

Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor: a population-based cohort study



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BACKGROUND: Maternal obesity is associated with increased risks of gestational diabetes, gestational hypertension, preeclampsia, and post-term pregnancy, all of which increase the likelihood of induction of labor (IOL). Current guidelines for oxytocin dosing and administration do not account for maternal body mass index (BMI).

OBJECTIVE: To evaluate the association between maternal BMI and (1) cumulative oxytocin dose and (2) maximum oxytocin infusion rate during the first stage of labor among nulliparous women undergoing term IOL.

STUDY DESIGN: This prospective, population-based cohort study included 1163 nulliparous women with singleton term pregnancies undergoing IOL with oxytocin between 2017 and 2019 in Sweden. Cumulative oxytocin dose, from initiation of infusion until birth, was available for 637 women, and maximum oxytocin infusion rate during the first stage of labor for 974 women. Participants were categorized according to WHO BMI classification: normal weight ($<25 \text{ kg/m}^2$, $n=527$), overweight ($25.0-29.9 \text{ kg/m}^2$, $n=359$), obesity class I ($30.0-34.9 \text{ kg/m}^2$, $n=167$) and obesity class II to III ($\geq 35.0 \text{ kg/m}^2$, $n=108$). Kaplan–Meier analyses and Cox proportional hazard models were used to assess the probability of vaginal birth or the decision to perform an emergency cesarean section (CS) at a given cumulative oxytocin dose/maximum oxytocin infusion rate, adjusting for maternal age.

RESULTS: Mean cumulative oxytocin dose increased progressively across BMI categories (normal weight: 6230 mU; overweight: 7410 mU; obesity class I: 8698 mU; obesity class II to III: 10,128 mU; $P<.001$). Maximum oxytocin infusion rate also increased with BMI (normal weight: 17.2 mU/min; overweight: 18.8 mU/min; obesity class I: 21.1 mU/min; and obesity class II to III: 24.1 mU/min; $P<.001$). Kaplan–Meier curves demonstrated that women with higher BMI required progressively higher cumulative oxytocin doses and maximum oxytocin infusion rates to give birth (vaginal birth or emergency CS) (log-rank $P<.001$). This association remained after adjustment for potential confounders in Cox proportional hazards models. The adjusted hazard ratio (aHR) 95% confidence interval (CI) for birth at a given cumulative oxytocin dose=0.84 (0.70–1.01) for overweight, aHR (95% CI)=0.73 (0.57–0.92) for obesity class I and aHR (95% CI) 0.63 (0.48–0.84) for obesity class II to III.

CONCLUSION: Increasing maternal BMI was independently associated with higher cumulative oxytocin doses and infusion rates during IOL. These findings suggest reduced oxytocin responsiveness with increasing BMI and support consideration of BMI-tailored dosing strategies during labor induction.

Key words: body mass index, cumulative dose, induction of labor, infusion rate, oxytocin

Introduction

Obesity has become a major global public health challenge, with its prevalence among women more than doubling since 1990.¹ Consequently, an increasing proportion of pregnancies occur in women with overweight or obesity.² Between 2010 and 2019, nearly half of all pregnancies worldwide were affected by maternal overweight or obesity.³

Maternal obesity is associated with adverse obstetric outcomes, including

gestational diabetes, hypertensive disorders, post-term gestation, and labor dystocia.^{4,5} The risk of these complications increases in a dose-dependent manner with rising body mass index (BMI),⁶ and may ultimately necessitate induction of labor (IOL).^{7,8} As a result, women with obesity are disproportionately represented among those undergoing labor induction.

