

Family Profiles at High Risk of Neonatal Mortality in Tshopo, DRC: A Case-Control Study

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ABSTRACT

Introduction

Neonatal mortality remains a critical global public health challenge. The Democratic Republic of the Congo (DRC) continues to report high neonatal mortality rates, exceeding 26 deaths per 1,000 live births.

Purpose

This study aimed to identify family profiles at high risk of neonatal mortality in Tshopo Province, DRC, by evaluating associated maternal, obstetric, and neonatal risk factors to establish a predictive risk score.

Methods

A case-control study with nested prospective follow-up was conducted between January 2022 and July 2024 among live births across health facilities in Tshopo Province (N=690; n=230 cases, n=460 controls). Multivariable logistic regression was performed to identify independent risk factors and calculate adjusted odds ratios (aOR). Significant predictors were incorporated into a cumulative risk score to stratify family risk profiles.

Results

High-risk family profiles for neonatal mortality were characterized by lack of antenatal care attendance (aOR=5.39, 95% CI [1.92,15.19], p=.001), maternal pathologies during pregnancy (aOR=8.23, 95% CI [5.51,12.30], p<.001), operative delivery (aOR=3.60, 95% CI [1.90,6.81], p<.001), a 5-minute APGAR score <7 (aOR=1.54, 95% CI [1.01,2.35], p=.043), and low birth weight (aOR=3.83, 95% CI [2.16,6.80], p<.001). A cumulative score of ≥2 risk factors was associated with an eightfold increase in neonatal mortality risk compared to low-risk families.

Conclusion

Neonatal mortality in Tshopo Province is driven by interrelated maternal, obstetric, and neonatal factors. Routine community-based screening utilizing the five-factor risk score by community health workers can facilitate early identification, rapid referral, and targeted preventive interventions.

INTRODUCTION

Neonatal mortality, defined as death occurring within the first 28 completed days of life, remains a global public health priority (World Health Organization [WHO], 2024). Globally, approximately 2.3 million infants die during the neonatal period annually, equivalent to nearly 6,700 daily deaths, with 99% of these events occurring in low- and middle-income countries (United Nations Inter-agency Group for Child Mortality Estimation [UN IGME], 2023). This burden is particularly acute in the Democratic Republic of the Congo (DRC), where the national neonatal mortality rate is estimated at 26 deaths per 1,000 live births—substantially higher than the global average of 17 per 1,000 live births (Mafuta et al., 2025).

While direct clinical causes of neonatal death—such as perinatal asphyxia, premature birth complications, severe neonatal infections, and birth trauma—are well documented (Sharkh et al., 2025), these outcomes are deeply embedded in broader socioeconomic, structural, and maternal health contexts. Bhutta et al. (2014) highlighted the imperative of implementing integrated maternal and child health interventions that address household dynamics, maternal education, healthcare-seeking behavior, and economic vulnerability. Furthermore, health interventions restricted solely to formal facility settings often fail to reach marginalized populations residing in geographically isolated and rural regions. Lawn et al. (2014) emphasized that the most effective neonatal health programs integrate household and community strategies, targeting families characterized by cumulative risk factors such as poor healthcare access, low educational attainment, poverty, and inadequate prenatal immunization.

Although prior regional studies have addressed hospital-based determinants of neonatal mortality within Kisangani and surrounding areas (Ramazani-Tabora et al., 2025), there remains a critical evidence gap regarding multicenter, cumulative household risk profiles across urban and rural zones of Tshopo Province. Tshopo Province represents a unique geographic context marked by substantial disparities between urban centers and remote rural territories, limited transportation infrastructure, and uneven access to essential maternal and neonatal health services.

To address this gap, the primary objective of this study was to identify family profiles at high risk of neonatal mortality in Tshopo Province by evaluating maternal, obstetric, and neonatal risk factors. Specifically, this study sought to characterize high-risk households, assess the protective effect of antenatal care (ANC) visits, evaluate the clinical impacts of maternal morbidities, delivery characteristics, low birth weight, and low APGAR scores, and synthesize these factors into a practical 5-factor cumulative risk score for deployment in community early-warning systems.

METHODS

Study Design and Setting

A retrospective case-control study with a nested prospective follow-up of newborns through 28 completed days of life was conducted between January 2022 and July 2024. The study was carried out across multiple health facilities located within both urban and rural health zones of Tshopo Province, DRC.

