic review. Int Wound J. 2025;22(5):e70068. https://doi.org/10.1111/iwj.70068
13. Coombs J, Billow D, Cereijo C, Patterson B, Pinney S. Current Concept Review: Risk Factors for Infection Following Open Fractures. Orthop Res Rev. 2022;14:383-391. https://doi.org/10.2147/ORR.S384845
14. Sahoo K, Meshram S. Biofilm Formation in Chronic Infections: A Comprehensive Review of Pathogenesis, Clinical Implications, and Novel Therapeutic Approaches. Cureus. 2024;16(10):e70629. https://doi.org/10.7759/cureus.70629
15. Hrynyshyn A, Simões M, Borges A. Biofilms in Surgical Site Infections: Recent Advances and Novel Prevention and Eradication Strategies. Antibiotics (Basel). 2022;11(1):69. DOI: https://doi.org/10.3390/antibiotics11010069

NEWS

Physicians' Association of South Sudan admitted as the 7th member body of the East, Central and Southern African College of Physicians (ECSACOP)

PASS members during Diabetes Symposium in Juba, South Sudan, in May 2025.

Dr Ruot Garjiek Teny
Chairperson,
Physicians' Association of South Sudan

The East, Central, and Southern African College of Physicians (ECSACOP) Council, during its meeting held during the 10th annual ECSACOP conference in Mombasa on 28th August 2025, approved the admission of the Physicians' Association of South Sudan (PASS) as a Member body of ECSACOP. South Sudan became the seventh Member of the College.

This success came as a result of efforts and engagement with the College over the past two years. This admission comes with many opportunities for South Sudan, especially in areas of postgraduate training, scientific exchange, as well as research collaboration.

Subject to confirmation of satisfactory training facilities at Juba Teaching Hospital (JTH) following a formal inspection by an ECSACOP team in the near future, JTH will be granted the status of an ECSACOP fellowship training centre. Dr. Eluzai Hakim, Consultant Physician and International Adviser to the Royal College of Physicians, London, on South Sudan, gave an hour-long lecture via ZOOM on 6th September, 2025 on how to structure the training programme for members of the South Sudan Physicians Association. The Executive Committee of the Physicians' body is now working on setting up a training committee and hopes to reach out to Epsom and Saint Helier University Hospitals Trust in London for support with this process.

After successfully fulfilling the ECSACOP requirements and setting up the necessary training infrastructure at JTH, the South Sudan General Medical Council will be invited for the accreditation process prior to commencement of the fellowship programme.

Short Communication

Statement on the Position of the Association of Gynecologists and Obstetricians of South Sudan (AGOSS) on the Use of Paracetamol During Pregnancy and Its Linkage with Neurodevelopmental Disorders Among Children: September 2025

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Background

Paracetamol, known as acetaminophen is an over-the-counter (OTC) pain reliever and fever-reducing medication. The drug is chemically named as N-acetyl-p-aminophenol, with its international brand name" Panadol". It is classified as an analgesic (pain reliever) and also as antipyretic (fever reducer). It is produced in different formulations; these include tablets, capsules, liquid suspensions, suppositories and intravenous (IV).[1]

AGOSS understands that pregnant women in South Sudan may require safe, easily accessible, and effective medications to alleviate fever, pain, or discomfort during pregnancy.

Based on the best available data, paracetamol (acetaminophen) is still one of the safest options for managing mild to moderate pain and decreasing fever during pregnancy, when used at approved therapeutic levels.[2]

There is presently no conclusive scientific evidence that paracetamol, when used as intended, causes neurodevelopmental abnormalities (such as autism or ADHD) in children or congenital deformities in infants.[2] There are limits to observational studies that show probable connections, such as potential confounding factors. AGOSS also acknowledged many statements on the use of acetaminophen released by well-known worldwide regulators and professional obstetrics associations.

I. In 2017, the Society for Maternal-Fetal Medicine (SMFM) "conducted an independent review of large cohort studies" and concluded there is "no clear causal relationship" between the use of acetaminophen-containing products during pregnancy and neurodevelopmental disorders in children.[2]

II. The Medicines and Healthcare products Regulatory Agency (MHRA) in the United Kingdom confirms paracetamol remains safe in pregnancy when used as directed, and that there is no evidence it causes autism.[3]

III. The European Medicines Agency (EMA) recommends that paracetamol should be used for controlling pain or fever during pregnancy if clinically necessary. It recommends utilising the lowest effective dose for the shortest possible time.[4]

IV. According to the Royal College of Obstetricians and Gynaecologists (ROCG), controlling pain and fever during pregnancy is crucial, as uncontrolled fever can pose dangers. Therefore, paracetamol is the recommended first-line pain medication when used carefully.[5]

V. FIGO also advised that healthcare providers should continue following established clinical guidelines regarding paracetamol use in pregnancy because it remains the safest analgesic option during pregnancy when used appropriately, supported by decades of clinical experience and the highest-quality epidemiological evidence.[6]

VI. In a position made by the Society of Obstetricians and Gynaecologists of Canada (SOGC) recommended the use of acetaminophen as a first line analgesic for management of pain and fever drug during pregnancy when medically prescribed with the recommended dose and for the shortest duration possible.[7]

Recommendation

I. In regards to the current available scientific evidences, AGOSS advises that paracetamol should only be used when medically indicated, i.e., when fever or pain is significant, and not as a routine measure without symptoms.