Rates of IOL have increased substantially in many high-income countries.^{9,10} In Sweden, induction rates rose from 20% in 2018 to 30% in 2025,¹¹ largely attributed to revised national guidelines recommending induction at 41 rather than 42 completed weeks of gestation.¹² Among nulliparous women with obesity in Sweden, more than half (51%) undergo labor induction.¹¹

Oxytocin infusion is routinely administered to initiate or augment uterine contractions during IOL.⁷ Normal pregnancy is characterized by increased myometrial

sensitivity to oxytocin, mediated in part by upregulation of oxytocin receptors.^{13,14} However, women with obesity are at increased risk of labor dystocia and appear to require greater oxytocin exposure to achieve adequate labor progress.^{7,15–18} Experimental and clinical studies suggest that maternal obesity may be associated with altered myometrial contractility, different levels of adipokines, impaired intracellular calcium signaling, and changes in oxytocin receptor expression or function^{13,14,19} all of which may affect uterine contractility.

These findings provide a biologically plausible explanation for reduced oxytocin sensitivity and increased oxytocin requirements in women with obesity. Consistent with this hypothesis, previous studies have reported longer inductions, prolonged labor, higher cumulative oxytocin exposure, and an increased risk of failed induction and cesarean delivery among women with

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AJOG MFM at a Glance

Why was this study conducted?

To determine whether maternal body mass index (BMI) is associated with cumulative oxytocin dose and maximum oxytocin infusion rate during the first stage of labor, during induction of labor (IOL) in nulliparous women at term.

Key findings

Both cumulative oxytocin dose and maximum oxytocin infusion rate increased progressively with rising BMI. The probability of delivery at a given oxytocin dose decreased as BMI increased.

What does this add to what is known?

This large, population-based study confirms and extends previous evidence by demonstrating a clear dose-dependent association between BMI and oxytocin requirements during induced labor and successively less chance to give birth at comparable oxytocin exposure with increasing BMI. The findings support further evaluation of BMI-adapted dosing strategies to optimize outcomes during labor induction and potentially reduce unnecessary cesarean deliveries.

obesity.⁷ However, the available evidence regarding oxytocin requirements remains limited by relatively small sample sizes, heterogeneous study populations, and inclusion of both nulliparous and multiparous women.^{16,20,21}

A better understanding of the association between maternal BMI and oxytocin requirements during induced labor may facilitate more individualized labor induction management and optimize oxytocin administration, dosing strategies, reduce the risk of under- and over-treatment, and improve induction management. Therefore, the primary aim of this study was to evaluate whether the cumulative oxytocin dose during term IOL in nulliparous women is associated with maternal BMI. The secondary aim was to examine the association between maternal BMI and maximum oxytocin infusion rate during the first stage of labor. We hypothesized that nulliparous women with obesity require higher doses and infusion rates of oxytocin during IOL than normal-weight women.

Material and methods**Study design and population**

This prospective, population-based cohort study was conducted at seven obstetric units in the southeast health region of Sweden between April 2017 and February 2019. Eligible participants were nulliparous women undergoing

IOL at term (≥ 37 weeks' gestation), with a singleton fetus in cephalic presentation who received oxytocin during labor and had a documented early pregnancy BMI. All units adhered to uniform national guidelines for oxytocin administration throughout the study period.²²

Oxytocin administration

Oxytocin infusion was typically initiated following amniotomy or spontaneous rupture of membranes if cervical dilation failed to progress within 1 hour, or during the active phase of the first stage of labor if cervical dilation was delayed by ≥ 3 hours relative to the expected rate of 1 cm per hour. During the second stage, oxytocin infusion was indicated in the absence of fetal descent after 1 hour or if active pushing exceeded 30 minutes.²²

Oxytocin was administered intravenously via a peripheral venous catheter, using an electronic infusion pump (B Braun Infusomat Space or Alaris GP Plus). The standard infusion solution consisted of 5 units of oxytocin diluted in 500 mL of 0.9% sodium chloride, yielding a concentration of 10 milliunits (mU)/mL. Infusion was initiated at 3.3 mU/min and increased by 3.3 mU/min every 20 minutes, until adequate uterine activity (4–5 contractions per 10 minutes), or normal labor

progress, as assessed by partograph, was achieved.

