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RESEARCH ARTICLE

Stillbirth mortality by Robson ten-group classification system: A cross-sectional registry of 80 663 births from 16 hospital in sub-Saharan Africa

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Abstract

Objective: To assess stillbirth mortality by Robson ten-group classification and the usefulness of this approach for understanding trends.
Design: Cross-sectional study.
Setting: Prospectively collected perinatal e-registry data from 16 hospitals in Benin, Malawi, Tanzania and Uganda.
Population: All women aged 13–49 years who gave birth to a live or stillborn baby weighting >1000 g between July 2021 and December 2022.
Methods: We compared stillbirth risk by Robson ten-group classification, and across countries, and calculated proportional contributions to mortality.
Main outcome measures: Stillbirth mortality, defined as antepartum and intrapartum stillbirths.
Results: We included 80 663 babies born to 78 085 women; 3107 were stillborn. Stillbirth mortality by country were: 7.3% (Benin), 1.9% (Malawi), 1.6% (Tanzania) and 4.9% (Uganda). The largest contributor to stillbirths was Robson group 10 (preterm birth, 28.2%) followed by Robson group 3 (multipara with cephalic term singleton in spontaneous labour, 25.0%). The risk of dying was highest in births complicated by malpresentations, such as nullipara breech (11.0%), multipara breech (16.7%) and transverse/oblique lie (17.9%).
Conclusions: Our findings indicate that group 10 (preterm birth) and group 3 (multipara with cephalic term singleton in spontaneous labour) each contribute to a quarter of stillbirth mortality. High mortality risk was observed in births complicated by malpresentation, such as transverse lie or breech. The high mortality share of group 3 is unexpected, demanding case-by-case investigation. The high mortality rate observed for Robson groups 6–10 hints for a need to intensify actions to improve labour management, and the categorisation may support the regular review of labour progress.

KEYWORDS
caesarean section, cause of mortality, determinates of stillbirth, obstetric risk, stillbirths, sub-Saharan Africa, ten-group classification system

*For details of the ALERT team, see the Acknowledgements.

1 | INTRODUCTION

Globally, 1.9 million babies are stillborn and 2.3 million babies die within the first 28 days of life every year, mostly within the first hours and days postpartum.[1,2] In high-mortality settings, including sub-Saharan Africa, half of stillbirths occur during childbirth.[1] In addition, intrapartum-related complications contribute to about one-third of annual global neonatal deaths, making improved intrapartum care a priority.[3] To achieve the Sustainable Development Goals and Every Newborn Action Plan, accelerated efforts are needed to reduce stillbirths from the current levels of around 19 to below 12 deaths per 1000 live births.[4,5]

Analysis of the causes and underlying obstetric factors of stillbirth is helpful for developing national strategies and institutional quality improvement.[6–10] However, most classification systems require many parameters, making them cumbersome to use within routine data collection. For example, the World Health Organization (WHO) application of the International Classification of Diseases to Perinatal Mortality (ICD-PM) requires detailed clinical information, entailing careful review of case sheets and often a research team auditing cases.[6] The few studies that used the system described challenges in non-mutually exclusive categories and missing information complicating categorisation.[11,12]

Concerns regarding the overuse of caesarean section (CS) triggered the conceptualisation of simple obstetric categories that can be reviewed to address reasons for obstetric practices, first published by Michel Robson.[13] This Robson ten-group classification system (Figure S1) – herein referred to as Robson groups – categorises births into mutually exclusive groups based on clearly defined and routinely recorded obstetric characteristics.[14]

The Robson groups are widely used to analyse in-facility CS rates,[14,15] and are sporadically used to review perinatal mortality.[16–18] In Tanzania, an adapted Robson classification was applied to population-based survey data that found very high neonatal mortality in multiple pregnancies (group 7) and small babies (group 10).[16] An analysis of the Peruvian Perinatal Information System found high stillbirth rates in groups 6–8 and 10, representing deliveries with breech or transverse presentation and preterm births.[17]

Although the Robson classification offers a simple categorisation, it has not been used to compare stillbirth rates across countries or to assess the contributions of Robson groups to overall stillbirth rates.

Our objective was to assess stillbirth mortality (ante- and intrapartum stillbirth) by Robson group to identify the obstetric risks captured by this classification system across referral hospitals in Benin, Malawi, Tanzania and Uganda, with a view to gain an understanding of the usefulness of the classification for auditing (Video S1).

