BMJ Open

Epidural analgesia during labour in uncomplicated pregnancy low-risk women: intrapartum care and maternal–neonatal outcomes–a retrospective cohort study

Simona Fumagalli,[1,2] Rosemary Turco,[1,2] Maria Panzeri ,[1] Alessandra Moretto,[3] Luca Maria Pietro D'andrea,[3] Antonella Nespoli,[1] Margherita Guglielmetti,[1,2] Marzia Maini,[2] Anna Locatelli ,[1,2] Sara Ornaghi [1,2]

To cite: Fumagalli S, Turco R, Panzeri M, *et al*. Epidural analgesia during labour in uncomplicated pregnancy low-risk women: intrapartum care and maternal–neonatal outcomes–a retrospective cohort study. *BMJ Open* 2026;**16**:e117505. doi:10.1136/bmjopen-2026-117505

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2026-117505).

Received 27 January 2026
Accepted 21 July 2026

[1]School of Medicine and Surgery, University of Milan–Bicocca, Milano, Italy
[2]Department of Obstetrics, Fondazione IRCCS San Gerardo dei Tintori, Monza, Lombardy, Italy
[3]Department of Anesthesiology, Fondazione IRCCS San Gerardo dei Tintori, Monza, Italy

Correspondence to
Dr Maria Panzeri;
maria.panzeri@unimib.it

ABSTRACT

Objectives To investigate the associations between the use of epidural analgesia (EA) and intrapartum care, labour, birth and neonatal outcomes in uncomplicated pregnancy low-risk women, to inform evidence-based intrapartum practices and support informed maternal choice.

Design Retrospective cohort study.

Setting Single maternity hospital in Northern Italy.

Participants A total of 3406 uncomplicated pregnancy low-risk women who gave birth between 2019 and 2023 were included. Participants were grouped according to whether they received EA (n=417) or not (n=2989).

Primary and secondary outcome measures Labour progression, intrapartum care practices, maternal and neonatal outcomes were evaluated according to exposure to EA. Associations between EA and the study outcomes were assessed using descriptive and inferential statistics and multivariable logistic and linear regression analyses, adjusted for maternal age, parity and other outcome-specific confounders.

Results Women receiving EA experienced higher rates of prolonged first and second stage of labour (adjusted OR (aOR) 24.3 and 5.0, 95% CI 17.8 to 33.6 and 3.8 to 6.6, respectively), amniotomy and oxytocin use (aOR 7.7 and 17.8, 95% CI 5.7 to 10.6 and 12.9 to 24.6, respectively), caesarean section (aOR 7.2, 95% CI 3.1 to 17.1), lithotomy position at birth (aOR 2.3, 95% CI 1.7 to 3.0) and urinary retention (aOR 6.0, 95% CI 3.1 to 11.5). No differences were observed in neonatal outcomes.

Conclusion In uncomplicated pregnancy low-risk women, EA during active labour was associated with increased rates of clinical interventions and altered labour patterns, with no differences in neonatal outcomes. These findings underscore the importance of the midwife's role in promoting physiological labour while ensuring effective pain management.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A large cohort of women with uncomplicated, low-risk pregnancies was analysed.
⇒ Restriction to women eligible for physiological birth reduced clinical heterogeneity.
⇒ Inclusion of both nulliparous and multiparous women allowed adjustment for parity.
⇒ The retrospective design based on routinely collected data limited adjustment for unmeasured confounders.
⇒ Selection bias and the absence of stratification by cervical dilatation at admission may have affected estimates of labour progression.

INTRODUCTION

Labour and birth are recognised as intensely physical and emotional processes, often accompanied by significant pain and psychological stress.[1 2] Beyond the physiological challenges, childbirth also represents a major life event that can influence a woman's sense of self, her relationships and her longer-term well-being.[1 2] This biopsychosocial perspective highlights the importance of comprehensive, woman-centred care that addresses the full range of women's needs during labour. In this context, effective pain management is a crucial component of intrapartum care, contributing to maternal satisfaction and a positive birth experience.[3] Various approaches have been developed to support women in coping with pain during labour, including both non-pharmacological and pharmacological methods.[4] Among the latter, epidural analgesia (EA)—the injection of local anaesthetic and/or opioid agents into the epidural space—is the most widely used.[5 6]

EA is considered the most effective pharmacological method for labour pain relief, while the WHO recommends that intrapartum care should promote physiological labour and

minimise unnecessary interventions, supporting women in making informed choices about pain relief options according to their preferences and clinical needs.[3]

The use of EA varies considerably between countries and settings, with reported rates of use ranging from 10% to 64% in high-income countries, reflecting differences in clinical practice, access to care and cultural attitudes.[5–8]

Although EA is considered the safest pharmacological approach for labour-related pain management[9] and recent developments in drug formulations, concentrations and combinations have further improved its safety and efficacy profile[5 6 10] it remains an invasive procedure potentially associated with side effects and complications.[9 11 12] Reported side effects include a prolonged second stage of labour,[4–6 13–20] increased rates of operative vaginal birth,[5 10 13 15 16 19–22] caesarean section,[13 23] hypotension,[14 24] urinary retention,[5 14] fever[5 14 19 20 25 26] and altered uterine activity that may require labour augmentation with synthetic oxytocin.[5 16 19 20] EA has also been associated with adverse neonatal outcomes, such as low Apgar scores and Neonatal Intensive Care Unit (NICU) admission,[13 27–29] as well as reduced early breastfeeding success and delayed newborn suckling.[13]

Although numerous studies have explored the effects of EA on intrapartum interventions and maternal–neonatal outcomes in the general obstetric population, evidence focusing specifically on low-risk women remains limited.[30] However, the WHO recommends that intrapartum care for 'healthy pregnant women' should prioritise the promotion of physiological labour and the minimisation of unnecessary interventions.[31–33] The use of pharmacological pain relief, while often beneficial, may interfere with this approach and can shift women out of the 'low obstetric risk' category.[31 32]

Given that reduction of unnecessary interventions is a global priority it is pivotal to investigate the association of EA within uncomplicated pregnancy low-risk populations. Such knowledge is key to ensuring that women receive clear, evidence-based information and are supported in making informed, autonomous choices regarding labour pain management.