II. Dosage should follow South Sudan Ministry of Health or WHO guidelines, using the lowest effective dose for the shortest possible duration.

III. Pregnant women should consult a health professional (midwife, obstetrician, pharmacist) before using paracetamol, particularly if:

a) They are in the very early stages of pregnancy, or approaching the third trimester.

b) They are using other medications that might interact.

c) They have liver disease or other medical conditions.

IV. It is also important to consider non-pharmacological measures for managing mild pain and fever (e.g., rest, hydration, cold compresses, cooling environment) when feasible.

Conclusion

We recommend that all healthcare providers continue to prescribe paracetamol as per clinical indications, considering the lowest possible doses in the shortest possible time.

AGOSS also commits to monitoring emerging research closely, and will update this guidance if new evidence indicates a need for change.

References

1. Kumar N, Prasad T, Singh S, Kumar P, Rathi R, Kumar N, et al. Paracetamol (N-acetyl-p-aminophenol, APAP) Threats: Therapeutic Clock. International Journal of Pharma Professionals Research. 2023;14. Available from: https://www.researchgate.net/publication/377752084
2. SMFM Response to Administration Announcement on Acetaminophen Use During Pregnancy and Autism. Available from: https://www.smfm.org/news/smfm-response-to-administration-announcement-on-acetaminophen-use-during-pregnancy-and-autism
3. Drug Safety Update (DSU) Paracetamol and pregnancy-reminder that taking paracetamol during pregnancy remains safe. 2025.
4. European Medicines Agency's (EMA). PRAC recommendations on signals. Adopted 12-15 March 2019. https://www.ema.europa.eu/en/documents/prac-recommendation/prac-recommendations-signals-adopted-12-15-march-2019-prac-meeting_en.pdf
5. Damkier P, Gram EB, Ceulemans M, Panchaud A, Cleary B, Chambers C, et al. Acetaminophen in Pregnancy and Attention-Deficit and Hyperactivity Disorder and Autism Spectrum Disorder. Obstetrics and Gynecology. 2025 Feb 1;145(2):168–76.
6. FIGO. Paracetamol (acetaminophen) use during pregnancy and autism risk: evidence does not support causal association FIGO Statement [Internet]. 2025. Available from: www.figo.org
7. Ahlqvist VH, Sjöqvist H, Dalman C, Karlsson H, Stephansson O, Johansson S, et al. Acetaminophen Use During Pregnancy and Children's Risk of Autism, ADHD, and Intellectual Disability. JAMA. 2024 Apr 9;331(14):1205–14.

SUPPORTING WET NURSING
DURING EMERGENCIES

A guide for **frontline workers** working in emergency preparedness and response

It is crucial to safeguard the health, development and survival of infants and young children in emergencies. If an infant cannot be fully breastfed by his/her mother, wet nursing is a feeding alternative that should be quickly explored.

What is wet nursing?

Breastfeeding of a child by someone other than the child's mother.

Informed consent is crucial in securing a wet nurse

The importance of breastfeeding during emergencies

It is essential to protect, promote and support breastfeeding, particularly in emergencies. All forms of breastmilk feeding are safer than breastmilk substitutes. In almost all circumstances, wet nursing is safer and more beneficial than breastmilk substitutes.

Technical and operational guidance for increasing access to breastmilk through wet nursing in emergency settings

Cultural context and acceptability

Wet nursing is a traditional practice in many parts of the world.
Consider the cultural context in which you are working.
Community sensitisation and education of wet nursing should be ongoing.

Language and terminology When discussing wet nursing, neutral and local terms which imply mutual consent and dignity are preferred. If no suitable local terms exist, descriptive language can be used instead. Consult the community to check which terminology is understood and accepted.

Islamic milk kinship is not a barrier to wet nursing. Wet nursing has a long tradition in Islam. There is an understanding that wet nursing creates permanent family bonds between wet nurses, their families, and the wet nursed infants. This must be taken into consideration in Islamic contexts.

Key principles of identifying and engaging a wet nurse

- Voluntary and consensual participation
- Cultural sensitivity
- Confidentiality and privacy
- Shared decision making

Step-by-step guide to establishing wet nursing in emergencies

Step 1: Which infants might benefit from wet nursing?

- Motherless infants, infants separated from their mothers, infants whose mothers are acutely ill and/or unable to breastfeed, infants whose mothers are in the process of relactation.
- Prioritise wet nurses for the youngest infants first.
- Is the infant being fully breastfed? If not, consult the infant's parents/primary caregiver and their family to identify ways to increase milk supply and if wet nursing and/or relactation are acceptable options.
- Assess the need for referral to IYCF support services (for breastfeeding, relactation and/or wet nursing support).