2 | METHODS

2.1 | Study design, setting and participants

This cross-sectional study used the Action leveraging evidence to reduce perinatal mortality and morbidity in sub-Saharan Africa (ALERT) prospective electronic perinatal registry from 16 hospitals in Benin, Malawi, Tanzania and Uganda. Details on the ALERT study, the e-registry and inclusion criteria for countries and hospitals have been published previously.[19,20] The four countries are low- or lower middle-income countries with a high perinatal mortality burden.[21] The four medium-size hospitals in each country have >2500 births annually and are typically district or regional public or faith-based hospitals providing CS care. Our assessment of competences and skills of midwifery staff identified major deficiencies.[22]

All 16 hospitals suffer from resource limitations and experience issues with applying international fetal monitoring standards. These challenges are similar to those described in Uganda (Table S1).[23]

We included all mother–baby pairs admitted for childbirth in the 16 hospitals between 1 July 2021 and 31 December 2022. We included stillbirths with birthweights of >1000 g, applying the international recommendation.[24] We excluded mother–baby pairs who were referred after giving birth, except when one of the multiples was delivered in the hospital.

The data collection tool was modelled on perinatal registers employed at the national university hospital in Tanzania and in other European settings.[25,26] A complete list of indicators was published previously.[20] The tool was piloted and went through several iterations of reviews and adaptations.

Ethical approval for the study was obtained from national ethics authorities in all four participating countries, the Swedish Ethics Review Authority and a Belgian ethics committee. Yearly approvals were obtained where applicable, and approval numbers are available in our protocol article.[19]

2.2 | Outcomes and exposure variables

The main outcome was stillbirth (ante- and intrapartum stillbirth). Intrapartum deaths were classified by the staff, trained nurses or midwives, through the clinical assessment of signs of maceration, according to national guidelines. We did not use the assessment of fetal heart rate at admission because it was not considered sufficiently reliable and data were missing for 12% of all births and 19% of stillbirths, with large variation among hospitals and countries. Data for outcome based on physical appearance had only 0.1% missing.

The main exposure variable was Robson obstetric risk group (1–10) (Figure S1). The classification uses six obstetric risk parameters: parity, number of fetuses, previous CS, onset of labour, gestational age and fetal presentation. Groups 1 and 3 are generally considered as lower obstetric

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risk groups. Groups 6–10 are considered as higher obstetric risk groups because malpresentation, multiple fetuses and preterm labour are generally accepted to increase the risk of obstructed labour, thus leading to higher CS rates and a higher risk of stillbirth. Group 5 is singled out as the group that often drives high overall CS rates.[27–29]

Variables used in the Robson classification were included in the routine documentation of all hospitals included. Health providers in the facilities were directed during initial training and follow-up visits to also weigh stillbirths and small babies, for consistent inclusion. Gestational age was determined using the information on the antenatal card, which is derived from the last menstrual period, as early ultrasound was not available in any of the hospitals.[30]

2.3 | Data collection and management

The data collection approach was discussed with the hospital teams as part of formative research in November 2020. Data collection commenced in July 2021 after a 2-day training, pre-testing and piloting phase run between March and June 2021. Data were entered daily into a pre-programmed tool in the maternity ward by nurse-midwives using the Research Electronic Data Capture (REDCap, https://www.projectredcap.org) platform available on tablets.[31] We checked the completeness of the e-registry against the standard Health Management Information Systems documentation. We established checks in REDCap including ranges, completeness and internal consistency. Using biweekly pre-prepared do-files run in Stata (StataCorp LLC, College Station, TX. USA), we further assessed the total number of births, completeness of outcome variables, and key predictors to ensure complete and accurate data.

2.4 | Statistical analysis

We examined the characteristics of the included women and their births using percentages and 95% confidence intervals (95% CIs), and standard deviation, where appropriate. We calculated percentages with 95% CIs of babies born by CS per Robson group. Stillbirth mortality was expressed as a percentage of all births (live and stillbirths). Percentage distribution by Robson group and the relative contribution from each group to all stillbirths and intrapartum stillbirths were examined using percentages and 95% CIs. Estimates were produced per country.

2.5 | Role of funding

The funder of the study had no role in the study design, data collection, analysis, interpretation or write-up of the results.