Target Population and Eligibility Criteria

The target population comprised mother-newborn pairs admitted to the participating health facilities during the study timeframe.

- i. **Inclusion criteria for cases:** Live-born infants delivered at or transferred to a study facility during the study period who subsequently died within the first 28 days of life, whose mothers provided written informed consent, and whose medical records contained complete clinical and outcome data.
- ii. **Inclusion criteria for controls:** Live-born infants delivered at or transferred to the same facility during the same timeframe who survived beyond 28 days of life, whose mothers provided written informed consent, and whose medical records were complete.

Mother-newborn pairs with missing primary outcome records exceeding 10% or where informed consent was declined were excluded from the study.

Sampling Strategy and Sample Size Determination

A multi-stage sampling strategy was employed to ensure regional representation across urban and rural settings:

- a) **Stage 1 (Health Zones):** Seven health zones were selected from the city of Kisangani and surrounding territories: Makiso-Kisangani, Mangobo, Lubunga, Yakusu, Wanierukula, Banalia, and Yahisule.
- b) **Stage 2 (Health Areas):** Reference health areas (Aires de Santé, AS) were selected from each health zone (e.g., AS Boyoma, Libota, and Rosaria for Makiso-Kisangani; AS Matete, Maman Mwilu, and Bombula for Mangobo; AS Uzima, Saint-André, and Pêcheur d'Homme for Lubunga; AS Ilota, Yalokombe, and Yasendo for Yakusu; AS Gloria, Mokili, and Foyer for Kabondo; AS Bongonza, Bethsaida, and Banalia for Banalia; AS Babingi, Kipokoso, and Madula for Wanierukula; and AS Ekondi and Wenge-Bas for Yahisule).
- c) **Stage 3 (Health Facilities):** One primary hospital or health center was selected per health area, including Alwaleed CS, Cinquanteaire HGR, CELPA CS, HGR Lubunga, CS Saint-André, CS Pêcheur d'Hommes, HGR Mokili, HGR Rekapi, Banalia HGR, and associated rural health centers.

The required sample size was calculated using OpenEpi (v3.01) based on Fleiss' formula with continuity correction. Assuming a statistical power of 80%, a 95% confidence level ($\alpha=.05$), a case-to-control ratio of 1:2, an estimated prevalence of non-attendance to ANC among controls of 15%, and an anticipated odds ratio of 2.0, the initial calculated sample size was 654 participants (218 cases and 436 controls). To account for potential missing data and non-response, the sample size was increased by approximately 5% (Charan & Biswas, 2013), yielding a final sample size of 690 participants (230 cases and 460 controls).

Data Collection and Variables

Data collection utilized a hybrid approach combining retrospective medical chart extraction with prospective household follow-up. A structured data extraction grid and standardized questionnaire were implemented via KoboToolbox and executed on mobile devices using KoboCollect. Maternal-newborn pairs discharged prior to 28 days post-partum were followed up through scheduled daily field visits or phone calls by trained health personnel until the 28th day post-delivery to confirm vital status.

The primary outcome (dependent variable) was neonatal vital status at 28 days (0 = Survived, 1 = Deceased). The independent variables evaluated are summarized in [Table 1](#).

Table 1:
Operational Definitions and Coding of Study Variables

Factor	Description	Operational Coding
Prenatal consultation	Antenatal care (ANC) attendance during pregnancy	0= ≥ 4 visits; 1= < 4 visits
Tetanus vaccination	Received maternal tetanus toxoid vaccination within last 5 years	0=Yes; 1=No
TTV doses < 3	Documented receipt of fewer than 3 doses of tetanus toxoid vaccine	0=No; 1=Yes
Illnesses during pregnancy	Presence of diagnosed maternal medical condition during pregnancy	0=No; 1=Yes
Mode of delivery	Vaginal delivery versus operative delivery (cesarean section)	0=Cesarean section; 1=Vaginal
Scarred uterus	Presence of prior uterine scar (e.g., previous cesarean section)	0=No; 1=Yes
Delivery outside facility	Delivery occurring en route or outside a recognized health facility	0=No; 1=Yes
Sex of newborn	Biological sex assigned at birth	0=Female; 1=Male
APGAR score (5 min)	Standard APGAR composite score measured at 5 minutes post-birth	0= ≥ 7 ; 1= < 7
Birth weight	Measured infant birth weight in grams	0= ≥ 2500 g; 1= < 2500 g
Inter-birth interval	Elapsed time between consecutive births in multiparous mothers	0= ≥ 2 years; 1= < 2 years