Operational Guidance: Breastfeeding Counselling in Emergencies

Procurement and use of breastmilk substitutes in humanitarian settings

Step 2: How to identify a potential wet nurse?

Who can be a wet nurse?

- The most convenient wet nurse is any woman who is currently breastfeeding, but this is not essential.
- A female relative or friend might be preferred.

Wet nurses should be:

1. Able to breastfeed another infant without detrimental consequences to herself or her child(ren), provided they are adequately supported.
2. In good overall mental and physical health, with adequate nutrition.
3. Willing and motivated to breastfeed someone else's infant.
4. Trusted and accepted by the infant's caregivers/family.
5. Within the infant's household or living nearby.
6. Supported by her family to breastfeed someone else's infant.

Reminder! Consider risk of infectious disease transmission.

Infographic: Infant feeding during infectious disease outbreaks

When screening a potential wet nurse, consider factors that affect her physical health, mental health and nutrition.

For more detailed guidance on these factors, see ***the Technical and Operational Guidance on Supporting Access to Breastmilk Through Wet Nursing in Emergencies, and the Wet Nursing screening tool.***

Wet Nursing screening tool

Technical and operational guidance for increasing access to breastmilk through wet nursing in emergency settings

Reminder! A short-term wet nurse is an option until a long-term feeding option can be arranged (e.g. mother's relactation, long term wet nurse, or other sustainable feeding option).

Reminder! Remember, how will the infant be fed today?

Step 3: What to do once a wet nurse has been identified and confirmed?

Reach agreement on the practical aspects of wet nursing with the infant's parents/primary caregiver and wet nurse. Consider:

- How often will the infant be fed by the wet nurse?
- Where will the infant be breastfed?
- Where and how will night feeds be managed?
- See the ***Technical and Operational Guidance on Supporting Access to Breastmilk Through Wet Nursing in Emergencies*** for more guidance on key topics to discuss during the agreement process.

N.B. In the case of orphaned infants there may be additional considerations for care beyond breastfeeding.

Provide support and counselling:

- For the mother to increase milk supply/relactate, if feasible.
- For the wet nurse to support breastfeeding the infant.
- For the mother and/or wet nurse on the benefits of breastfeeding for their physical and emotional health.

Women often think that stress and poor nutrition limits their ability to breastfeed. Reassure women that they can still produce breastmilk even if they are stressed and malnourished. Help facilitate the let-down reflex by helping with stress relief. Provide necessary support (both psychosocial and nutrition) as soon as possible.

Refer to and link with support services and sectors e.g. further IYCF-E support, Water, Sanitation and Hygiene (WASH), Mental Health and Psychosocial Support (MHPSS), Food assistance, Protection, etc.

Continue to raise awareness on wet nursing through community sensitisation, education and counselling.

Provide ongoing support, monitoring and follow-up, including addressing fears/concerns, adjusting the wet nursing arrangement as needed, etc.

*For more detailed guidance on establishing a wet nursing agreement and the above elements, please see the ***Technical and Operational Guidance on Supporting Access to Breastmilk Through Wet Nursing in Emergencies***.

Technical and operational guidance for increasing access to breastmilk through wet nursing in emergency settings

Step 4: How to support the end of a wet nursing agreement

- Assess readiness and circumstances for the infant, wet nurse and mother/caregiver.
- Plan a gradual transition to appropriate alternative feeding options.
- Provide follow-up and ongoing emotional support and counselling.
- Ensure that contact details have been exchanged with the wet nurse so any future issues can be addressed.
- In contexts where Islamic milk kinship is relevant, ensure the relationship established through wet nursing is appropriately documented.

*For more detailed guidance on ending a wet nursing agreement and the above elements, please see the ***Technical and Operational Guidance on Supporting Access to Breastmilk Through Wet Nursing in Emergencies***.

Technical and operational guidance for increasing access to breastmilk through wet nursing in emergency settings

Alternatives to wet nursing

Feeding options To be explored in the following order of priority	Age of child		
	<6 months	6-11 months	12-23 months
1 **Donor human milk**	✓	✓	✓
2 **An appropriate breastmilk substitute:**			
Infant formula milk* (Ready to Use or Powdered Infant Formula)	✓	✓	●
Whole cream pasteurised animal milk	●	✓	✓

*Follow-on/toddler formula is not recommended. **N.B.** Avoid bottles and teats, instead use a spoon or cup for feeding.

Infographic: Supporting infants dependent on artificial feeding during emergencies

Additional considerations

HIV: Breastfeeding mothers living with HIV should be supported to breastfeed as per WHO breastfeeding guidelines, while being fully supported for adherence to Antiretroviral therapy. The known risks associated with withholding the protection from breastfeeding must be given greater weight in a risk/benefit calculation than the potential and unknown risk of the infant contracting HIV. For more information on HIV risk assessment, see the:

HIV and Infant Feeding in Emergencies Operational Guidance

Wet Nursing screening tool

Part of the **Infant Feeding in Emergencies Core Group** infographic series.
Find out more at **www.ennonline.net/ife**

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