3 | RESULTS

We included 78 085 women giving birth in the hospitals (Table 1). Women giving birth in hospitals in Benin were slightly older (mean age 27.1 years) and women giving birth in hospitals in Malawi were the youngest (mean age 23.8 years). We observed differences in the proportion of women who were referred to the hospitals: 45.5% in Benin, 33.7% in Malawi, 6.5% in Tanzania and 20.5% in Uganda. We also observed differences in the proportion of births for which antenatal risk factors were documented: 45.3% in Benin, 9.0% in Malawi, 14.9% in Tanzania and 19.6% in Uganda. A higher proportion of women gave birth by CS (45.5%) in Benin, compared with 17.3% in Malawi, 28.3% in Tanzania and 27.4% in Uganda. The rates of assisted vaginal deliveries were 1% or lower in hospitals in all countries.

The 78 085 women gave birth to 80 663 babies. Stillbirth mortality was 7.3% in Benin, 1.9% in Malawi, 1.6% in Tanzania and 4.9% in Uganda (Table 1). In Benin, a higher share of all births (35.4%) came from Robson groups 6–10, compared with the other three settings, where the higher obstetric risk groups of breech, multiples, transverse/oblique lie and preterm birth were present in around 20% of women (Figure 1; Table S2). Robson groups 1 and 3 (nullipara and multipara in spontaneous labour with a cephalic term baby) contributed to 16.7%, 38.1%, 28.4% and 28.4% (nullipara) and 23.8%, 39.2%, 38.7% and 38.3% (multipara) of the total births in Benin, Malawi, Tanzania, and Uganda, respectively.

The overall CS rate was 44.4% of births in Benin, with the lowest rate of 19.7% in group 3, representing multipara in spontaneous labour with a cephalic term birth (Table 2). Hospitals in Malawi, Tanzania and Uganda had CS rates of around 10% in group 3. CS rates were above 70% in nullipara in induced labour or with a CS before spontaneous labour (Robson group 2) across all countries. CS rates in deliveries complicated by transverse/oblique lie ranged from 51.2% to 88.1%.

The risk of stillbirth was highest in births complicated by malpresentation, such as breech presentation in nullipara (group 6, 11.0%), breech presentation in multipara (group 7, 16.7%) and transverse/oblique lie (group 9, 17.9%). Stillbirth mortality was 9.7% in preterm birth (group 10). We observed greater variation among countries for Robson group 1, with risks spanning 4.2% in Benin, 1.2% in Malawi, 0.8% in Tanzania and 2.6% in Uganda. Similarly, the risk of stillbirth in group 3 was 7.6% in Benin, 1.3% in Malawi, 0.9% in Tanzania and 3.3% in Uganda. Stillbirth risk was 2% in births complicated by a previous CS. The largest contributors to stillbirths were Robson group 10 (preterm, 28.6%) and group 3 (multipara cephalic in spontaneous labour, 25.3%), followed by group 1 (nullipara cephalic in spontaneous labour, 14.2%) (Table 3).

The risk of intrapartum stillbirth showed similar variation across countries: 2.7% in Benin, 0.7% in Malawi, 0.4% in Tanzania and 1.6% in Uganda for Robson group 1 (Table S3).

TABLE 1 Women's demographic profile, obstetric risk factors, mode of birth and perinatal mortality from 16 hospitals in Benin, Malawi, Tanzania and Uganda, from 1 July 2021 to 31 December 2022 (78 085 women giving birth to 80 663 babies).

	Benin		Malawi		Tanzania		Uganda	
Women (*n*)	15 997		27 040		13 125		21 923	
Age, mean/SD	27.1	6.2	23.8	6.3	26.2	7.2	25.2	5.9
Adolescent births, <18 years of age	502	3.1%	2775	10.3%	965	7.4%	1211	5.5%
Parity, mean/SD	2.2	1.6	1.7	1.2	1.7	1.1	2.0	1.5
Nullipara (%)	4894	30.6%	12 485	46.2%	5015	38.2%	8087	37.0%
Referred to hospital	8709	54.5%	9116	33.7%	848	6.5%	4440	20.5%
Any antenatal risk factor[a]	7240	45.3%	2433	9.0%	1952	14.9%	4295	19.6%
Any admission risk factors[b]	4473	28.0%	1275	4.7%	1367	10.4%	2205	10.1%
Mode of birth (*n*)	15 987		27 036		13 107		21 704	
Spontaneous vaginal birth	8466	53.0%	21 852	80.8%	9291	70.9%	15 635	72.0%
Birth by caesarean section	7277	45.5%	4684	17.3%	3707	28.3%	5945	27.4%
Assisted vaginal birth[c]	130	0.8%	264	1.0%	45	0.3%	12	0.1%
Assisted breech birth	114	0.7%	236	0.9%	64	0.5%	112	0.5%
Total babies born (*n*)								
Total stillbirths	1263	7.3%	525	1.9%	217	1.6%	1102	4.9%
Antepartum stillbirths	519	3.0%	267	1.0%	126	0.9%	474	2.1%
Intrapartum stillbirths	744	4.3%	258	0.9%	91	0.7%	628	2.8%