The primary aim of this study is to investigate the association between the use of EA and labour, birth and neonatal outcomes in uncomplicated pregnancy low-risk women, to inform evidence-based intrapartum practices and support informed maternal choice.

MATERIALS AND METHODS

Study design

This was a retrospective cohort study aimed at investigating maternal and neonatal outcomes associated with the use of EA during labour in uncomplicated pregnancy low-risk women.

Setting

The study setting was an Obstetric Unit of a large maternity hospital in Northern Italy with approximately 2500 births/year. Women included in the study had given birth at the hospital between 1 January 2019 and 31 December 2023.

The hospital promotes normal childbirth through a model of care that supports maternal autonomy and competence, also among women using EA. A one-to-one midwifery care model is employed in all labouring women, both low-risk and high-risk. To provide contextual information about the study setting, the overall caesarean section rates in 2024 were 4.3% in Robson Group 1 and 0.7% in Robson Group 3, two groups that broadly reflect the low-risk population included in this study. EA is offered as a pharmacological option for pain relief, after non-pharmacological pain relief strategies have been used, and administered by a dedicated anaesthesiology team available 24/7 in the Labour & Birth Unit. Indications for EA include maternal request, induction or augmentation of labour or medical conditions. Although women receiving EA are shifted to a shared model of care,[32] they are still provided with continuous one-to-one midwifery care and evidence-based practices that support normal labour, including free movement.

Participants

Electronic records of women who gave birth between 1 January 2019 and 31 December 2023 were reviewed to identify those meeting predefined criteria for low obstetric risk. Low obstetric risk was defined according to regional clinical guidelines.[34] Inclusion criteria were: singleton pregnancy in cephalic presentation, gestational age between 37+0 and 41+5 weeks, estimated fetal weight between 2500 and 4000 g, spontaneous onset of labour in active phase defined according to NICE guideline,[2] normal amniotic fluid volume, intact membranes or prelabour rupture of membranes <24 hours with clear fluid, normally inserted placenta with no significant bleeding, absence of uterine scars or previous major obstetric complications, and maternal age between 18 and 45 years. Women with obesity (BMI>30 kg/m^2), moderate anaemia (Hb<8.5 g/dL), thrombocytopenia (<100 000/mm^3), uncontrolled hypothyroidism, substance abuse or known fetal anomalies were excluded. These criteria ensured the inclusion of a homogeneous population of low-risk women, excluding those with intercurrent maternal diseases or pregnancy-related complications that could independently affect labour outcomes.

Clinical and sociodemographic data were obtained through the integration of two data sources: the CeDAP (Certificate of Delivery Care) system—Italy's national birth registry—and the electronic medical records routinely used in the participating facility.

Variables

The variables analysed were grouped into five main categories: (1) *Maternal demographics and obstetric history:* maternal age, ethnicity, parity, pregnancy course, gestational age at birth and onset of labour. (2) *Epidural characteristics:* mode of administration (manual boluses,

patient-controlled EA—PCEA and programmed intermittent epidural bolus—PIEB; the mode was chosen by the clinician in charge), maternal position during epidural catheter placement and use of ultrasound guidance for the procedure, number of doses, drug concentration, cervical dilation at the time of request and placement, and time interval (in minutes) between labour onset and the first dose and request for EA following intrapartum interventions (including amniotomy and oxytocin administration). (3) *Intrapartum factors:* duration of the first and second stages of labour (active and passive phases), delayed progression requiring amniotomy and/or oxytocin, cervical dilation at the beginning of the partograph, labour augmentation (including amniotomy and the use of oxytocin), maternal position during labour and use of non-pharmacological support (water, free movement and other). (4) *Maternal outcomes:* mode of birth, perineal outcomes (episiotomy and severe perineal tears, including third and fourth degree), postpartum haemorrhage (blood loss>1000 mL), position at birth, maternal fever (≥37.5 °C), urinary retention and management of the third stage. (5) *Perinatal outcomes:* fetal heart rate abnormalities within 30 minutes of EA, umbilical artery acidosis (pH<7.1), low Apgar score at 5 minutes (<7), early skin-to-skin contact and admission to the NICU.

Statistical analysis

Data reporting was conducted according to the Strengthening the Reporting of Observational Studies in Epidemiology checklist (STROBE checklist) (online supplemental material 1). Descriptive statistics were calculated for all study parameters and presented for the overall study population and stratified by exposure to EA (EA vs no EA). Normal distribution was graphically checked. For normally distributed continuous variables, mean and SD were reported, whereas median and IQR were used for non-normally distributed variables. Categorical variables were summarised using frequencies and percentages. Differences between groups were assessed using t-tests or Mann-Whitney test as appropriate for continuous variables, and Fisher's exact test or χ^2 test for categorical variables. Univariate and multivariate linear and logistic regression were performed as appropriate to examine the independent association of EA with outcomes of interest. All multivariate models were adjusted at least for maternal age and parity, while additional confounders were included depending on the specific outcome, based on literature review and clinical expertise. The full list of covariates included in each model is reported in the footnotes of the corresponding table. For outcomes with a low number of events, adjusted analyses were not performed to avoid model overfitting, and only descriptive or unadjusted results are presented. Stratified analyses by parity (nulliparous and multiparous women) were also performed as sensitivity analyses. Statistical significance was set at p<0.05. Data analysis was performed using R software (V.4.3.1, 2023–06-16).

