Association of armed conflict with extreme preterm birth and pre-eclampsia and eclampsia in Ukraine, 2022–24: a repeated cross-sectional national surveillance study

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Summary

Background Armed conflict can affect maternal and neonatal health through disruption of health services, population displacement, psychosocial stress, and deterioration of living conditions. However, population-based evidence obtained during large-scale modern warfare in countries with previously high-functioning maternal–newborn services remains sparse. We aimed to investigate whether rates of extreme preterm birth and pre-eclampsia or eclampsia among recorded facility-based deliveries in Ukraine changed during 2022–24 and whether these changes differed by regional conflict intensity.

Methods We conducted a repeated cross-sectional national surveillance study of monthly aggregated facility-based deliveries recorded in Ukraine's Ministry of Health forms N-21 (maternal outcomes) and N-21A (neonatal outcomes) from Feb 24, 2022, to Dec 31, 2024. Primary outcomes were extreme preterm birth (at 22–27 weeks' gestation) and pre-eclampsia or eclampsia (defined using ICD-10 codes O14–O15). Secondary outcomes included early neonatal mortality (death at 0–6 days). We analysed temporal changes in outcomes using interrupted time-series models and examined regional contrasts in extreme preterm birth using difference-in-differences analyses comparing regions of high and low conflict exposure. Conflict intensity was defined using documented attacks on health facilities and front-line proximity. Poisson regression was used to estimate risk ratios (RRs), adjusted for maternal age, parity, facility type, urbanicity, and seasonality.

Findings Recorded facility-based deliveries declined from 195 243 in 2022 to 172 230 in 2024. Rates of extreme preterm birth increased from 3·62 cases per 1000 deliveries in 2022 to 4·38 cases per 1000 deliveries in 2024 (adjusted RR 1·21 [95% CI 1·09–1·34]; p=0·0012). Pre-eclampsia or eclampsia increased from 66·7 cases per 1000 deliveries in 2022 to 88·5 cases per 1000 deliveries in 2024 (RR 1·33 [95% CI 1·28–1·38]; p=0·0014). Reported early neonatal mortality was lower in 2024 than in 2022 (1·71 deaths per 1000 deliveries in 2024 *vs* 2·1 deaths per 1000 deliveries in 2022; RR 0·81 [95% CI 0·70–0·94]). In regions with high exposure to conflict, 8·2 extreme preterm births per 1000 deliveries were recorded during 2022–24, compared with 3·1 extreme preterm births per 1000 deliveries in low-conflict regions (difference-in-differences estimate 2·1 [95% CI 1·4–2·8] per 1000 deliveries).

Interpretation Among recorded facility-based deliveries in Ukraine from 2022 to 2024, increases in the rates of extreme preterm birth and pre-eclampsia or eclampsia were noted during the conflict period, with greater rates of extreme preterm birth in regions of high conflict exposure than in those with low conflict exposure. These findings might reflect a possible changing underlying population during wartime, because the number of recorded deliveries decreased from 2022 to 2024, and women who remained in Ukraine might have differed socioeconomically from those who left the country. The number and functionality of health facilities and reporting completeness also fell from 2022 to 2024, making selective under-ascertainment in conflict-affected areas likely, particularly in view of the decrease from 2022 to 2024 in recorded early neonatal mortality. Thus, these findings should be interpreted with caution as hypothesis-generating associations rather than direct estimates of population incidence.

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Introduction

Armed conflict poses profound threats to maternal and neonatal health, which can occur either directly, by mechanisms such as disruption of health-care infrastructure, or indirectly, via pathways such as psychosocial stress and socioeconomic collapse.[1,2] Global evidence demonstrates elevated rates of extreme preterm birth, hypertensive disorders of pregnancy, obstetric emergencies, and perinatal mortality during active hostilities.[3,4] Maternal exposure to conflict-related stress could activate the hypothalamic–pituitary–adrenal axis, elevating cortisol and promoting preterm labour, intrauterine growth restriction, and pre-eclampsia.[5–7]

Research in context

Evidence before this study

We searched PubMed, Scopus, and Google Scholar for studies published from Jan 1, 2000, to Oct 3, 2025, using combinations of the terms "armed conflict", "war", "pregnancy", "preterm birth", "pre-eclampsia", "eclampsia", "maternal health", "neonatal outcomes", and "Ukraine". We also screened references of relevant articles. We included articles published in English. We found evidence from conflict-affected settings including Ethiopia, Syria, and Yemen, but identified no national surveillance-based analysis of recorded facility-based deliveries during the full-scale war in Ukraine. In the conflict-affected settings of Ethiopia, Syria, and Yemen, preterm birth rate increases of 15-40%, and maternal mortality doubling, were documented during active hostilities. However, the effects of large-scale modern warfare within developed-economy nations with maintained government functionality have not been systematically studied.