The infusion rate was continuously adjusted according to labor progress, uterine hyperstimulation, and abnormalities in the cardiotocography (CTG) tracing. Midwives were authorized to increase the infusion rate independently up to 19.8 mU/min; higher infusion required consultation with the responsible obstetrician. Uterine hyperstimulation was defined as > 5 contractions per 10 minutes.²² An intrauterine pressure catheter was used only when external monitoring of uterine activity was inadequate. Continuous CTG was recommended throughout oxytocin administration.²²

The cumulative oxytocin dose from infusion initiation until vaginal birth or emergency cesarean section (CS) was automatically recorded by the infusion pump and documented in the electronic medical record. The maximum oxytocin infusion rate during the first stage of labor was manually extracted from the partograph by medical record review.

Definition of active labor

The Swedish national definition of active labor applied during the study requiring fulfillment of at least two of the following three criteria: spontaneous rupture of membranes, regular painful contractions (2–3 per 10 minutes), and cervical dilatation of ≥ 4 cm, or cervical effacement with dilation of at least 1 cm. In addition, labor progression within the subsequent 2 hours was required.²³

Maternal, obstetric and neonatal data

Maternal height and weight were recorded at the first antenatal visit, allowing calculation of BMI (kg/m^2) in early pregnancy. Participants were categorized into four BMI groups according to the WHO classification: normal weight ($\text{BMI} < 25 \text{ kg}/\text{m}^2$), overweight ($\text{BMI} 25\text{--}29.9 \text{ kg}/\text{m}^2$), obesity class I ($\text{BMI} 30\text{--}34.9 \text{ kg}/\text{m}^2$), and obesity class II to III ($\text{BMI} \geq 35.0 \text{ kg}/\text{m}^2$).

Maternal demographic and clinical data were extracted from electronic

medical records (Obstetrix, v2.19.0.301, Cerner Corporation, Kansas, MO) and supplemented by manual chart review when necessary. Variables included maternal age, smoking status, pre-existing medical conditions (diabetes mellitus, epilepsy, pulmonary disease, psychiatric disorders, and hypertension disorders), and maternal weight in the first trimester and at delivery.

Obstetric data included gestational age at delivery, indication for and methods of IOL, Bishop score at induction start, time of oxytocin initiation, time to full cervical dilation, maximum oxytocin infusion rate during the first stage of active labor, use of epidural analgesia, mode of delivery, cumulative oxytocin dose, occurrence of obstetric anal sphincter injury and postpartum hemorrhage. Neonatal outcomes included birth weight, Apgar score at 5 minutes, and umbilical arterial pH.

Ethical approval

Ethical approval for the study was granted by the Regional Ethical Review Board on June 14, 2017 (Dnr 2017/277-31) with an amendment approved on June 16, 2021 (Dnr 2021-03254).

Statistical analyses

Categorical variables are presented as frequencies and percentages. Continuous variables are expressed as mean $\pm$ standard deviation for normally distributed data and as median with interquartile range for non-normally distributed data. Group comparisons of categorical variables were conducted using Pearson's χ^2 test. Continuous variables were compared using Student's *t* test or one-way analysis of variance (ANOVA) for normally distributed data and the independent median test or Kruskal–Wallis test for non-normally distributed data.

Kaplan–Meier curves illustrate the cumulative proportion of women giving birth according to cumulative oxytocin dose and maximum oxytocin infusion rate during the first stage of labor across BMI categories. The endpoint was vaginal birth or emergency CS. Differences between BMI categories were assessed using the log-rank test. Cox proportional hazards regression was used to

estimate crude and adjusted hazard ratios (HRs and aHRs) and 95% confidence intervals (CIs) for reaching the study endpoint at a given cumulative oxytocin dose, adjusting for potential confounders and normal-weight women as reference category. Maternal age was identified as a confounder using directed acyclic graph analysis ([Supplemental Figure 1](#)). Birth weight, epidural analgesia, and indication for induction were considered potential mediators.