Ethics

Ethical approval was obtained from the Ethics Committee of the Azienda Socio-Sanitaria Territoriale (ASST) of Vimercate, Italy (Approval Number: 37/2018, Ethical Review Board of the ASST Vimercate) before the study initiation. All data were anonymised prior to analysis, and each participant was assigned a unique identification code to ensure confidentiality.

Patient and public involvement

Patients were not directly involved in the design, conduct, reporting or dissemination plans of this research. However, the findings will be disseminated to the target population through appropriate clinical and educational channels, with the aim of improving knowledge, expectations and informed decision-making regarding labour and childbirth.

RESULTS

A total of 12 570 maternal records were screened, of which 3406 (27.1%) met the inclusion criteria and were enrolled in the study. Among these, 417 women (12.2%) received EA whereas 2989 (87.8%) used only non-pharmacological methods for pain relief. The recruitment and inclusion process is shown in figure 1. The applied inclusion and exclusion criteria resulted in a clinically homogeneous population of low-risk women, as individuals with intercurrent maternal diseases or pregnancy-related complications were excluded.

Sample characteristics are presented in table 1. A significantly higher proportion of nulliparous women was present in the EA group compared with the non-EA group (83.2% vs 41.8%, p < 0.001). Women who received EA had a lower cervical dilatation at the time of partograph initiation compared with those who did not (5 cm vs 6 cm; p < 0.001). Stratified analyses by parity were performed and are reported in supplementary material (online supplemental tables S1–S3).

Variables concerning EA are fully reported in table 2. In the EA group, 89.7% of women (n=374) requested epidural due to difficulty in coping with pain during labour. The mode of epidural administration varied: 62.8% received manual boluses, 8.2% PCEA and 33.3% PIEB. The median time from the onset of labour to the epidural request was 165 min (IQR 90.0, 300.0) and the median cervical dilatation at time of administration was 6 cm (IQR 5–0, 7.0). Side effects of EA, including paraesthesia and hypotension, were reported in 11.3% of women (n=47), whereas dural puncture occurred in 0.7% (n=3).

Variables concerning intrapartum characteristics are fully reported in table 3. In women who received EA, the duration of all stages of active labour was significantly prolonged (first stage: coeff. 313.0, 95% CI 299.8 to 326.1; second stage: coeff. 56.4, 95% CI 51.3 to 61.4). This association was observed in both the passive (coeff. 36.3, 95% CI 29.7 to 42.9) and active phase (coeff. 15.0, 95% CI 12.0 to 18.0) of the second stage of labour even after adjusting for

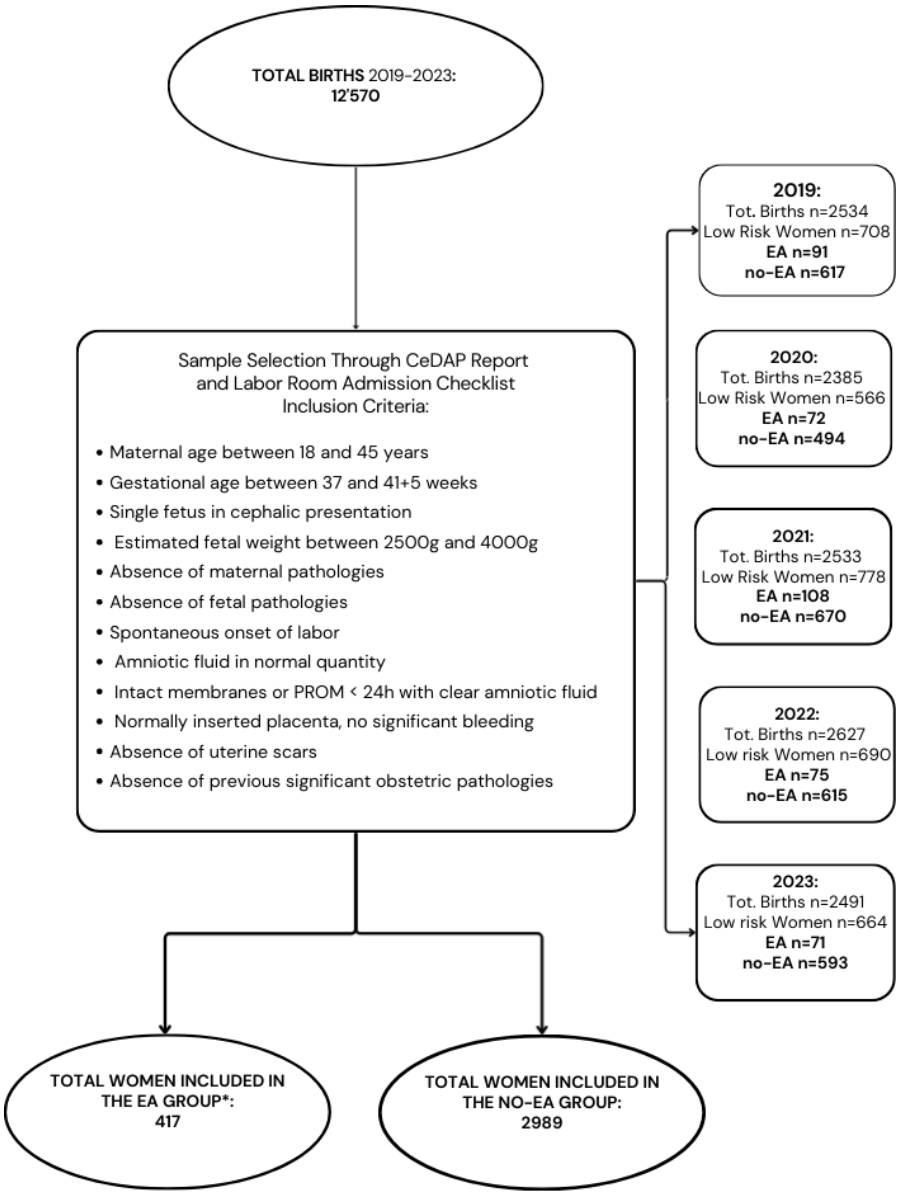

Figure 1 Flowchart of recruitment and retention. CeDAP, Certificate of Delivery Care; EA, epidural analgesia; PROM, prelabour rupture of membranes.