Added value of this study

Our analysis provides the first national surveillance-based estimates among recorded facility-based deliveries in Ukraine, covering 517 968 deliveries over 3 years of sustained conflict. We applied interrupted time-series and difference-in-differences approaches to examine temporal and geographical variation in recorded obstetric outcomes.

Implications of all the available evidence

Our findings from Ukraine support prioritisation and further evaluation of strategies to maintain maternal and newborn care continuity, protect health facilities, and strengthen surveillance in conflict-affected settings.

Ukraine's health-care system has faced unprecedented strain since February, 2022, when the full-scale invasion by Russia began. Before the war, skilled birth attendance exceeded 99% in Ukraine. During the first 18 months of conflict, WHO verified more than 1700 attacks on health facilities, including systematic targeting of maternity hospitals, in violation of international humanitarian law.[8,9] Concurrent mass displacement has affected millions of people, further straining perinatal care capacity.[10,11] Despite evidence from other conflict-affected settings, including Ethiopia, Syria, and Yemen, population-level data from Ukraine's comprehensive national surveillance system have not been published, limiting understanding of the effects of the conflict within this previously high-functioning health system.

Using data collected routinely in Ukraine's health surveillance system, we aimed to investigate whether rates of extreme preterm birth and pre-eclampsia or eclampsia changed between Feb 24, 2022, when the full-scale Russian invasion of Ukraine began, and Dec 31, 2024, which was the most recent complete reporting period available in the national routine surveillance system at the time of data extraction and analysis. We also assessed whether any changes differed by regional conflict intensity.

Methods

Study design

We did a repeated cross-sectional analysis of data for monthly aggregated facility-based deliveries, which were recorded in Ukraine's national routine surveillance system, from Feb 24, 2022, to Dec 31, 2024. Ministry of Health forms N-21 and N-21A routinely capture all facility-based births, maternal complications, and neonatal outcomes. Variables were coded according to ICD-10 and Ukraine Ministry of Health definitions. Maternal indicators were obtained from form N-21 (medical care for pregnant women, women in labour, and postpartum women). Neonatal indicators were obtained from form N-21A (medical care for postpartum women, newborns, and infants). Form N-21A was only available in the national reporting system from 2022; therefore, analyses requiring N-21A data were restricted to 2022 onwards. To provide additional context before the Russian invasion in 2022, we summarised data for maternal indicators that were available on form N-21 from 2018 to 2024.

The study received ethics approval from the Bogomolets National Medical University ethics committee (approval number 45; Sept 17, 2025). Informed consent was not required because these data are routinely collected as part of usual perinatal care; all data were de-identified at source, stored on secure Ministry of Health servers, and analysed in accordance with Ukrainian health data privacy legislation. The study was not prospectively registered because it was a retrospective analysis of routinely collected, de-identified national surveillance data.

Procedures

We included all livebirths and stillbirths from 22 weeks' gestation with a birthweight of at least 500 g that were recorded in the Ukraine health surveillance system from Feb 24, 2022, to Dec 31, 2024. We excluded deliveries with multiple gestations, missing region or month identifiers, or from facilities with more than 20% of non-reporting months.

Our primary outcomes were extreme preterm birth (22–27 weeks' gestation) and pre-eclampsia or eclampsia (ICD-10 codes O14-O15). Secondary outcomes included very preterm birth (28–31 weeks' gestation), moderate-to-late preterm birth (32–36 weeks' gestation), very low birthweight (<1500 g), low birthweight (<2500 g), and admission to a neonatal intensive care unit (NICU). We also assessed perinatal mortality (defined as stillbirths plus early neonatal deaths within 7 days) and early

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neonatal mortality (0–6 days). Maternal secondary outcomes included obstetric haemorrhage (ICD-10 code O72), uterine rupture (O71), puerperal sepsis (O85), and mode of delivery (eg, caesarean section). Exploratory outcomes included descriptive maternal indicators available in form N-21, such as selected obstetric complications (diabetes in pregnancy [O24.4], circulatory system diseases complicating pregnancy and labour [O99.4], and anaemia complicating pregnancy and labour [O99.0]) and postpartum deaths within 42 days, in addition to neonatal indicators available in form N-21A, such as the distribution of livebirths by birthweight. The denominator used for postpartum maternal deaths (women whose pregnancy ended) was derived from a separate national summary table in form N-21 and is not identical to facility-based delivery totals. Because related hypertensive conditions were captured in more than one routine national reporting table, we predefined a single source construct for the primary analysis and used alternative tables only for descriptive or exploratory purposes, when explicitly stated.