Post hoc analyses were performed using Tukey's honestly significant difference test or Bonferroni correction, as appropriate. Statistical significance was defined as a two-sided $P < .05$. All statistical analyses were conducted using IBM SPSS Version 30.0.0.0 (IBM Corp., Armonk, NY) (172).

Results

The selection of the study population is illustrated in [Figure 1](#). Of 1543 eligible women, 1163 met the inclusion criteria. Cumulative oxytocin dose data were available for 637 participants, and maximum infusion rate data during the first stage of labor for 974 participants.

Baseline characteristics stratified by BMI category are presented in [Table 1](#). The rate of emergency CS increased with BMI (12.7% in normal-weight, 19.9% in overweight women, 22.2% in obesity class I and 25.5% in obesity class II–III; $P < .001$). Mean cumulative oxytocin dose increased with BMI (normal weight 6230 mU; overweight 7410 mU; obesity class I 8698 mU; and obesity class II to III 10,128 mU; $P < .001$ ([Table 2](#)). Post hoc analyses confirmed significant difference between normal-weight women and those with obesity class II to III ($P = .003$).

Maximum oxytocin infusion rate also increased across BMI categories (normal weight 17.2 mU/min, overweight 18.8 mU/min, obesity class I 21.1 mU/min and obesity class II–III 24.4 mU/min, respectively; $P < .001$), with statistically significant differences between normal-weight women and those with obesity class I ($P = .005$) and obesity class II to III ($P < .001$), as well as between overweight women and

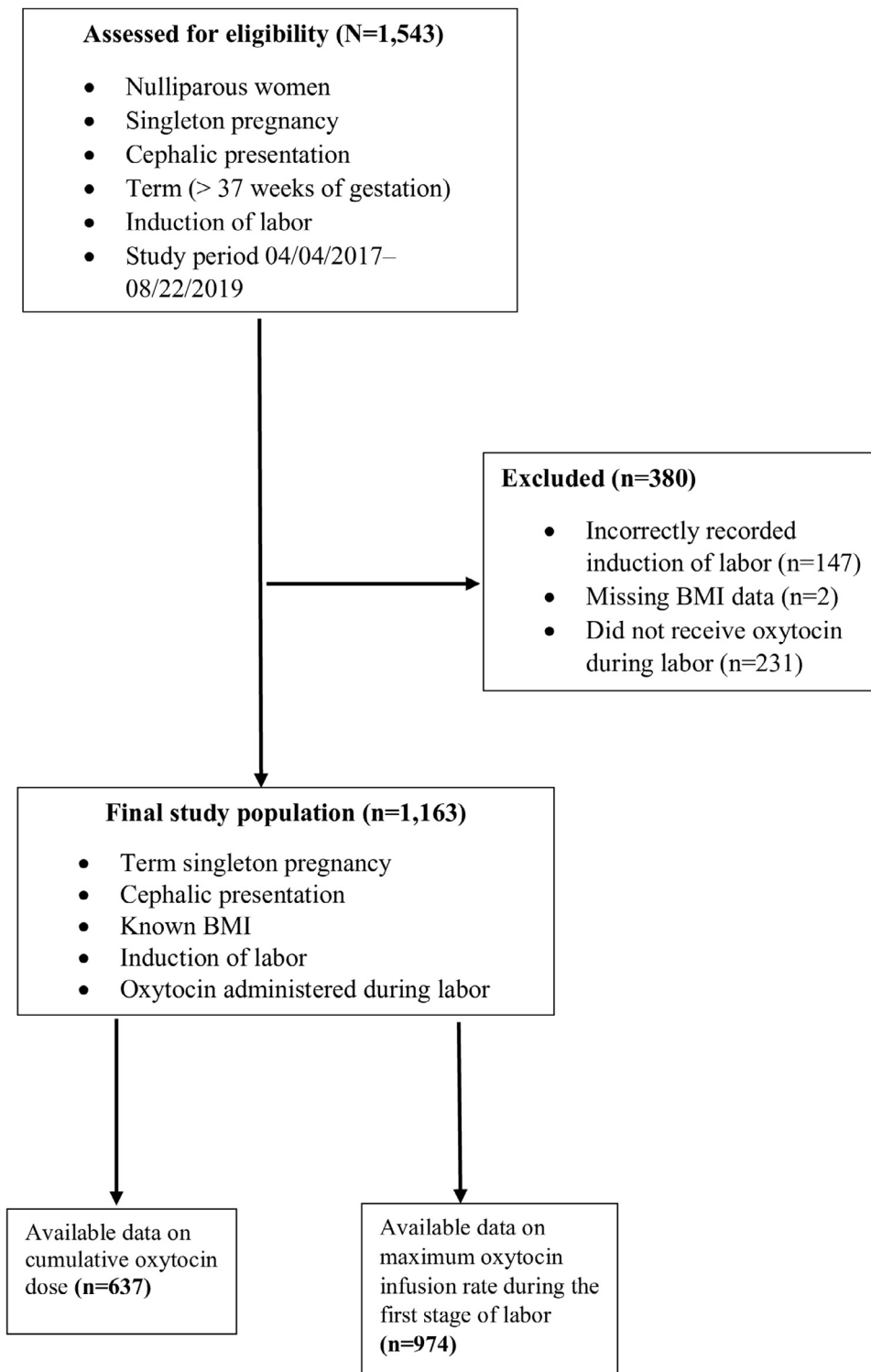
those with obesity class II to III ($P < .001$).