Operational Definition of At-Risk Family Profile and Risk Score Construction

An "at-risk family profile" was defined based on the cumulative aggregation of independent predictors

identified during multivariable analysis. Specifically, multivariable logistic regression identified five independent clinical and obstetric predictors of neonatal mortality: (a) non-attendance to ANC, (b) presence of

illnesses during pregnancy, (c) vaginal delivery under compromised emergency conditions, (d) 5-minute APGAR score <7, and (e) birth weight <2500 g. Each statistically significant predictor was assigned a weight of 1 point (and 0 points if absent). Summing these items yielded an individual risk score ranging from 0 to 5. Families were categorized into three risk strata: low risk (score=0), moderate risk (score=1), and high risk (score≥2).

Statistical Analysis

Data were cleaned in Microsoft Excel 2016 and analyzed using IBM SPSS Statistics (Version 26.0). Categorical variables were summarized as absolute frequencies (n) and relative percentages (%). Univariate comparisons between cases and controls were performed using the Pearson chi-square test (χ^2). Variables achieving statistical significance at $p<.20$ in bivariate analyses were entered into a multivariable binary logistic regression model using the enter method.

Adjusted odds ratios (aOR) and their corresponding 95% confidence intervals (95% CI) were calculated. Model calibration and goodness-of-fit were assessed using the

Hosmer-Lemeshow test (a p -value $>.05$ indicating acceptable fit). Multicollinearity was evaluated using the Variance Inflation Factor (VIF) and tolerance statistics; VIF values ranged between 1.02 and 1.26 (well below the threshold of 10), and tolerance values ranged from 0.796 to 0.985, confirming the absence of significant multicollinearity. Statistical significance was set at $p\leq.05$. Missing quantitative data (<5%) were handled using mean or median imputation based on distributional normality.

RESULTS

Socio-Demographic Characteristics of the Study Population
The baseline socio-demographic characteristics of mothers in the case (n=230) and control (n=460) groups were comparable (Table 2). Most mothers in both groups were aged 20–34 years (73.5% vs. 73.7%), cohabiting in common-law unions (60.4% vs. 62.6%), had attained primary education or less (91.7% vs. 92.8%), and resided in urban health zones (55.2% vs. 56.3%). No statistically significant differences were observed between cases and controls regarding age, education level, geographic residence, or marital status ($p>.05$).

Table 2:
Socio-Demographic Characteristics of Cases and Controls

Socio-Demographic Factor	Deceased (Cases) (n=230)	Living (Controls) (n=460)	p-value
Maternal age (years)			.405
<20	39 (17.0%)	89 (19.3%)	
20–34	169 (73.5%)	339 (73.7%)	
>34	22 (9.6%)	32 (7.0%)	
Education level			.610
Primary or below	211 (91.7%)	427 (92.8%)	
Secondary / University	19 (8.3%)	33 (7.2%)	
Place of residence			.786
Rural	103 (44.8%)	201 (43.7%)	
Urban	127 (55.2%)	259 (56.3%)	
Marital status			.579
Married	91 (39.6%)	172 (37.4%)	
Common-law union	139 (60.4%)	288 (62.6%)	

Multivariable Logistic Regression Analysis of Risk Factors

Multivariable logistic regression identified five independent determinants of neonatal mortality in Tshopo Province (Table 3). Maternal health pathologies during pregnancy posed the highest risk (aOR=8.23,

95% CI [5.51,12.30], $p<.001$), followed by failure to attend antenatal care visits (aOR=5.39, 95% CI [1.92,15.19], $p=.001$), low birth weight <2500 g (aOR=3.83, 95% CI [2.16,6.80], $p<.001$), vaginal delivery (aOR=3.60, 95% CI [1.90,6.81], $p<.001$), and a 5-minute APGAR score <7 (aOR=1.54, 95% CI [1.01,2.35], $p=.043$).