maternal age and parity. Similarly, delayed first and second stages of labour, defined as the need for pharmacological augmentation, were more common among women who received EA (adjusted OR (aOR) 24.3 and aOR 5.0, respectively, 95% CI 17.8 to 33.6 and 95% CI 3.8 to 6.6). While non-pharmacological methods were widely used across both groups, their use was less frequent among women who received EA compared with those who did not receive it (aOR 0.4; 95% CI 0.3 to 0.5). Compared with the no-EA group, women who received EA had a significantly higher probability of experiencing fever (OR 166.6, 95% CI 35.8 to 296.8; adjusted analysis was not performed due to the limited number of events), urinary retention (aOR 6.0, 95% CI 3.1 to 11.5) and lithotomy position at birth (aOR 2.3, 95% CI 1.7 to 3.0). Moreover, they had lower risk of experiencing spontaneous voiding during labour (aOR 0.04, 95% CI 0.03 to 0.06). Considering mode of birth, women who requested EA had lower probability of experiencing spontaneous vaginal birth (aOR 0.4, 95% CI 0.2 to 0.6), higher risk of caesarean section (aOR 7.2, 95% CI 3.1 to 17.1), without differences in operative vaginal birth (aOR 1.6, 95% CI 0.9 to 2.8).

No significant differences were found within postpartum maternal outcomes such as manual removal of placenta, episiotomy, severe perineal tears and postpartum haemorrhage as reported in table 4.

Table 1 Distribution of sample characteristics by epidural analgesia (EA) use

	Overall (n=3406)		EA (n=417)		No EA (n=2989)		
	N/mean	%/SD	N/mean	%/SD	N/mean	%/SD	P value
Maternal age	32.1	4.7	31.3	4.7	32.2	4.7	<0.001
Maternal age>35	1052	30.9	101	24.2	951	31.8	0.002
Place of birth							
Italy	2736	80.3	354	84.9	2382	79.7	0.044
Europe	322	9.5	30	7.2	292	9.8	
Not Europe	348	10.2	33	7.9	315	10.5	
Nulliparous	1596	46.9	347	83.2	1249	41.8	<0.001
Gestational age at birth	39.5	1.0	39.7	1.0	39.4	1.0	<0.001
	Median	IQR	Median	IQR	Median	IQR	p
Cervical dilatation at partograph initiation	6.0	5.0, 8.0	5.0	4.0, 6.0	6.0	5.0, 8.0	<0.001

Additionally, no significant differences were observed between groups in neonatal outcomes and procedures such as Apgar scores, early skin-to-skin contact or NICU admission. However, women who received EA had higher risk of meconium-stained amniotic fluid (aOR 1.9, 95% CI 1.2 to 3.0) while they had lower risk of umbilical artery acidosis (aOR 0.5, 95% CI 0.2 to 0.9) (table 4).

Similar patterns of association were observed in the subgroup of nulliparous women, confirming the overall findings. In this subgroup, EA was still associated with increased intrapartum interventions and prolonged labour stages. The only exception was umbilical artery acidosis, which did not show a statistically significant association with EA (online supplemental table S3). A detailed presentation of these data is provided in the online supplemental tables S1–S3).

Table 2 Distribution of epidural characteristics among women who received epidural analgesia (EA)

	EA (n=417)	
	N/median	%/IQR
Motivation EA administration		
EA for maternal request	374	89.7
EA for labour augmentation/ other	43	10.3
Mode of administration		
Manual epidural	262	62.8
PCEA	34	8.2
PIEB	139	33.3
US before EA administration	264	63.3
Maternal sitting position	409	98.1
Time from partograph start and EA administration	165.0	90.0, 300.0
Cervical dilatation at EA use	6.0	5.0, 7.0
EA use after amniotomy	38	33.6
EA use after oxytocin administration	9	5.4
FHR abnormalities 30 min after EA	44	10.6
Dural puncture	3	0.7
Side effects*	47	11.3

*Side effects (n=47): urinary retention (n=27), legs' sensory and/or strength disturbances (n=9), EA catheter retraction or replacement (n=8); over analgesia with associated motor block (n=3)
FHR, fetal heart rate; PCEA, patient-controlled epidural analgesia; PIEB, programmed intermittent epidural bolus; US, ultrasound.

DISCUSSION

Our study investigated the association between EA and intrapartum care and perinatal outcomes in uncomplicated pregnancy low-risk women. Our findings suggest that epidural use can be associated with an increased likelihood of intrapartum interventions, including amniotomy, oxytocin augmentation and caesarean section, as well as of prolonged first and second stages of labour, maternal fever, urinary catheterisation and lithotomy birth position. In contrast, neonatal outcomes such as Apgar scores, skin-to-skin contact and NICU admission did not differ between groups. These results reinforce existing evidence and suggest that, even in the absence of obstetric risk, EA use can be associated with variations in labour progression and increased likelihood of medical interventions. Given the observational design of the study, the findings should be interpreted in terms of associations rather than causal relationships.