[a]Antenatal risk factors of previous caesarean section, hypertensive disorders, ruptured membranes, diabetes and gestational diabetes.

[b]Admission risk factors of breech or transverse lie, suspected small for gestational age, post-term, chorioamnionitis, antepartum haemorrhage or hypertensive disorder.

[c]Vacuum/forceps.

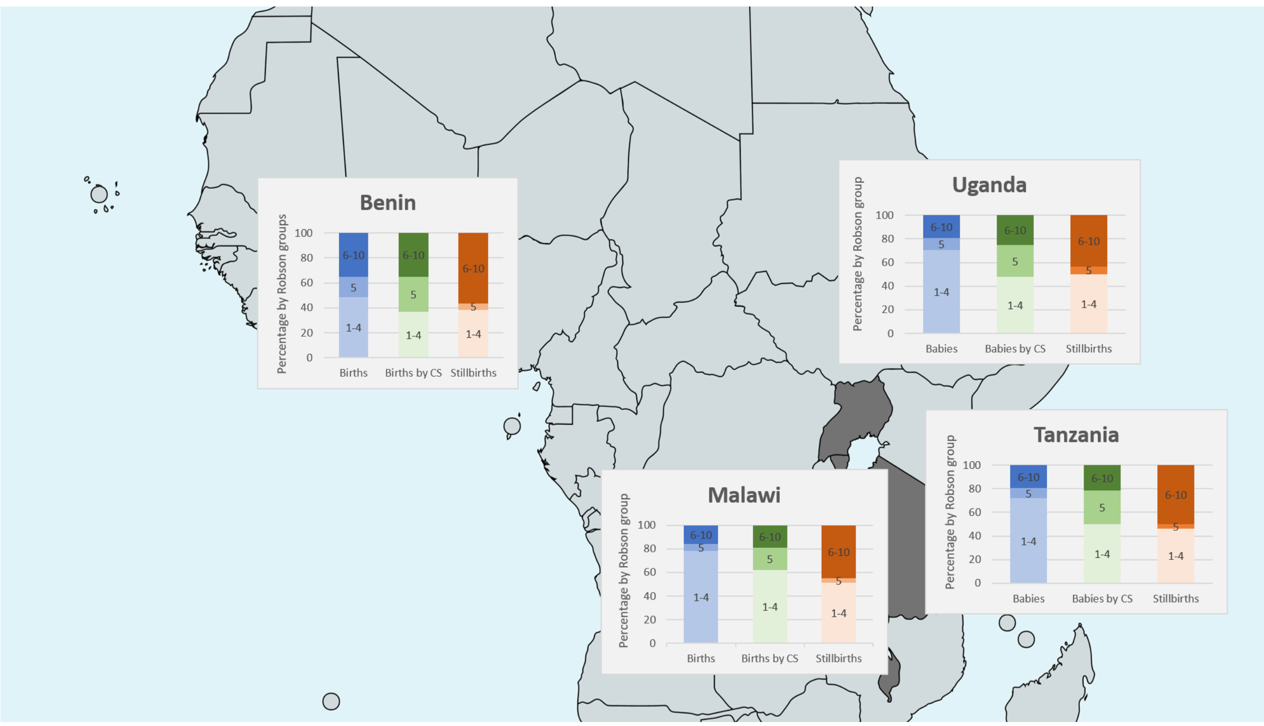

FIGURE 1 Percentages of babies, caesarean section (CS) and stillbirth deaths in Robson groups 1–4, 5 and 6–10, by country.