Table 3:
Multivariable Logistic Regression of Determinants Associated With Neonatal Mortality

Risk Factor	aOR	95% CI Lower	95% CI Upper	p-value
Intercept	0.05	0.02	0.11	<.001
No ANC attendance (<4 visits)	5.39	1.92	15.19	.001
No tetanus vaccination	1.17	0.51	2.68	.712
Number of TTV doses <3	1.50	0.95	2.36	.082
Illnesses during pregnancy	8.23	5.51	12.30	<.001
Vaginal delivery	3.60	1.90	6.81	<.001
Scarred uterus	1.19	0.68	2.08	.551
Delivery outside facility	1.51	0.77	2.96	.227
Male sex	1.34	0.91	1.97	.136
APGAR score ≤7 at 3 min	0.94	0.61	1.46	.792
APGAR score <7 at 5 min	1.54	1.01	2.35	.043
Low birth weight (<2500 g)	3.83	2.16	6.80	<.001
Inter-birth interval ≤2 years	1.51	0.87	2.63	.142

Note. aOR= Adjusted Odds Ratio; CI= Confidence Interval; ANC= Antenatal Care; TTV= Tetanus Toxoid Vaccine; APGAR= Appearance, Pulse, Grimace, Activity, Respiration. p<.05. p<.01. p<.001.

Neonatal Mortality Distribution Across Cumulative Risk Score Strata

A progressive, direct relationship was observed between the accumulation of risk factors and the risk of neonatal mortality (Table 4). In households with a score of 0, the proportion of neonatal deaths was 11.9%. This proportion

increased to 48.0% among families with 1 risk factor (RR=4.04, 95% CI [3.06,5.32]), 81.3% among families with 2 risk factors (RR=6.85, 95% CI [5.12,9.18]), and reached 100.0% in families accumulating 3 or more risk factors (RR=8.42, 95% CI [4.83,14.67]).

Table 4:
Neonatal Mortality Rates and Relative Risks Stratified by Risk Score

Risk Score (Number of Factors)	Total Families (N)	Neonatal Deaths (n)	Death Proportion	Relative Risk (RR) [95% CI]
0 (Low Risk)	362	43	.119	1.00 [Reference]
1 (Moderate Risk)	244	117	.480	4.04 [3.06, 5.32]
2 (High Risk)	75	61	.813	6.85 [5.12, 9.18]
3 (High Risk)	9	9	1.000	8.42 [4.83, 14.67]

DISCUSSION

The findings of this multi-center study demonstrate that neonatal mortality in Tshopo Province is substantially shaped by measurable maternal, obstetric, and neonatal factors. Applying a cumulative family risk profile approach provides empirical justification for targeted community early-warning systems and clinical screening protocols.

Role of Antenatal Care Attendance

The absence of adequate antenatal care visits represented a major risk factor (aOR=5.39). This finding aligns with World Health Organization guidelines recommending at least eight antenatal contacts to optimize maternal and fetal outcomes (Martin, 2025; WHO, 2024). ANC visits

serve as the primary vehicle for screening maternal anemia, malaria, hypertension, and obstetric abnormalities, as well as providing preventive interventions such as tetanus vaccination and nutritional supplementation. As noted by Bhutta et al. (2014), optimizing ANC coverage and quality can avert over a quarter of global neonatal deaths.

Impact of Pregnancy Illnesses

The presence of untreated or unmanaged maternal medical conditions during pregnancy was associated with an eightfold increase in neonatal mortality risk (aOR=8.23). Infectious diseases (such as severe malaria and sexually transmitted infections) and hypertensive disorders of pregnancy severely compromise placental perfusion,

predisposing infants to intrauterine growth restriction, acute fetal distress, and premature birth. Similar findings have been reported in epidemiological surveys conducted in Kinshasa and other sub-Saharan regions (Atuba et al., 2023; Ramazani-Tabora et al., 2025).

Obstetric and Delivery Management

Delivery characteristics significantly altered neonatal survival trajectories. Unassisted or complicated vaginal deliveries carried a elevated risk (aOR=3.60), particularly in peripheral settings lacking facilities for immediate neonatal resuscitation or emergency obstetric care (EMNC). While delivery outside formal maternity facilities did not achieve statistical significance in the final multivariable model (aOR=1.51, $p=.227$), non-institutional births remain clinically concerning due to the risks of hypothermia, sepsis, unmanaged birth asphyxia, and delayed transfer to tertiary care (Lawn et al., 2014).