We defined conflict intensity temporally as the number of months that elapsed since the beginning of the full-scale Russian invasion on Feb 24, 2022. Exposure tiers were derived from external and independently verified reports of attacks on health care from the WHO Surveillance System for Attacks on Health Care, complemented by Ukrainian Health Cluster bulletins. For each administrative region of Ukraine and Kyiv, we calculated an attack rate as the number of documented attacks divided by the number of deliveries (attacks per 1000 deliveries) over the study period, and classified regions as low (less than five), medium (between five and seven, inclusive), or high (more than seven) exposure. We defined front-line proximity as the presence of active hostilities within 50 km. We assessed service disruption based on monthly facility closures and supply interruptions documented in Ministry of Health situation reports. We analysed gestational exposure windows via stratified analysis of the trimester at the onset of conflict.

Statistical analysis

We used interrupted time-series analyses to examine whether rates of extreme preterm birth and pre-eclampsia or eclampsia changed after the onset of the full-scale Russian invasion on Feb 24, 2022, and difference-in-differences analyses to examine regional contrasts in extreme preterm birth by conflict intensity. Ukraine's administrative regions and Kyiv served as the primary units of analysis. We produced a directed acyclic graph (appendix p 1) to clarify plausible pathways linking conflict intensity to obstetric and neonatal outcomes, including displacement or out-migration, stress-related pathways, and health-system disruption. Because data were aggregated and facility-based, we interpreted the estimates as associations among recorded deliveries rather than as direct causal or population-incidence estimates.

We adjusted analyses for maternal age (<20, 20–34, and ≥35 years), parity (0, 1–2, and ≥3), facility type (primary, secondary, and tertiary, urbanicity (urban and rural), and calendar month×year fixed effects (seasonality). The regional socioeconomic index was derived from Ministry of Statistics unemployment and per capita income data, when available. We additionally extracted aggregate counts of selected maternal conditions recorded in the national reporting system (ICD-10 coded), including anaemia complicating pregnancy (O99.0), diabetes in pregnancy (O24.4), and circulatory system diseases complicating pregnancy (O99.4). These indicators were summarised to characterise baseline maternal morbidity and to support sensitivity analyses, when feasible, given the aggregate structure of the data.

We used Poisson regression to model binary outcomes with a log link and an offset for the log of monthly births by region, yielding risk ratios (RRs) with robust variance clustered by region. Interrupted time-series analyses were conducted using segmented regression models applied to monthly aggregate outcome rates, with terms for level and slope change after Feb 24, 2022, harmonic terms for seasonality, and Newey–West standard errors to account for autocorrelation. Difference-in-differences analysis employed two-way fixed effects for region and month by year, comparing high conflict-exposure versus low conflict-exposure regions. We assessed parallel trends by visual inspection and event-study coefficients. Data are presented as absolute counts, percentages, or rates per 1000 deliveries, as appropriate. Effect estimates are presented as RRs with 95% CIs and, where relevant, as absolute risk differences per 1000 deliveries. All statistical tests were two-sided, and p values of less than 0·05 were considered statistically significant. Primary outcomes were prespecified, and we controlled the false discovery rate for secondary outcomes. Sensitivity analyses included logistic regression and quantile regression for birthweight. Seasonality was accounted for a priori using calendar month×year fixed effects, and interrupted time-series models additionally included harmonic seasonal terms. We conducted analyses using R (version 4.2.1).

For more on the **WHO Surveillance System for Attacks on Health Care** see https://extranet.who.int/ssa/Index.aspx

For the **bulletins and reports** see https://healthcluster.who.int/countries-and-regions/ukraine/key-resources

Role of the funding source

There was no funding source for this study.