Kaplan–Meier curves demonstrated that women with higher BMI required progressively higher cumulative oxytocin doses to give birth (vaginal birth or emergency CS) (log-rank $P < .001$) ([Figure 2](#)). The association remained after adjustment for maternal age in Cox proportional hazards models ([Table 3](#)). Compared with normal-weight women, aHRs (95% CIs) for reaching the endpoint were 0.84 (0.70–1.01), 0.73 (0.57–0.92) and 0.63 (0.48–0.84) for overweight women, women with obesity class I and obesity class II to III, respectively ([Table 3](#)). Corresponding Kaplan–Meier curves for maximum oxytocin infusion rate showed a similar pattern across BMI categories ([Figure 3](#)). Women with increasing BMI gave birth at progressively higher maximum oxytocin infusion rates compared to women with lower BMI (log-rank $P < .001$).

As shown in [Table 4](#), induction-to-delivery time and time from induction start to onset of active labor increased significantly with increasing BMI ($P < .001$). Oxytocin exposure duration also differed significantly across BMI categories ($P < .001$), with the longest duration observed among women with obesity class II to III. The duration of first stage of labor was significantly longer among women with obesity class II to III ($P = .01$), whereas the second stage was shortest in this group ($P = .03$).

A missing data analysis comparing women with and without recorded cumulative oxytocin dose is presented in [Supplemental Table 1](#). Baseline characteristics were largely comparable between groups. The proportion of women with and without recorded oxytocin dose was similar across BMI categories. However, women without recorded cumulative oxytocin dose had lower Bishop score at induction (3.5 vs 4.0, $P \leq .001$), longer oxytocin exposure (7.5 vs 6.3 hours, $P = .007$), longer first (5.8 vs 5.5 hours, $P = .03$) and second-stage labor (157 vs 132 minutes, $P = .01$), and a higher CS rate (24.1% vs 12.1%, $P \leq .001$).

FIGURE 1
Flow chart of study population.



Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. *Am J Obstet Gynecol MFM* 2026.