This study contributes observational data on the impact of EA on labour and birth outcomes in uncomplicated pregnancy low-risk women. While causality cannot be definitively established in a retrospective cohort design, the findings suggest that EA use may be associated with a shift in the intrapartum care trajectory, characterised by increased intervention and medicalisation, even in populations without pre-existing obstetric risk factors.

Table 3 Distribution of intrapartum variables according to epidural analgesia (EA) use, and association between EA and these variables assessed through linear or logistic regression as appropriate, presented as crude and adjusted estimates

	Overall	EA (n=417)	No EA (n=2989)		Coeff. (95% CI)			
	Median (IQR)	Median (IQR)	Median (IQR)	P value	(linear/logistic regression)	P value	Coeff*. (95% CI)	P value
Duration of I stage	97.5 (32, 205)	420 (280, 600)	80 (30, 160)	<0.001	346.4 (333.1 to 359.7)	<0.001	313 (299.8 to 326.1)	<0.001
Duration of II stage	29 (13, 67.7)	109 (48, 187)	25 (12, 57)	<0.001	80.7 (75 to 86.3)	<0.001	56.4 (51.3 to 61.4)	<0.001
Duration of passive phase of II stage†	45 (25, 81.5)	80 (45, 120)	30 (20, 60)	<0.001	44 (37.1 to 50.4)	<0.001	36.3 (29.7 to 42.9)	<0.001
Duration of active phase of II stage	25.5 (12, 56)	59 (33, 96)	22 (11, 47)	<0.001	32.4 (28.9 to 36)	<0.001	15.0 (12-18)	<0.001
	n (%)	n (%)	n (%)	P	OR (95% CI)	P	aOR (95% CI)	P
Delayed I stage	254 (7.5)	182 (43.6)	72 (2.4)	<0.001	31.4 (23.3 to 42.7)	<0.001	24.3 (17.8 to 33.6)	<0.001
Delayed II stage	277 (8.1)	126 (30.2)	151 (5.1)	<0.001	8.1 (6.2 to 10.6)	<0.001	5.0 (3.8 to 6.6)	<0.001
Intrapartum interventions	404 (11.9)	225 (54.0)	179 (6.0)	<0.001	18.4 (14.4 to 23.5)	<0.001	13.9 (10.8 to 17.9)	<0.001
Augmentation using amniotomy	223 (6.5)	107 (25.7)	116 (3.9)	<0.001	8.5 (6.4 to 11.4)	<0.001	7.7 (5.7 to 10.6)	<0.001
Augmentation using oxytocin	232 (6.8)	165 (39.6)	67 (2.2)	<0.001	28.6 (21 to 39.2)	<0.001	17.8 (12.9 to 24.6)	<0.001
Use of non-pharmacological support	2949 (86.6)	331 (79.4)	2618 (87.6)	<0.001	0.5 (0.4 to 0.7)	<0.001	0.4 (0.3 to 0.5)	<0.001
Free movement	2433 (71.4)	297 (71.2)	2136 (71.5)	0.965	1.0 (0.8 to 1.2)	0.919	1.1 (0.9 to 1.4)	0.413
Use of water	836 (24.5)	124 (29.7)	712 (23.8)	0.01	1.4 (1.1 to 1.7)	0.00874	0.8 (0.6 to 1)	0.0872
Other	642 (18.8)	49 (11.8)	593 (19.8)	<0.001	0.5 (0.4 to 0.7)	<0.001	0.5 (0.4 to 0.7)	<0.001

*Linear multivariate regression: other covariates, maternal age and parity.
†Calculated among women who experienced passive phase of the second stage (n=818, epidural use n=265, non-epidural use n=553)
aOR, adjusted OR; Coeff., coefficient.

Table 4 Distribution of maternal and neonatal outcomes according to epidural analgesia (EA) use, and association between EA and these variables assessed through logistic regression, presented as crude and adjusted estimates