Results

Temporal changes from 2022 to 2024 in maternal and neonatal characteristics that were available within routine surveillance are shown in table 1. Total recorded deliveries decreased from 195 243 in 2022 to 178 255 in 2023 and 172 230 in 2024. Antenatal care coverage remained above 98·99% across all years, although the proportion of women delivering without previous antenatal contact increased from 0·87% (n=1703)

See **Online** for appendix

	2022	2023	2024	p value*
Total deliveries	195 243	178 255	172 230	0·0011
Gestational age ≥22 weeks	194 536 (99·6%)	177 616 (99·6%)	171 475 (99·6%)	0·68
Multiple gestations	2556 (1·3%)	2245 (1·3%)	2283 (1·3%)	0·12
No antenatal care	1703 (0·9%)	1775 (1·0%)	1731 (1·0%)	0·0052
Regional reporting completeness	97·2%	94·1%	95·8%	0·035

Data are n (%), with total number of deliveries as the denominator, unless otherwise specified. *p value for interaction.

Table 1: **Maternal and neonatal characteristics during the study period, 2022–24**

in 2022 to 1·00% (n=1775) in 2023, and 1·01% (n=1731) in 2024 (RR 1·15 [95% CI 1·07–1·24]; p=0·0052 for interaction). The proportion of multiple gestations remained stable from 2022 to 2024, at about 1·3%. Population representativeness remained constrained by the structure of wartime routine surveillance. Regional reporting completeness exceeded 95% for primary outcomes in all regions (appendix p 2). Regional reporting varied modestly across years (97·2% in 2022, 94·1% in 2023, and 95·8% in 2024). These measures provide only limited proxies for compositional change and do not capture migration history, socioeconomic position, or the size of the underlying population of women of childbearing potential over time.

Extreme preterm births increased across the study period, from 707 cases among 195 243 births in 2022 to 755 cases among 172 230 births in 2024 (adjusted RR 1·21 [95% CI 1·09–1·34]; p=0·0012; table 2), an absolute increase of 0·76 per 1000 deliveries. Rates rose from 3·62 cases per 1000 deliveries in 2022 to 3·58 cases per 1000 deliveries in 2023 and 4·38 cases per 1000 deliveries in 2024. Interrupted time-series analysis showed an immediate post-invasion level change of 0·58 (95% CI 0·32–0·84) per 1000 deliveries (p=0·0014) and a sustained slope change of 0·12 (95% CI 0·04–0·20) per 1000 deliveries (p=0·015) every 3 months (figure).

A pooled supplementary analysis of data across the study period showed that high conflict-exposure regions had extreme preterm rates of 8·2 cases per 1000 deliveries, substantially exceeding regions with moderate conflict exposure (5·7 cases per 1000 deliveries) and low conflict exposure (3·1 cases per 1000 deliveries; appendix p 3). The difference-in-differences estimate comparing high conflict-exposure versus low conflict-exposure regions yielded an average treatment effect of 2·1 (95% CI 1·4–2·8) excess extreme preterm births per 1000 deliveries. Event-study analysis confirmed parallel pre-war trends with divergent post-February, 2022, trajectories (appendix p 2). Among nulliparous women, first-trimester exposure was associated with higher recorded extreme preterm birth risk compared with third trimester exposure (5·1 cases per 1000 deliveries *vs* 3·8 cases per 1000 deliveries; p=0·043 for interaction; adjusted RR 1·34 [95% CI 1·18–1·52]; p=0·0014). Tertiary care facilities also recorded higher extreme preterm birth rates compared with secondary and primary facilities (6·8 extreme preterm births per 1000 deliveries *vs* 4·1 extreme preterm births per 1000 deliveries for secondary facilities and 2·9 extreme preterm births per 1000 deliveries for primary facilities; p=0·0017 for interaction), probably reflecting referral concentration and case-mix effects.

Reports of pre-eclampsia and eclampsia increased sharply between 2022 and 2024, from 13 012 cases per 195 243 births in 2022 to 15 246 cases per 172 230 births in 2024 (adjusted RR 1·33 [95% CI 1·28–1·38]; p=0·0014; table 2). The rate rose from 66·7 cases per 1000 deliveries in 2022 to 88·5 cases per 1000 deliveries in 2024, indicating a substantially greater burden across the conflict period. Eclampsia cases increased nominally during the study period, from 51 cases (0·26 [95% CI 0·19–0·33]) per 1000 deliveries in 2022 to 62 cases (0·36 [0·27–0·45]) per 1000 deliveries in 2024. Related hypertensive conditions recorded in alternative national reporting tables are shown descriptively in the appendix (p 4).

Secondary maternal and neonatal outcomes are presented in table 2. Rates of very preterm birth (28–31 weeks), very low (<1500 g) and low (<2500 g) birthweight, and caesarean sections all rose notably from 2022 to 2024. Although rates of NICU transfers increased from 2022 to 2024, admissions declined slightly, potentially reflecting changes in admission thresholds or reporting patterns (appendix p 2). An exploratory analysis of selected maternal comorbidities that were recorded in the Ukraine national health reporting system from 2018 to 2024 showed that reported cases of diabetes in pregnancy increased during the study period while cases of anaemia complicating pregnancy and circulatory diseases complicating pregnancy decreased (appendix p 5).