TABLE 1

Maternal, obstetric and neonatal characteristics of nulliparous women with term singleton pregnancies undergoing induction of labor and treatment with oxytocin, stratified by body mass index

	BMI <25 (n=527)	BMI 25–29.9 (n=359)	BMI 30–34.9 (n=167)	BMI ≥35 (n=108)	P value
Maternal characteristics					
Maternal age, y	29.1 (5.0)	29.3 (5.2)	29.1 (5.1)	28.5 (4.6)	.52 ^a
Smoking during pregnancy	18 (3.5)	11 (3.1)	5 (3.0)	5 (4.7)	.88 ^b
Diabetes mellitus	7 (1.3)	9 (2.5)	3 (1.8)	3 (2.8)	.55 ^b
Hypertension disorders of pregnancy	47 (9.0)	52 (14.6)	33 (19.8)	26 (24.3)	<.001 ^a
First trimester weight, kg	60.8 (6.9)	74.9 (7.3)	87.7 (7.4)	108.6 (11.8)	<.001 ^a
Gestational weight gain, kg	15.9 (5.5)	16.3 (6.6)	13.8 (7.2)	11.2 (8.7)	<.001 ^a
Obstetric characteristics					
Gestational age at delivery, d	286.3 (10.2)	285.4 (10.6)	284.7 (11.2)	285.1 (10.9)	.27 ^a
Bishop score at induction	4 (2)	4 (2)	4 (2)	4 (2)	.16 ^a
Cervical dilatation at oxytocin start, cm	5.5 (3.0)	5.2 (2.8)	4.9 (2.6)	4.2 (1.7)	<.001 ^a
Mode of delivery					
<i>Spontaneous vaginal</i>	369 (70.0)	229 (63.8)	108 (64.7)	68 (62.9)	<.001 ^c
<i>Instrumental vaginal</i>	91 (17.3)	60 (16.7)	17 (10.2)	16 (14.9)	
<i>Cesarean delivery</i>	67 (12.7)	70 (19.5)	42 (25.1)	24 (22.2)	
Obstetric anal sphincter injury	25 (4.7)	11 (3.1)	7 (4.2)	5 (4.6)	.65 ^b
Blood loss at delivery, mL	560 (442)	592 (469)	612 (409)	637 (532)	.30 ^a
Postpartum hemorrhage >1000 mL	64 (12.1)	48 (13.4)	24 (14.4)	18 (16.7)	.57 ^b
Epidural analgesia	426 (80.8)	311 (86.6)	126 (75.4)	90 (83.3)	.01 ^b
Neonatal characteristics					
Birth weight, g	3545 (545)	3640 (556)	3678 (568)	3655 (567)	.01 ^a
Apgar score <7 at 5 min	18 (3.4)	13 (3.6)	8 (4.8)	6 (5.6)	.67 ^b
Apgar score <4 at 5 min	2 (0.4)	4 (1.1)	0 (0)	1 (0.9)	.36 ^b
Umbilical arterial pH <7.0	8 (1.5)	6 (1.7)	1 (0.6)	3 (2.8)	.58 ^b

Data are presented as mean (SD) or number (%).

BMI, body mass index.

^a One-way ANOVA; ^b Pearson χ^2 -test (df=3); ^c Pearson χ^2 -test (df=9).

Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. Am J Obstet Gynecol MFM 2026.

TABLE 2

Cumulative oxytocin dose and maximum oxytocin infusion rate according to maternal body mass index in nulliparous women with term singleton pregnancies during induction of labor

	BMI <25.0	BMI 25.0–29.9	BMI 30.0–34.9	BMI ≥35.0	P value
Cumulative oxytocin dose, mU	6230 (7534)	7410 (6862)	8698 (8162)	10,128 (11,015)	<.001 ^a
Maximum oxytocin infusion rate, mU/min	17.2 (11.4)	18.8 (11.2)	21.1 (13.9)	24.1 (14.4)	<.001 ^a