Intrapartum stillbirth risk was 5.1% in nullipara breech (group 6) and 11.1% in multipara breech (group 7). Stillbirth risk was 8.5% in group 9 (transverse/oblique lie) and 4.5% in group 10 (preterm), with major variations among the countries.

Overall stillbirth rates were 3.7% in vaginal births and 4.3% in births by CS. Stillbirth rates were slightly lower in birth by CS compared with vaginal birth in Robson groups 6 and 7 (nullipara and multipara with breech presentation) (Table S4).

TABLE 2 Caesarean section rates by Robson ten-group classification system from 16 hospitals in Benin, Malawi, Tanzania and Uganda, from 1 July 2021 to 31 December 2022 ($N = 80\,663$ babies).

		Benin	Malawi	Tanzania	Uganda	All countries (pooled)		
Robson group		% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	*N*	% (95% CI)	Recommended CS rate[13]
1		34.5 (29.1–40.4)	16.9 (10.1–26.8)	20.5 (14.3–28.6)	23.2 (18.6–28.5)	5028	21.4 (16.7–26.9)	<10%
2		80.1 (70.3–87.2)	71.2 (43.4–88.8)	92.9 (87.3–96.2)	72.1 (61.7–80.6)	1124	81.0 (73.6–86.6)	20%–35%
3		19.7 (15.4–24.9)	9.6 (5.9–15.4)	10.9 (7.3–15.9)	12.0 (8.8–16.0)	3443	12.0 (9.3–15.4)	<3%
4		65.5 (51.0–77.6)	65.0 (49.9–77.6)	84.1 (70.6–92.0)	54.7 (42.7–66.2)	985	66.9 (57.3–75.3)	<15%
5		77.2 (72.9–81.0)	55.6 (43.4–67.2)	94.7 (93.0–95.9)	72.2 (68.7–75.6)	5790	73.8 (67.1–79.5)	50%–60%
6		73.4 (71.1–75.6)	53.3 (30.5–74.9)	76.2 (64.3–85.1)	48.9 (38.0–59.8)	443	64.2 (53.2–73.9)	Not provided
7		64.5 (55.3–72.7)	30.5 (19.0–45.2)	44.1 (39.1–49.2)	47.1 (40.4–53.9)	880	54.8 (44.7–64.6)	Not provided
8		30.3 (23.5–38.1)	29.4 (18.1–44.1)	45.9 (36.5–55.6)	37.7 (35.3–40.0)	1892	33.7 (28.7–41.4)	60%
9		86.6 (72.1–94.1)	51.2[a] (17.1–84.3)	64.0[a] (33.9–86.0)	88.1 (80.8–92.9)	184	78.6 (62.3–89.1)	100%
10		45.9 (35.7–56.4)	16.0 (9.6–25.4)	24.0 (16.5–33.6)	29.4 (24.3–35.2)	2511	27.9 (20.8–36.3)	30%
Unclassified		69.6[a] (54.2–81.5)	30.0[a] (17.4–46.5)	93.3[a] (68.8–98.9)	49.1 (40.4–57.8)	287	49.9 (41.4–58.4)	–
Total per country		44.4 (40.3–48.5)	17.5 (10.9–26.9)	28.6 (21.2–37.4)	27.8 (23.5–32.4)	22 567	28.0 (21.9–35.0)	–

[a]Sample <50.

TABLE 3 Stillbirths (number, percentage of all babies, 95% CI) by Robson group and relative contribution to overall stillbirth mortality from 16 hospitals in Benin, Malawi, Tanzania and Uganda included in the ALERT trial, from 1 July 2021 to 31 December 2022.[a]