The number of maternal deaths within 42 days of delivery, both before the full-scale invasion started (2018–21) and during the conflict period under study (2022–24) are presented in table 3. The rate of maternal deaths with 42 days of delivery per 100 000 women whose pregnancy ended decreased from 33·5 per 100 000 in 2021 (a pre-war level) to 13·2 per 100 000 women in 2024. Rates of reported early neonatal mortality also fell during the study period, from 2·1 deaths per 1000 deliveries in 2022 to 1·7 deaths per 1000 deliveries in 2024 (adjusted RR 0·81 [95% CI 0·70–0·94]; p=0·0066; table 2). These decreases in maternal and neonatal mortality happened despite concurrent increases in premature births and some maternal complications. The reported mortality rate fell substantially below pre-war Ukrainian levels and international comparisons for similar health-care settings, indicating systematic data quality challenges obscuring true conflict burden. The low mortality could be indicative of systematic underascertainment in conflict-affected regions, because facilities in high-conflict zones were missing 8·3% of monthly reports versus 2·1% in low-conflict areas (appendix p 2). Cross-validation studies that linked

	2022		2024		Adjusted RR (95% CI)	p value
	n	Rate (95% CI)	n	Rate (95% CI)		
Primary outcomes						
Extreme preterm birth (22–27 weeks' gestation)	707	3·62 (3·36–3·90)	755	4·38 (4·08–4·71)	1·21 (1·09–1·34)	0·0012
Pre-eclampsia and eclampsia	13 012	66·7 (65·1–68·3)	15 246	88·5 (86·5–90·6)	1·33 (1·28–1·38)	0·0014
Eclampsia cases	51	0·26 (0·19–0·33)	62	0·36 (0·27–0·45)	1·38 (0·95–2·00)	0·10
Secondary neonatal outcomes						
Very preterm birth (28–31 weeks' gestation)	1640	8·40 (8·00–8·82)	1843	10·70 (10·22–11·20)	1·27 (1·15–1·41)	0·0017
Moderate-to-late preterm (32–36 weeks' gestation)	10 309	52·80 (51·79–53·83)	9318	54·10 (53·01–55·21)	1·02 (0·98–1·07)	0·35
Very low birthweight (<1500 g)	1913	9·8 (9·2–10·5)	1843	10·7 (10·0–11·5)	1·09 (1·02–1·17)	0·018
Low birthweight (<2500 g)	11 500	58·90 (57·83–59·99)	10 850	63·00 (61·82–64·19)	1·07 (1·04–1·10)	0·0017
Newborn transfers to NICU						
Total	9780	50·09 (49·10–51·09)	9407	54·62 (53·53–55·74)	1·09 (1·06–1·12)	0·0001
Within 0–6 days	9233	47·29 (46·34–48·27)	8966	52·06 (50·99–53·15)	1·10 (1·07–1·13)	0·0001
NICU admission	11 070	56·70 (55·65–57·76)	9404	54·60 (53·50–55·72)	0·96 (0·93–0·99)	0·026
Early neonatal mortality (0–6 days)	410	2·1 (1·9–2·4)	293	1·7 (1·5–2·0)	0·81 (0·70–0·94)	0·0066
Perinatal mortality	1507	7·72 (7·33–8·12)	1016	5·90 (5·54–6·27)	0·76 (0·71–0·82)	0·0001
Secondary maternal outcomes						
Caesarean section	53 575	274·4 (272·08–276·74)	49 464	287·2 (284·67–289·74)	1·05 (1·03–1·07)	0·0018
Postpartum haemorrhage (≥1000 mL)	937	4·80 (4·50–5·12)	896	5·20 (4·87–5·55)	1·08 (0·98–1·19)	0·12
Uterine rupture	21	..	13	0·075 (0·04–0·13)	0·69 (0·28–1·68)	0·42
Puerperal sepsis	6	..	11	0·064 (0·026–0·102)	2·08 (0·77–5·62)	0·15

Rates are per 1000 deliveries. RRs adjusted for maternal age, parity, facility type, urbanicity, and seasonality. RR=risk ratio. NICU=neonatal intensive care unit.