Intrinsic Neonatal Vulnerabilities

Intrinsic neonatal physiological parameters—specifically low birth weight <2500 g (aOR=3.83) and persistent low 5-minute APGAR scores <7 (aOR=1.54)—were strongly predictive of neonatal death. Low birth weight infants suffer from immature thermal regulation, metabolic fragility, and heightened susceptibility to severe pulmonary and systemic infections (Blencowe et al., 2019). Similarly, a low 5-minute APGAR score reflects prolonged intrapartum asphyxia and predicts early neonatal neurological or respiratory failure, underscores the critical need for skilled birth attendants capable of performing immediate neonatal resuscitation (Lee et al., 2013; Mafuta et al., 2025).

Utility of the Cumulative Risk Score Strategy

A core contribution of this investigation is the empirical validation of a additive 5-factor risk score. The cumulative aggregation of risk factors demonstrated a strong dose-response relationship with mortality risk, rising from 11.9% among zero-risk households to over 80% among families presenting ≥ 2 risk factors. Similar scoring systems have proved effective in risk stratification across resource-constrained sub-Saharan contexts (Bréart et al., 1993; Sharkh et al., 2025). Operationalizing this tool enables Community Health Workers (CHWs) to rapidly identify at-risk pregnant women during home visits and coordinate timely transfers to secondary care centers.

Limitations and Strengths

Several limitations should be noted. The retrospective component of data extraction relied on clinical registers, which are subject to incomplete documentation. Potential recall bias during maternal interviews was minimized by limiting retrospective recall to structural demographic facts and corroborating self-reports with physical health cards (*Carnet de Santé*). Additionally, unmeasured confounding from socioeconomic household micro-variables (e.g., exact household income, indoor air quality) could not be completely excluded.

Conversely, the study's primary strength lies in its multi-stage, multi-center sampling across both urban and rural health zones in Tshopo Province, enhancing regional generalizability. Furthermore, the hybrid prospective design ensured near-complete 28-day follow-up for vital status, minimizing attrition bias.

CONCLUSION

This study identifies key maternal, obstetric, and neonatal factors driving neonatal mortality in Tshopo Province, DRC. The non-attendance of antenatal care visits, presence of maternal illness during pregnancy, complicated delivery conditions, low birth weight, and low 5-minute APGAR scores serve as strong independent predictors of neonatal death.

Translating these empirical findings into a simplified 5-factor cumulative risk score provides a practical framework for community-based screening. Deploying community health workers to administer this screening tool can enable early identification of vulnerable households, facilitate rapid referral to emergency obstetric and neonatal care facilities, and reduce preventable neonatal deaths across Tshopo Province.

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Authors' Contributions:

- i. JTR, BBR, CAM, EKM, and KNN: Conceptualized and designed the study, designed data collection instruments, and drafted the initial manuscript.
- ii. JTR, KNN, MM, RRB, RMM, and FKT: Led data management, statistical analysis, and data interpretation.
- iii. All authors: Critically reviewed and revised the manuscript for intellectual content and approved the final version.

Data Availability Statement: The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Approval: Ethical approval was obtained from the Bioethics Committee of the Institut Supérieur des Techniques Médicales de Kinshasa (ISTM-KIN), Democratic Republic of the Congo (Reference Nos. 055/ESU/ISTM/DG/2022, dated 06/10/2022; and 0024/CBE/ISTM/KIN/RDC/PMBBL/2023, dated 29/11/2023). All research activities strictly adhered to national and international ethical standards for biomedical research involving human subjects.

Informed Consent and anonymity: Written informed consent was obtained from all participating mothers prior to data collection and follow-up.