	Stillbirth mortality by Robson group						Relative contribution to stillbirth mortality (column total)				
	Benin	Malawi	Tanzania	Uganda	Total		Benin	Malawi	Tanzania	Uganda	Total
Robson group	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	*n*	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
1	4.2 (2.4–7.0)	1.2 (0.8–1.6)	0.8 (0.6–1.1)	2.6 (2.2–3.0)	436	1.9 (1.2–2.8)	9.5 (7.1–12.6)	23.0 (18.5–28.3)	14.7 (10.8–19.8)	14.8 (11.8–18.4)	14.0 (11.1–17.5)
2	3.1 (2.6–3.7)	4.8 (1.7–12.6)	0.3 (0.0–2.6)	9.2 (7.8–10.9)	51	3.7 (2.3–5.8)	1.7 (0.8–3.7)	1.0 (0.4–2.6)	0.5 (0.1–2.4)	2.1 (1.3–3.3)	1.6 (1.1–2.5)
3	7.6 (4.4–12.7)	1.3 (0.9–1.7)	0.9 (0.5–1.6)	3.3 (2.4–4.6)	776	2.7 (1.5–4.7)	24.6 (18.5–32.0)	25.9 (22.4–29.8)	20.7 (12.6–33.2)	25.8 (21.9–30.1)	25.0 (22.0–28.3)
4	4.7 (3.1–7.0)	5.1 (2.4–10.7)	6.2 (2.2–16.4)	14.2 (8.3–23.3)	108	7.3 (4.4–11.9)	2.5 (1.0–5.9)	1.3 (0.4–4.1)	9.2 (7.5–11.3)	4.5 (3.1–6.7)	3.5 (2.1–5.8)
5	2.2 (1.3–3.5)	1.2 (0.9–1.6)	0.7 (0.4–1.4)	3.0 (1.7–5.4)	157	2.0 (1.4–2.8)	4.8 (4.0–5.8)	3.8 (2.5–5.8)	3.7 (2.6–5.2)	6.2 (4.1–9.1)	5.1 (4.1–6.2)
6	13.1 (7.7–21.5)	9.1 (4.5–17.6)	2.5 (0.4–15.2)	13.6 (8.9–20.4)	76	11.0 (7.1–16.7)	3.2 (1.9–5.4)	2.9 (1.6–4.9)	0.9 (0.2–4.8)	1.6 (1.2–2.2)	2.4 (1.6–3.8)
7	17.2 (14.2–20.7)	12.8 (9.2–17.6)	11.0 (7.0–17.0)	19.8 (14.0–27.1)	268	16.7 (14.1–19.7)	12.7 (11.0–14.6)	5.0 (3.8–6.4)	6.5 (4.5–9.1)	6.2 (4.8–7.9)	8.6 (6.2–11.8)
8	4.3 (2.9–6.4)	4.9 (3.3–7.2)	2.8 (1.4–5.3)	6.5 (4.3–9.8)	237	4.9 (3.6–6.1)	8.9 (6.6–11.8)	8.4 (6.3–11.1)	6.9 (4.2–11.1)	9.3 (7.6–11.3)	8.8 (7.5–10.2)
9	20.9 (9.7–39.3)	12.2 (6.4–21.9)	8.0 (1.8–28.8)	20.8 (14.6–28.7)	42	17.9 (12.6–24.9)	1.1 (0.3–3.6)	1.0 (0.3–2.6)	0.9 (0.2–4.8)	1.9 (1.5–2.5)	1.4 (0.8–2.3)
10	17.8 (13.5–23.1)	4.9 (3.7–6.3)	4.3 (1.8–9.5)	13.1 (9.2–18.3)	877	9.7 (6.3–14.8)	30.7 (23.4–39.2)	27.4 (22.0–33.7)	35.9 (29.5–42.9)	24.2 (19.6–29.5)	28.2 (24.7–32.0)
Total	7.3 (5.0–10.5)	1.9 (1.5–2.5)	1.6 (0.9–2.8)	4.9 (3.5–6.9)	3107	3.9 (2.5–5.9)	100	100	100	100	100

[a]A total of 79 stillbirths (2.5%) could not be classified.

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4 | DISCUSSION

4.1 | Main findings

To our knowledge, this is the first study analysing stillbirth mortality across four high-burden countries using the Robson classification. We included 80 663 babies born in 16 referral hospitals between July 2021 and December 2022. In all four countries, stillbirth mortality rates were highest in pregnancies with breech presentation, transverse/oblique lie and multiples, as well as preterm births, which are all childbirth events demanding timely adequate obstetric management. However, a high share – roughly one-quarter of stillbirths – was reported in Robson group 3 (cephalic term babies of multipara admitted in spontaneous labour). Our analysis suggests that the Robson ten-group classification system provides a useful analysis framework to monitor mortality in high-risk obstetric groups, whereas more in-depth clinical auditing is needed to understand the large share of stillbirths in Robson group 3 as well as the variation observed among countries.