***Table 2:* Primary and secondary outcomes among recorded facility-based deliveries in Ukraine, in 2022 and 2024**

facility-based surveillance with community-based vital events registration in available regions estimated true early neonatal mortality at 3·2 deaths per 1000 deliveries in 2024, versus the reported rate of 1·7 deaths per 1000 deliveries, suggesting 15–20% under-ascertainment in conflict-affected regions (appendix p 2).

Discussion

In this national analysis of recorded facility-based deliveries in Ukraine, rates of extreme preterm birth and pre-eclampsia and eclampsia increased notably during the conflict period (2022–24), with evidence of both a post-invasion level shift and an upward temporal trend. Regions of high conflict exposure had greater rates of extreme preterm birth than did regions with low conflict exposure. Reported neonatal mortality was low during the conflict period, which could be attributable to selective under-ascertainment and incomplete follow-up in conflict-affected areas. These findings should be interpreted as associations within a disrupted facility-based reporting system rather than as direct estimates of true national population incidence.

Our findings support evidence from other conflict-affected settings, including Ethiopia, Syria, and Yemen,[12–14] and are the first data reported from a country with previously high coverage of skilled maternity care and in which state functionality was maintained in non-occupied territories. The underlying population of women of childbearing potential was unlikely to be stable across the study period because of displacement, out-migration, demographic contraction, and differential access to functioning facilities.[15–17] Accordingly, the

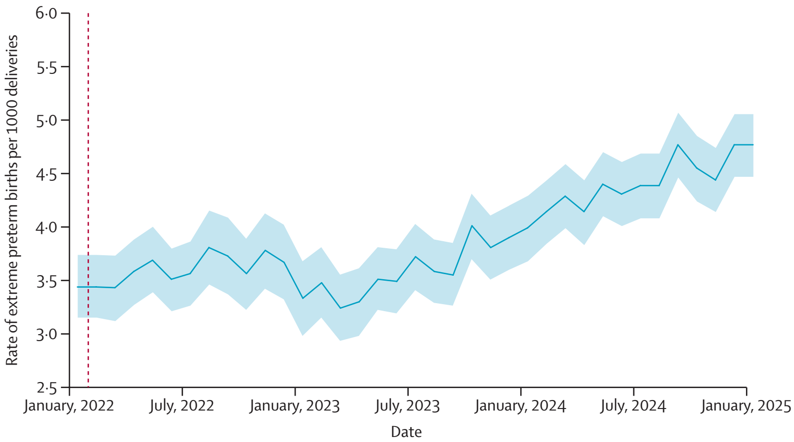

***Figure:* Interrupted time-series analysis of extreme preterm births in Ukraine, 2022–24**
Data are model-fitted monthly rates from the interrupted time-series model and are not numerically identical to the annual crude rates reported in table 2. The blue line shows the rate of extreme preterm births per 1000 deliveries from the segmented regression model and the shaded region shows the 95% CI. The red vertical line indicates the beginning of the full-scale Russian invasion on Feb 24, 2022.

	Women whose pregnancy ended (n)	Maternal deaths within 42 days after delivery (n)	Rate per 100 000 pregnancies that ended
2018	315 210	44	14·0
2019	285 113	37	13·0
2020	272 755	51	18·7
2021	247 608	83	33·5
2022	196 212	26	13·3
2023	169 684	21	12·4
2024	158 646	21	13·2

Women whose pregnancy ended is an administrative denominator from a separate national summary table in form N-21 and is not identical to the facility-based delivery totals reported in table 1.

***Table 3:* Maternal deaths in Ukraine within 42 days after delivery, 2018–24**

observed changes in recorded rates could reflect a combination of true changes in obstetric risk, health-system disruption, reporting artefacts, and compositional change in the population captured by surveillance. Women with eclampsia were rare, resulting in limited precision despite the increase in the composite pre-eclampsia and eclampsia outcome. Additionally, related constructs were captured across different reporting forms, and pre-2022 comparability was not uniform across all indicators.

The observed changes in selected maternal conditions (ie, diabetes, anaemia, and circulatory system disorders) are consistent with broader disruption-related mechanisms, including altered access to antenatal screening and chronic disease management, delayed presentation, and shifting case-mix due to displacement and selective out-migration. The main message is that conflict intensity could be associated with adverse obstetric outcomes in routine surveillance, but these associations probably reflect a combination of direct stress-related pathways and indirect effects mediated through health-system disruption and population change. Maternal mortality indicators should be interpreted cautiously because absolute numbers are small and might be sensitive to reporting disruptions and population displacement. Nonetheless, inclusion of postpartum maternal deaths provides an additional system-level outcome alongside obstetric and neonatal indicators. The combination of increasing prematurity with slightly lower NICU admission and stable transfer counts probably reflects changes in admission thresholds and reporting patterns during sustained hostilities, including transport constraints and capacity reconfiguration. In parallel, the observed decline in reported early neonatal mortality should be interpreted cautiously, as selective reporting disruption and under-ascertainment in conflict-affected areas could bias mortality downwards.