		Overall	EA (n=417)	No EA (n=2989)				
		N (%)	N (%)	N (%)	Or (95% CI)	P value	aOR (95% CI)	P value
Maternal outcomes								
Mode of birth	Spontaneous vaginal birth	3261 (95.7)	337 (80.8)	2924 (97.8)	0.1 (0.1 to 0.1)	<0.001	0.4 (0.2 to 0.6)	<0.001
	Operative vaginal birth	97 (2.8)	45 (10.8)	52 (1.7)	6.8 (4.5 to 10.3)	<0.001	1.6 (0.9 to 2.8)	0.093
	Caesarean section	48 (1.4)	35 (8.4)	13 (0.4)	21 (11.3 to 41.5)	<0.001	7.2 (3.1 to 17.1)	<0.001
Maternal fever†		35 (1.5)	34 (8.2)	1 (0.1)	166.6 (35.8 to 296.8)	<0.001	N.A.	N.A.
Lithotomic position at birth†‡		1589 (48.7)	240 (71.2)	1349 (46.1)	2.9 (2.3 to 3.7)	<0.001	2.3 (1.7 to 3.0)	<0.001
Manual removal of placenta†‡		77 (2.3)	10 (2.6)	6 (2.3)	1.2 (0.6 to 2.2)	0.653	0.8 (0.3 to 1.6)	0.501
Spontaneous voiding during labour†		2934 (86.1)	108 (25.9)	2826 (94.5)	0 (0 to 0)	<0.001	0.04 (0.03 to 0.06)	<0.001
Urinary retention†		84 (2.5)	53 (12.7)	31 (1.0)	13.9 (8.9 to 22.1)	<0.001	6 (3.1 to 11.5)	<0.001
Episiotomy†‡		249 (7.4)	70 (18.3)	179 (6.0)	3.5 (2.6 to 4.7)	<0.001	0.8 (0.5 to 1.3)	0.439
Severe perineal tears†‡		82 (2.4)	15 (3.9)	67 (2.3)	1.8 (1 to 3.1)	0.049	0.8 (0.4 to 1.6)	0.577
Postpartum blood loss>1000 mL†‡		80 (2.3)	7 (1.7)	73 (2.4)	0.8 (0.3 to 1.5)	0.478	0.7 (0.3 to 1.7)	0.475
Neonatal outcomes								
Meconium-stained amniotic fluid†		167 (4.9)	59 (14.1)	108 (3.6)	4.4 (3.1 to 6.1)	<0.001	1.9 (1.2 to 3.0)	0.003
Fetal OP position at birth*‡		84 (2.5)	25 (6)	59 (2.0)	2.6 (1.5 to 4.3)	<0.001	1.4 (0.7 to 2.8)	0.360
Umbilical artery acidosis†‡		118 (4.5)	14 (3.4)	104 (4.7)	0.7 (0.4 to 1.3)	0.312	0.5 (0.2 to 0.9)	0.027
Low Apgar score at 5 min†‡		3 (0.1)	1 (0.2)	2 (0.1)	3.9 (0.2 to 40.8)	0.267	N.A.	N.A.
Early skin-to-skin contact†		3245 (95.3)	385 (92.3)	2860 (95.7)	0.5 (0.4 to 0.8)	0.003	1.5 (0.9 to 2.7)	0.134
Admission to NICU†‡		2769 (1.1)	6 (1.4)	30 (1.0)	1.6 (0.6 to 3.7)	0.285	1.1 (0.3 to 2.9)	0.903

N.A. Adjusted OR not estimated due to limited number of events.
*aOR: adjusted for parity, maternal age, cervical dilatation at partograph start, intrapartum interventions.
†aOR: adjusted for parity, maternal age, cervical dilatation at partograph start, intrapartum interventions and mode of birth.
‡Calculated within women who experienced vaginal birth (spontaneous or operative vaginal birth).
aOR, adjusted OR; NICU, neonatal intensive care unit; OP, occiput posterior.

A central element in interpreting these results is the predominance of nulliparous women among those who received EA. Since nulliparity is independently associated with longer and more painful labours, as well as higher rates of intervention, it likely influenced both the decision to request EA and the subsequent clinical trajectory. In line with NICE guidance,[2] parity should be considered not only as a factor influencing EA uptake, but also as a determinant of labour progression and obstetric decision-making. Importantly, parity was included as a confounder in all multivariate analyses. Sensitivity analyses by parity confirmed broadly similar patterns of association, particularly among nulliparous women, supporting the robustness of the main findings despite the imbalance between groups. Overall, these findings highlight the complexity of disentangling the role of parity in real-world intrapartum care, where it acts both as a key confounder and as a marker of different baseline labour trajectories. In addition, the lower cervical dilatation observed at partograph initiation among women who received EA may reflect earlier admission during labour or differences in labour progression. This finding is consistent with the known variability in labour onset and progression, particularly among nulliparous women.[2]

Importantly, the data show that many women who received EA also used at least one non-pharmacological strategy during labour. While we cannot determine whether these methods were used prior to or following the administration of EA, this pattern may reflect an initial attempt to cope with labour physiologically before opting for pharmacological support, in line with the midwifery model of care employed at our institution.

Maternal request was the most frequent reason documented for EA administration, suggesting that pain management—rather than clinical complications—primarily motivated its use. Women who received EA also showed a higher likelihood of undergoing intrapartum interventions, raising the possibility that EA use may be part of a cascade of obstetric interventions rather than solely a consequence of them.

This interpretation is in line with existing literature.[5 16 25] The association between EA and prolonged labour stages may reflect the neurohormonal and mechanical effects of EA on uterine contractility and fetal descent,[20 35] as well as the more medicalised approach to intrapartum care and the challenges faced by midwives in supporting the normality of labour progress in women with EA.[36 37]

Our data show an increased rate of caesarean section among women with EA, compared with those without. Caesarean section represents a major obstetric intervention with important implications for maternal and future reproductive health. From a broader perspective, increasing caesarean section rates remain a recognised global concern in obstetric care.[12] Although specific indications for caesarean section were not formally analysed in this study, intrapartum caesarean delivery is commonly associated with clinical conditions such as arrest disorders (including secondary arrest of cervical dilation), failure of fetal head descent, malposition, non-reassuring fetal heart rate patterns and unsuccessful operative vaginal birth. Our findings are consistent with previous evidence suggesting an association between EA and mode of birth, likely mediated by labour progression and clinical decision-making processes.[22]

In line with earlier reports, we also found an increased incidence of intrapartum fever in the EA group, a phenomenon associated with epidural-induced alterations in thermoregulation, exposure duration and duration of labour.[14 26] While not necessarily infectious, maternal fever can lead to increased surveillance and neonatal interventions.

Consistent with our findings, the literature had already highlighted a trend towards an increased likelihood of urinary retention during labour in women receiving EA,[5] a pattern that remains significant even when considering healthy women with no pre-existing risk factors.

Although neonatal outcomes such as Apgar score, skin-to-skin contact and NICU admission were comparable between groups, EA use seems to be associated with umbilical cord acidosis. Given the observational design, these results should be interpreted in terms of association rather than causation. Previous evidence does not indicate consistent differences in neonatal acid–base outcomes between epidural and non-EA.[3 5]

Finally, the observation that women in the no-EA group had greater cervical dilation at the onset of active labour suggests that timely diagnosis of labour phase and supportive care during the latent phase may help reduce reliance on pharmacological analgesia. Promoting a physiological approach in early labour could mitigate the cascade of intervention often associated with EA.[31]

Future research should also incorporate women's experiences and preferences, in order to better inform models of care that promote both safety and woman-centred outcomes.