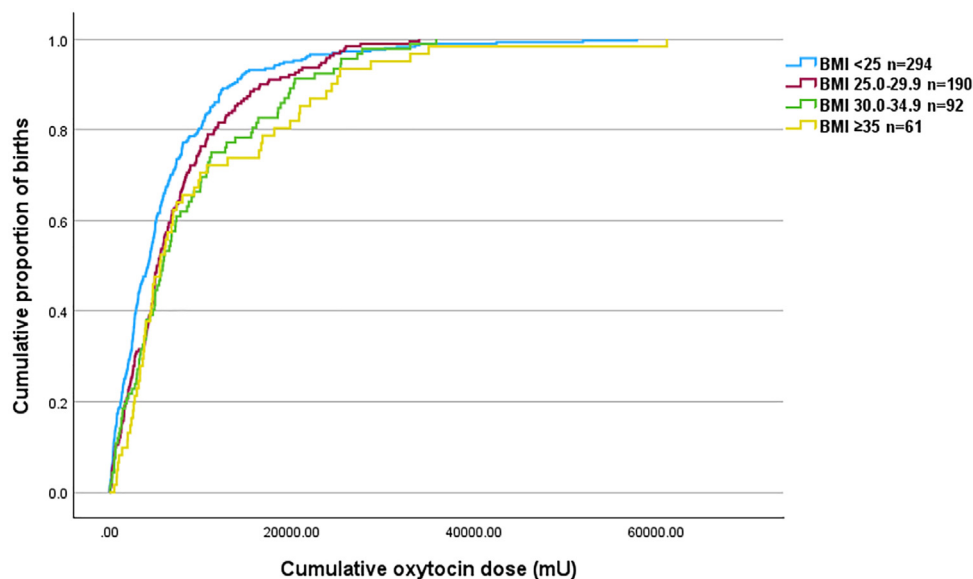
Data are presented as mean (SD).

BMI, body mass index.

^a One-way ANOVA.

Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. Am J Obstet Gynecol MFM 2026.

FIGURE 2
Kaplan–Meier graph illustrating the cumulative proportion of births according to cumulative oxytocin dose during labor in nulliparous women undergoing induction of labor stratified by to body mass index. The endpoint was defined as vaginal birth or emergency cesarean section. Log-rank $P \leq .001$.



Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. *Am J Obstet Gynecol MFM* 2026.

Comment
Principal findings

In this large population-based cohort of nulliparous women undergoing induction of IOL at term, increasing maternal BMI was associated with progressively higher cumulative oxytocin doses and higher maximum infusion rates during the active first stage of labor. In addition, the chance for birth at a given cumulative oxytocin dose decreased with increasing BMI, independent of maternal age. Collectively, these

findings indicate a graded reduction in clinical oxytocin responsiveness with increasing maternal BMI.

Results in the context of what is known

Our results corroborate and substantially extend prior evidence suggesting increased oxytocin requirements in women with obesity. Most previous studies have reported similar associations; however, they were often limited by small sample sizes, selected

subgroups (eg, vaginal deliveries only), mixed parity cohorts, spontaneous labor onset, or single-center designs.^{16,20,21,24–26}

Recently, Cohen et al examined more than 20,000 labor inductions in a large single-center US cohort and demonstrated that both maximum oxytocin dose rates and oxytocin exposure duration increased progressively with maternal BMI. They also reported that the association between high oxytocin dosing and adverse outcomes appeared

TABLE 3 Crude and adjusted hazard ratios and 95% confidence intervals for birth at a given cumulative oxytocin dose, in relation to maternal body mass index in nulliparous women with term singleton pregnancies undergoing induction of labor				
	BMI <25.0	BMI 25.0–29.9	BMI 30.0–34.9	BMI ≥35.0
Crude hazard ratio (95% CI)	Reference	0.84 (0.70–1.00)	0.72 (0.57–0.91)	0.63 (0.48–0.83)
Adjusted hazard ratio ^a (95% CI)	Reference	0.84 (0.70–1.01)	0.73 (0.57–0.92)	0.63 (0.48–0.84)

The study endpoint was defined as birth (vaginal birth or emergency cesarean section). Reference category: normal-weight women.