Chronic maternal stress from conflict exposure activates sustained hypothalamic–pituitary–adrenal axis dysregulation, elevating cortisol levels that promote premature cervical ripening, decidual activation, and uteroplacental insufficiency.[18,19] This pathway particularly affects women exposed to stress during early pregnancy, consistent with the elevated risk of extreme preterm birth among first-trimester exposures. Pre-eclampsia incidence rises through stress-mediated endothelial dysfunction and impaired placental angiogenesis.[18] Simultaneously, infrastructure damage disrupted antenatal surveillance networks essential for early hypertensive disorder detection, while transport barriers delayed emergency obstetric interventions.[12] More than 1700 documented attacks on health-care facilities (from February, 2022, to mid-2023) forced closures and evacuations.[3,16] Supply chain interruptions affected access to antihypertensive medications, magnesium sulphate, and neonatal resuscitation equipment. Power outages compromised incubator function, while water shortages impaired infection control. Mass internal displacement probably disrupted continuity of antenatal care and might have contributed to the modest increase in deliveries without previous antenatal contact.[10,20,21]

Routine national surveillance provided broad geographical coverage of recorded facility-based deliveries during wartime, which was a strength of our study. However, this study has several important limitations. First, the denominator of women of childbearing potential was not stable over time and could not be directly measured in these data. Recorded deliveries declined substantially between 2022 and 2024, consistent with displacement, out-migration, and wartime demographic contraction. Accordingly, the reported rates reflect outcomes among pregnancies captured within the facility-based reporting system rather than true population incidence among all women remaining in the country. Second, wartime displacement and out-migration were unlikely to be socioeconomically random. Women remaining in high-conflict areas might have differed systematically from those who relocated internally or abroad with respect to resources, mobility, nutrition, baseline health, and access to care. Because these characteristics were not captured in the reporting system, residual socioeconomic confounding and compositional selection bias are likely. Third, the number and functionality of facilities able to provide obstetric and neonatal care probably changed over time because of attacks, closures, evacuations, staff displacement, referral reconfiguration, and interruptions in transport and supply chains. These changes might have altered both access to care and the case-mix captured in the surveillance system, while also excluding some births from formal reporting in occupied or the least accessible territories. Fourth, under-ascertainment of neonatal deaths remains a major concern. Reported early neonatal mortality was lower than expected despite increases in prematurity and maternal complications, and missing monthly reports were more frequent in high-conflict than low-conflict regions. These patterns suggest selective reporting disruption, particularly for outcomes that require complete early follow-up. Fifth, routine surveillance data do not capture individual migration history, displacement status, or detailed socioeconomic position, and therefore do not allow direct adjustment for these important sources of compositional change. Nor do they permit complete separation of true pathophysiological changes from changes in referral thresholds, admission patterns, or service availability. Finally, the interrupted time-series and difference-in-differences analyses offered structured temporal and regional contrasts beyond simple before-and-after comparisons. However, because the data are aggregated, facility-based, and affected by wartime changes in population composition, service availability, and reporting completeness, these approaches cannot fully address residual confounding, selection effects, or the absence of a stable population denominator. Taken together, these limitations mean that our estimates should be interpreted as associations among recorded facility-based deliveries during wartime rather than as definitive national population-level incidence estimates.

Although national reporting completeness exceeded 95% for primary outcomes, facilities in high conflict-exposure zones had more missing monthly reports than did low conflict-exposure zones. Cross-validation of facility surveillance against available vital events registration suggested that reported early neonatal mortality probably underestimated true mortality, implying under-ascertainment in conflict-affected regions. This selective disruption would be expected to underestimate adverse outcomes in front-line settings and attenuate observed differences by conflict intensity. Routine surveillance completeness might vary by geography during wartime. Facilities located in temporarily occupied territories might not be reported into the Ministry of Health surveillance system, and some regions show structurally absent reporting in these forms (eg, Crimea and Sevastopol recorded as zero). As a result, adverse outcomes could be underestimated if the least accessible areas also experience the highest burden. Therefore, our estimates should be interpreted as minimum national burden based on available reports.