4.2 | Strength and limitations

We used data from a perinatal e-registry established in the 16 hospitals using a defined methodology and rigorous data assurance procedures. The standardised methodology allows comparison between hospitals and between settings. However, our study also faced limitations. Fetal heart rate at admission was deemed inappropriate for the distinction between ante- and intrapartum stillbirths, as contextual knowledge proposed that health providers were inclined to record a positive fetal heartbeat in cases in which they could not establish viability. Dopplers were rarely available for admission procedures. Thus, misclassification between antenatal and intrapartum stillbirths was possible. We also faced difficulties establishing gestational age, a well-established and widely recognised problem in settings where obstetric ultrasound is not available and women present late for the first antenatal care visit.[30,32] Thus we had to accept that some preterm babies may have been categorised in groups other than group 10, and that the reported mortality in the lower risk Robson groups 1–4 might be inflated because of this misclassification. The rates of breech presentation and multiples were within the international ranges. Although we included a large number of births, the number of stillbirths in the subgroups was small, leading to a lack of precision in estimates.

Despite these limitations, our analysis provides important insights into the subgroups in which mortality is concentrated. It is notable that the main advantage of the Robson classification is that the necessary information is readily available in most settings and the system is increasingly used to review CS rates. No expert review committee needs to be established to categorise these data. The analysis presented was facilitated by the electronic nature of our data collection and our data quality assurance. Only 2.5% of births could not be classified. The electronic nature of the data allowed stratification without time-consuming manual procedures, which typically hamper the use of the Robson classification.[33] As many countries in sub-Saharan Africa have ambitions to establish electronic medical records, our analysis may be an example of the potential this provides for auditing deaths.

Our analysis also hinted of a limitation for using the Robson classification for auditing stillbirths. Although providing a very good overview of where the mortality is concentrated, the classification – being a simple and easy to apply system – does not fully capture the complexity of individual cases, and nor does it consider other relevant factors such as referral status, maternal comorbidities or fetal conditions. This limitation is particularly relevant when explaining the large difference in mortality rates across settings in Robson groups 1 and 3. In contrast, the high mortality rate observed in groups 2 and 4, as well as groups 6–9, gives clear clinical indications towards the need for improvements in obstetric management, such as better fetal monitoring during induction or augmentation of labour, and the management of breech and twin deliveries.

4.3 | Interpretation

Our results need to be viewed in relation to differences in the birthing population accessing care in the 16 hospitals across the four countries, and the way in which these women differ from the underlying population of women giving birth. The hospitals in Benin included a higher share of women considered to be at high risk: 54.5% were referred for complications, and 45.3% had any risk detected during antenatal care. In comparison, the district and regional hospitals in Malawi, Tanzania and Uganda included less than one-third of births complicated by referral. Less than one-fifth had documented risk factors. It is of note that Benin, the country with the largest proportion of referred women, has a user fee policy that prevents women from seeking care without being formally referred.[34] Furthermore, beliefs and cultural context hinder the early use of hospitals for childbirth.[35]

Previous Demographic and Health Survey (DHS) analysis has reported that in Benin a marginally lower share of 30% of all live births take place in hospitals, compared with 33% in Malawi, 32% in Tanzania and 37% in Uganda.[36] Furthermore, the observed rates of breech and twins suggest that the hospitals of Malawi, Tanzania and Uganda provide care for a largely unselected birthing population, where we would expect 3%–4% of term breech births and around 3% of twin births.[37,28] In contrast, the hospitals in Benin have clearer characteristics for referral facilities.

Our analysis of CS rates by Robson group indicate relatively higher CS rates in groups 1–4 compared with international levels, whereas the high risk groups 6–9 had somewhat lower rates than expected.[14] We report major differences in stillbirth rates, particularly in Robson group 1, spanning from 0.8% in Tanzania, 1.2% in Malawi, 2.6% in Uganda to 4.2% in Benin. Group 3 is the largest group, including 35.8% of all births, and has similar major variation in mortality among the countries. The high rates of mortality in Uganda are somewhat surprising as international data suggest lower rates here than in Tanzania and Malawi.[2] Late or ineffective referral may be one factor explaining mortality differences, as we saw similar patterns when assessing birth asphyxia in the 16 hospitals.[38] Insufficient fetal monitoring may also explain these differences. Our assessment of the knowledge and skills of maternity providers in all 16 hospitals indicate knowledge deficits in fetal monitoring.[22]