Strengths and limitations of this study

This study has several strengths, including the large and well-defined cohort of women with uncomplicated low-risk pregnancies and the application of regional eligibility criteria for physiological birth, which reduced clinical heterogeneity and strengthened internal validity. In addition, the inclusion of both nulliparous and multiparous women allowed adjustment for parity in the analyses.

However, some limitations should be acknowledged. The retrospective design and use of routinely collected clinical data limited the ability to control for unmeasured confounders. As EA was not randomly assigned, selection bias related to maternal characteristics, labour progression and individual preferences cannot be excluded. Furthermore, the higher proportion of nulliparous women in the EA group and the lack of stratification according to cervical dilatation at admission may have influenced the assessment of labour progression and duration. Finally, the restriction to low-risk pregnancies

may limit the generalisability of the findings to more complex obstetric populations.

CONCLUSION

This study highlights potential associations between EA and increased intrapartum interventions, caesarean section and prolonged labour among uncomplicated pregnancy low-risk women. While causality cannot be inferred, the findings contribute to a growing body of evidence suggesting that EA use may be associated with alterations of the normal pattern of labour and intrapartum care.

In clinical practice, our findings highlight the importance of careful monitoring of labour progression and the use of evidence-based approaches to intrapartum care, while avoiding unnecessary interventions. Enhancing non-pharmacological pain management strategies and ensuring continuous, supportive care throughout labour remain essential components of high-quality maternity care, including for women who ultimately use EA.

Future prospective studies are needed to further explore the temporal sequence between EA use and subsequent interventions, and to capture additional variables—such as the timing and nature of complications, maternal mobility and overall satisfaction with care. Incorporating women's experiences and preferences into such research will be important to inform care models that promote both safety and woman-centred outcomes.

Contributors FS: Conceptualisation; methodology; validation; formal analysis; investigation; resources; data curation; writing—original draft; writing—review and editing; visualisation; project administration; supervision. Turco Rosemary: Conceptualisation; methodology; validation; investigation; writing—original draft; writing—review and editing. PM: Formal analysis; writing—review and editing; visualisation. MA and D'ALMP: Conceptualisation; writing—review and editing. NA and MIM: Writing—review and editing. GM: Investigation; writing—review and editing. LA: Conceptualisation; methodology; writing—review and editing. OS: Conceptualisation; methodology; validation; formal analysis; writing—review and editing; project administration; supervision and guarantor.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data are available upon reasonable request to the authors.

ORCID iDs
Maria Panzeri https://orcid.org/0009-0005-0140-7069
Anna Locatelli https://orcid.org/0000-0002-3919-4776
Sara Ornaghi https://orcid.org/0000-0001-6898-7217

REFERENCES

1 Nori W, Kassim MAK, Helmi ZR, *et al*. Non-Pharmacological Pain Management in Labor: A Systematic Review. *J Clin Med* 2023;12:7203.
2 National Institute for Health and Care Excellence. Intrapartum care. 2023. Available: https://www.nice.org.uk/guidance/ng235/resources/intrapartum-care-pdf-66143897812933
3 World Health Organization. WHO recommendations on intrapartum care for a positive childbirth experience. World Health Organization; 2018. Available: https://iris.who.int/bitstream/handle/10665/260178/9789241550215-eng.pdf
4 Deepak D, Kumari A, Mohanty R, *et al*. Effects of Epidural Analgesia on Labor Pain and Course of Labor in Primigravid Parturients: A Prospective Non-randomized Comparative Study. *Cureus* 2022;14:e26090.
5 Anim-Somuah M, Smyth RM, Cyna AM, *et al*. Epidural versus non-epidural or no analgesia for pain management in labour. *Cochrane Database Syst Rev* 2018;5:CD000331.
6 Sng BL, Zeng Y, de Souza NNA, *et al*. Automated mandatory bolus versus basal infusion for maintenance of epidural analgesia in labour. *Cochrane Database Syst Rev* 2018;5:CD011344.
7 de Verastegui-Martín M, de Paz-Fresneda A, Jiménez-Barbero JA, *et al*. Influence of Laboring People's Mobility and Positional Changes on Birth Outcomes in Low-Dose Epidural Analgesia Labor: A Systematic Review with Meta-Analysis. *J Midwifery Womens Health* 2023;68:84–98.
8 Halliday L, Kinsella M, Shaw M, *et al*. Comparison of ultra-low, low and high concentration local anaesthetic for labour epidural analgesia: a systematic review and network meta-analysis. *Anaesthesia* 2022;77:910–8.
9 Perlas A, Chaparro LE, Chin KJ. Lumbar Neuraxial Ultrasound for Spinal and Epidural Anesthesia: A Systematic Review and Meta-Analysis. *Reg Anesth Pain Med* 2016;41:251–60.
10 Garcia-Lausin L, Perez-Botella M, Duran X, *et al*. Relation between Length of Exposure to Epidural Analgesia during Labour and Birth Mode. *Int J Environ Res Public Health* 2019;16:2928.
11 Wang K, Cao L, Deng Q, *et al*. The effects of epidural/spinal opioids in labour analgesia on neonatal outcomes: a meta-analysis of randomized controlled trials. *Can J Anaesth* 2014;61:695–709.
12 The Lancet. Stemming the global caesarean section epidemic. *The Lancet* 2018;392:1279.
13 Lawson J, Amaratunge L, Goh M, *et al*. Perinatal outcomes after regional analgesia during labour. *Aust N Z J Obstet Gynaecol* 2024;64:334–40.
14 Halliday L, Nelson SM, Kearns RJ. Epidural analgesia in labor: A narrative review. *Int J Gynaecol Obstet* 2022;159:356–64.
15 Myrick TG, Sandri KJ. Epidural Analgesia and Any Vaginal Laceration. *J Am Board Fam Med* 2018;31:768–73.
16 Kurakazu M, Umehara N, Nagata C, *et al*. Delivery mode and maternal and neonatal outcomes of combined spinal-epidural analgesia compared with no analgesia in spontaneous labor: A single-center observational study in Japan. *J Obstet Gynaecol Res* 2020;46:425–33.
17 Jiang Q, Jin Z, Wang W, *et al*. Retrospective study to assess the effect of epidural analgesia on labor progress and women's pelvic floor muscle from the perspective of electromyography. *J Matern Fetal Neonatal Med* 2023;36:2211198.
18 Erickson EN, Hersh SR, Wharton MR, *et al*. The Role of Passive Descent and Epidural Analgesia in Outcomes Associated With Prolonged Pushing Among Nulliparous Individuals in Midwifery Care. *J Midwife Womens Health* 2024;69:499–513.
19 Reem RN, ReemA RN, Ishaq RN. Epidural analgesia and its effects on maternal and neonatal outcomes: a retrospective comparable study in Northern Jordan. 2019;135–42. Available: https://search.proquest.com/openview/899282f03b31c818593434b4ab37fc14/1?pq-origsite=gscholar&cbl=506296
20 Newnham EC, Moran PS, Begley CM, *et al*. Comparison of labour and birth outcomes between nulliparous women who used epidural