Several sources of bias are plausible in facility-based routine surveillance during active conflict. First, displacement and selective out-migration might change the composition of pregnancies captured in the reporting system, while individual migration history and socioeconomic position are not measured, introducing residual confounding and compositional (selection) bias. Second, reporting completeness can vary by conflict intensity; selective disruption in front-line settings and under-ascertainment, particularly for outcomes requiring complete follow-up (eg, neonatal deaths), might bias estimates towards underestimation and attenuate contrasts across exposure tiers. Third, incomplete geographical coverage is possible during wartime if facilities in temporarily occupied or least accessible territories do not report. Finally, related constructs are captured across different routine forms (ie, form N-21 and form N-21A, with form N-21A only available from 2022 onwards), limiting pre-2022 comparability for neonatal inpatient indicators. Taken together, estimates should be interpreted as associations among recorded facility-based deliveries, plausibly reflecting a mixture of direct and indirect (mediated) effects and residual bias.

Although these observational findings should be interpreted with caution, they support prioritisation of strategies to maintain continuity of maternal–newborn care and improve ascertainment in conflict-affected settings. Potential responses include preserving access to antenatal screening, maintaining referral pathways for hypertensive disease and preterm labour, protecting essential obstetric and neonatal services, and strengthening surveillance in areas affected by displacement and reporting disruption. Potential strategies include mobile antenatal screening units for displaced populations and damaged infrastructure areas, equipped for blood pressure monitoring, urinalysis, and ultrasound.[22,23] Strengthening emergency obstetric and newborn care networks requires prepositioning caesarean section capacity, blood products, and eclampsia treatment in secondary facilities rather than relying on tertiary referrals interrupted by hostilities.[24] Expanding telemedicine consultations between peripheral and specialist centres can partly compensate for workforce shortages.[22] Priority strategies include ensuring uninterrupted supplies of magnesium sulphate, antihypertensives, antenatal corticosteroids, and neonatal resuscitation equipment. Reinforcing surveillance systems necessitates implementing community-based vital events reporting in disrupted areas through trained community health workers and mobile-based platforms.[14] Maternity waiting homes near functioning facilities could reduce transport delays while providing safe accommodation during final gestational weeks.[25]

The applicability of these findings depends on pre-existing health system capacity and conflict characteristics. Ukraine has maintained government functionality and had pre-war skilled birth attendance above 99%; these factors provide resilience buffers that might be absent in other conflict settings with weaker baseline infrastructure.[26,27] Countries experiencing state collapse alongside conflict could face steeper deteriorations. The intensity and geographical spread of Ukraine's conflict across multiple fronts might make findings applicable to large-scale rather than localised conflicts. Middle-income conflict-affected nations with similar pre-war service coverage might most closely parallel Ukraine's experience.[28,29]

Areas for future research include prioritising the linkage of facility-based surveillance with civil registration systems to quantify under-ascertainment and validate mortality rates.[14] Establishing prospective cohorts that follow up pregnant women who have been exposed to varying conflict intensities could clarify gestational-age-specific vulnerability windows and distinguish direct conflict effects from poverty and displacement pathways. Qualitative investigations of women's care-seeking decisions and perceived barriers would inform intervention design. Economic evaluations comparing mobile antenatal units versus facility-based care under conflict conditions could guide resource allocation.[21] Long-term follow-up of conflict-period births will be essential to assess neurodevelopmental consequences of extreme prematurity and maternal stress exposure.[26,28]

In conclusion, among recorded facility-based deliveries in Ukraine during the Russian invasion of 2022–24, higher rates of extreme preterm birth and pre-eclampsia and eclampsia were noted, with geographical and temporal heterogeneity. These findings should be interpreted with caution because wartime changes in population composition, availability of facilities, and reporting completeness might have affected the observed rates. Our results support further work to strengthen maternal–newborn service continuity and conflict-resilient surveillance in affected settings.

Contributors
VVA and VOB conceived the study. VOB led the formal analysis and investigation and drafted the original manuscript. ID contributed to data curation and methodology. YPV contributed to validation and critical revision of the manuscript. DOG provided overall supervision, methodological oversight, and secured resources. VVA and VOB verified the underlying data. All authors had full access to the data used in the study, contributed to data interpretation, reviewed and approved the final version of the manuscript, and accept responsibility for the decision to submit for publication.

Declaration of interests
We declare no competing interests.

Data sharing
The data generated and analysed during this study are proprietary and are not publicly available. Researchers seeking access to the dataset should contact the corresponding author.

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