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REFERENCES

- Atuba, P. M., Pala, L. L., & Andjelani, A. N.** (2023). Perinatal morbidity and mortality in Kinshasa: Prevalence and risk factors in hospitals environment. *Open Access Library Journal*, 10(6), Article e10234. <https://doi.org/10.4236/oalib.1110234>
- Bhutta, Z. A., Das, J. K., Bahl, R., Lawn, J. E., Salam, R. A., Paul, V. K., Sankar, M. J., Blencowe, H., Rizvi, A., Chou, V. B., & Walker, N.** (2014). Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *The Lancet*, 384(9940), 347–370. [https://doi.org/10.1016/S0140-6736\(14\)60792-3](https://doi.org/10.1016/S0140-6736(14)60792-3)
- Blencowe, H., Krusevec, J., de Onis, M., Black, R. E., An, X., Stevens, G. A., Borghi, E., Hayashi, C., Estevez, D., Cegolon, L., Shiekh, S., Ponce Hardy, V., Lawn, J. E., & Cousens, S.** (2019). National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: A systematic analysis. *The Lancet Global Health*, 7(7), e849–e860. [https://doi.org/10.1016/S2214-109X\(18\)30565-5](https://doi.org/10.1016/S2214-109X(18)30565-5)
- Bréart, G., Maillard, F., Dormont, S., Adegbini, R., & Alihonou, E.** (1993). Advantages and limits of the concept of high risk in the perinatal field: Results of a survey in Benin. *Maghreb Journal of Pediatrics*, 3, 247–250.
- Charan, J., & Biswas, T.** (2013). How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine*, 35(2), 121–126. <https://doi.org/10.4103/0253-7176.116232>
- Kane, H.** (2020). Soins aux nouveau-nés: Les recommandations internationales face aux enjeux sociaux de la naissance. *Santé Publique*, 32(1), 17–27. <https://doi.org/10.3917/spub.200.0017>
- Lawn, J. E., Blencowe, H., Oza, S., You, D., Lee, A. C., Waiswa, P., Lalli, M., Bhutta, Z., Barros, A. J., Christian, P., Mathers, C., & Cousens, S. N.** (2014). Every Newborn: Progress, priorities, and potential beyond survival. *The Lancet*, 384(9938), 189–205. [https://doi.org/10.1016/S0140-6736\(14\)60496-7](https://doi.org/10.1016/S0140-6736(14)60496-7)
- Lee, A. C. C., Kozuki, N., Blencowe, H., Vos, T., Bahalim, A., Darmstadt, G. L., Niermeyer, S., Ellis, M., Robertson, N. J., Cousens, S., & Lawn, J. E.** (2013). Intrapartum-related neonatal encephalopathy incidence and impairment at regional and global levels for 2010 with trends from 1990. *Pediatric Research*, 74(Suppl. 1), 50–72. <https://doi.org/10.1038/pr.2013.206>
- Mafuta, E. M., Ishoso, D. K., Bose, C. L., Chi, B. H., Gomez, P., Haug, I. A., Myklebust, H., Tshetu, A. K., & Patterson, J. K.** (2025). Challenges encountered by midwives performing basic neonatal resuscitation in health facilities in Kinshasa, Democratic Republic of the Congo. *PLOS ONE*, 20(11), Article e0334847. <https://doi.org/10.1371/journal.pone.0334847>
- Martin, K.** (2025). Protocole de huit contacts ANC. The Challenge Initiative. <https://tciurbanhealth.org/fr/courses/mnch-service-delivery-antenatal-care/lessons/eight-anc-contacts-protocol/>

- Ramazani-Tabora, J.,** Mamenepi, P. A., Bongolu, B. R., Mpasi, O. B., Koto-te-Nyiwa, J.-P. N., Mwimba, R. M., & Kandolo, F. T. (2025). Determinants of neonatal mortality in hospitals in the Tshopo province of the Democratic Republic of Congo. *Orapuh Journal*, 6(1), Article e1290. <https://www.orapuh.org/ojs/ojs-3.1.2-4/index.php/orapj/article/view/e1290>
- Sharkh, A. A.,** Ighneimat, F., Khmour, Y. F., Aladam, N. Y., Nawajaa, I., Al Janazera, A., Najajrah, I., & Maraqa, B. (2025). Factors contributing to neonatal mortality in a tertiary center in south West Bank: A single-center retrospective cohort study. *PLOS Global Public Health*, 5(7), Article e0004885. <https://doi.org/10.1371/journal.pgph.0004885>
- United Nations Inter-agency Group for Child Mortality Estimation.** (2023). *Levels and trends in child mortality: Report 2023*. World Bank Group. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099606103132489570>
- World Health Organization.** (2024). *Newborn mortality: Fact sheet*. World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/newborn-mortality>