analgesia in labour and those who did not: A prospective cohort study. *Women Birth* 2021;34:e435–41.
21 Fieni S, di Pasquo E, Formisano D, *et al*. Epidural analgesia and the risk of operative delivery among women at term: A propensity score matched study. *Eur J Obstet Gynecol Reprod Biol* 2022;276:174–8.
22 Djaković I, Sabolović Rudman S, Košec V. Effect of epidural analgesia on mode of delivery. *Wien Med Wochenschr* 2017;167:390–4.
23 Damhuis SE, Groen H, Thilaganathan B, *et al*. Effect of intrapartum epidural analgesia on rate of emergency delivery for presumed fetal compromise: nationwide registry-based cohort study. *Ultrasound Obstet Gynecol* 2023;62:668–74.
24 Gude P, Kaci CSB, Sieker M, *et al*. The influence of labor epidural analgesia on maternal, uteroplacental and fetoplacental hemodynamics in normotensive parturients: a prospective observational study. *Int J Obstet Anesth* 2021;45:83–9.
25 Lu R, Rong L, Ye L, *et al*. Effects of epidural analgesia on intrapartum maternal fever and maternal outcomes: an updated systematic review and meta-analysis. *J Matern Fetal Neonatal Med* 2024;37:2357168.
26 Jansen S, Lopriore E, Naaktgeboren C, *et al*. Epidural-Related Fever and Maternal and Neonatal Morbidity: A Systematic Review and Meta-Analysis. *Neonatology* 2020;117:259–70.
27 Ravelli ACJ, Eskes M, de Groot CJM, *et al*. Intrapartum epidural analgesia and low Apgar score among singleton infants born at term: A propensity score matched study. *Acta Obstet Gynecol Scand* 2020;99:1155–62.
28 Kraft F, Wohlrab P, Meyer EL, *et al*. Epidural analgesia and neonatal short-term outcomes during routine childbirth: a 10-year retrospective analysis from the national birth registry of Austria. *Minerva Anestesiol* 2024;90:491–9.
29 Kearns RJ, Shaw M, Gromski PS, *et al*. Association of Epidural Analgesia in Women in Labor With Neonatal and Childhood Outcomes in a Population Cohort. *JAMA Netw Open* 2021;4:e2131683.
30 Eriksen LM, Nohr EA, Kjaergaard H. Mode of delivery after epidural analgesia in a cohort of low-risk nulliparas. *Birth* 2011;38:317–26.
31 Rota A, Antolini L, Colciago E, *et al*. Timing of hospital admission in labour: latent versus active phase, mode of birth and intrapartum interventions. A correlational study. *Women Birth* 2018;31:313–8.
32 Sandall J, Fernandez Turienzo C, Devane D, *et al*. Midwife continuity of care models versus other models of care for childbearing women. *Cochrane Database Syst Rev* 2024;4:CD004667.
33 Royal College of Anaesthetists. Best practice in the management of epidural analgesia in the hospital setting. 2020. Available: https://fpm.ac.uk/media/2576
34 Lombardia R. Linee Di Indirizzo Operativo per La Definizione Ed Organizzazione Della Presa Carico Da Parte Dell'ostetrica/o Nel Percorso Nascita Fisiologico Intraospedaliero Ai Sensi Della DGR 268/28.06. 2018.
35 Hasegawa J, Farina A, Turchi G, *et al*. Effects of epidural analgesia on labor length, instrumental delivery, and neonatal short-term outcome. *J Anesth* 2013;27:43–7.
36 Colciago E, Fumagalli S, Inzis I, *et al*. Management of the second stage of labour in women with epidural analgesia: A qualitative study exploring Midwives' experiences in Northern Italy. *Midwifery* 2019;78:8–15.
37 Aune I, Brøtmet S, Grytskog KH, *et al*. Epidurals during normal labour and birth - Midwives' attitudes and experiences. *Women Birth* 2021;34:e384–9.