Very few studies have been published using a similar approach to ours. A study in Peru supports our results by identifying high stillbirth rates in Robson groups 6–10; however, the study did not present their contribution to the overall mortality rate.[17] A study from Nigeria found a high share of stillbirth mortality in groups 3 and 10, thus confirming our key findings, but mortality rates are missing for a full comparison.[18]

In sum, our study highlights high mortality in birth complicated by breech presentation, transverse/oblique lie and multiples, as previously reported.[39,40] The higher stillbirth mortality risks in twins are well established.[28,16] High mortality rates in breech presentations were also reported from maternity hospitals in Dar-es-Salaam, Tanzania.[41]

The high stillbirth rate and specifically the intrapartum stillbirth mortality rate in breech presentations are of particular concern. In our 16 hospitals, 64% and 55% of all pregnancies in nullipara and multipara complicated by breech presentation received a CS, respectively. The rates are thus not very different from, for example, those in Norway (74% in nullipara and 63% in multipara).[42] It is notable that the guidelines in high-income countries (e.g. the National Institute for Health and Care Excellence, NICE[43]) propose the option of a planned CS for breech presentation at term in response to the latest Cochrane review on this topic.[27] National-level guidelines in our intervention countries suggest proceeding with vaginal breech delivery for nullipara and multipara mothers without additional risk factors.[44–46] Although little is systematically known about vaginal breech delivery skills, an assessment in Uganda suggested that there are limited skills to manage breech presentation.[47]

5 | CONCLUSION

The Robson ten-group classification system offers a simple framework to analyse not only in-facility CS rates across settings, but also to identify groups of high stillbirth mortality. We believe that our analysis may inspire similar analysis, for example, as part of the well-established Maternal and Perinatal Death Surveillance and Review (MPDSR) systems. The six obstetric variables were readily available from our perinatal e-registry, but quality issues around the assessment of gestational age provided a challenge. Our analysis clearly points to a need to prioritise intrapartum care and the management of obstetric complications of breech presentation, transverse/oblique lie and multiple births in these high-mortality settings in sub-Saharan Africa. A large share of mortality is seen in Robson groups 1 and 3, with major variations among countries. A case-by-case in-depth analysis might be needed to derive clear clinical action points as well as identify health system issues related to accessibility of care and timely referral, highlighting the limitations of the Robson classification system.

AUTHOR CONTRIBUTIONS

CH, KSA, MA, HK, HMA, ABP, PW, J-PD, EC and LB designed the protocol, and led the data curation, supervision, funding acquisition, methodology, project administration and management of resources. CH, MS and MRA performed the statistical analysis, validation and visualisation, under supervision from LB. CH wrote the original draft. All authors reviewed and edited the final draft. CH, MS and MRA had access to the full data set and directly assessed and verified the underlying data reported in the article. CH, MS and LB had the final responsibility for the submission of the article. All of the ALERT study team was involved in the conceptualisation of the ALERT study, data curation, supervision and project administration. All authors approved the final submission of the article for publication.

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CONFLICT OF INTEREST STATEMENT

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DATA AVAILABILITY STATEMENT

Data will be made publicly available after the finalisation of the trial, as outlined in our data management plan and publication policy. Before 2027, the data are available on request.

ETHICS STATEMENT

Ethical approval for the study was obtained from the Swedish Ethics Review Authority, the Belgian ethics committee and the national ethics authorities in all four participating countries: Comité National d'Ethique pour la Recherche en Santé, Cotonou, Bénin (83/MS/DC/SGM/CNERS/ST) (20th July 2020); College of Medicine Research and Ethics Committee (COMREC), Malawi, (COMREC P.04/20/3038) (20 July 2020); Muhimbili University of Health and Allied Sciences (MUHAS) Research and Ethics Committee, Tanzania (MUHAS-REC-04-2020-118); The Aga Khan University Ethical Review Committee, Tanzania (AKU/2019/044/fb) (21 March 2020); School of Public Health research and ethics committee (HDREC 808) and Uganda National Council for Science and Technology (UNCST) (HS1324ES) (4 August 2020); Karolinska Institutet, Sweden (Etikprövningsmyndigheten Dnr 2020–01587) (18 October 2020); and the Institutional Review Board at the Institute of Tropical Medicine Antwerp and The Ethics Committee at the University Hospital Antwerp, Belgium (ITG 1375/20, B3002020000116) (29 June 2020). All hospitals gave administrative approval.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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