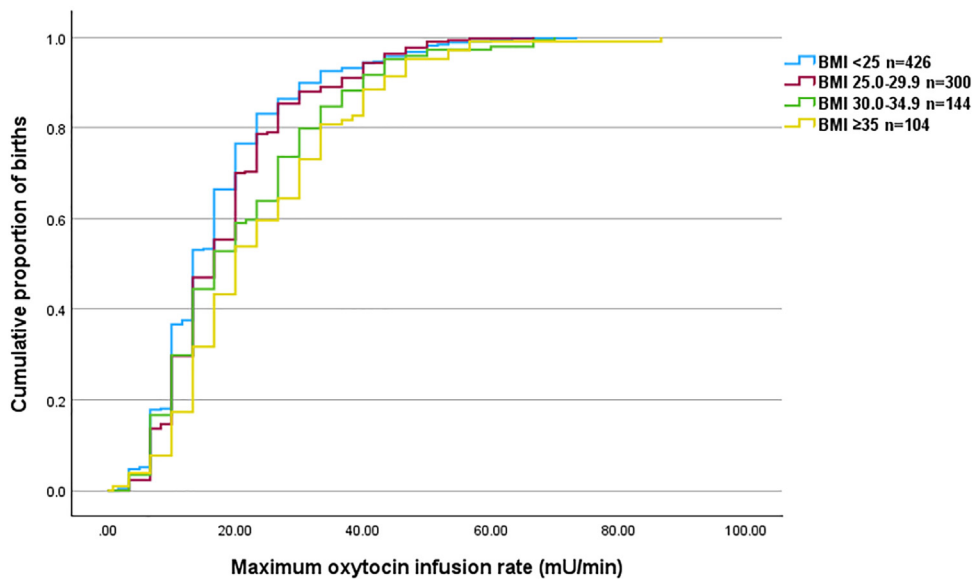
BMI, body mass index.

^a Adjusted for maternal age.

Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. *Am J Obstet Gynecol MFM* 2026.

FIGURE 3

Kaplan–Meier graph illustrating the cumulative proportion of births according to maximum oxytocin infusion rate during the first stage of labor in nulliparous women undergoing induction of labor stratified by body mass index. The endpoint was defined as vaginal birth or emergency cesarean section. Log-rank $P \leq .001$.



Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. *Am J Obstet Gynecol MFM* 2026.

attenuated among individuals with higher BMI.²⁵ Our findings support and extend these observations. Whereas Cohen et al primarily evaluated associations between oxytocin dosing rates and maternal outcomes across BMI categories in a mixed-parity population, our study quantified cumulative oxytocin

requirements according to BMI category and estimated the probability of delivery at a given cumulative oxytocin dose among nulliparous women. Restricting the analysis to nulliparous women is clinically relevant because labor progression, intervention rates, and cesarean delivery risk differ

substantially by parity. Our findings therefore add important evidence by demonstrating not only that women with obesity receive higher oxytocin doses, but also that increasing BMI is associated with a lower likelihood of delivery at comparable levels of oxytocin exposure. Collectively, these

TABLE 4

Duration of labor stages stratified by body mass index among nulliparous women with term singleton pregnancies undergoing induction of labor

	BMI <25.0 (n=527)	BMI 25.0–29.9 (n=359)	BMI 30.0–34.9 (n=167)	BMI ≥35.0 (n=108)	P value
First stage of labor, h	5.9 (5.5) (n=328)	6.0 (6.0) (n=207)	5.4 (4.3) (n=92)	7.5 (5.8) (n=59)	.01 ^a
Second stage of labor, min	115 (140) (n=479)	118 (148) (n=307)	106 (164) (n=136)	64 (130) (n=86)	.03 ^a
Time from oxytocin initiation to delivery, h	5.9 (7.4) (n=515)	6.9 (7.5) (n=350)	7.7 (8) (n=164)	8.9 (8.6) (n=108)	<.001 ^a
Time from induction start to delivery, h	21.0 (19.0) (n=526)	24.0 (22.0) (n=359)	26.0 (25.0) (n=167)	31.5 (27.0) (n=108)	<.001 ^a
Time from induction start to onset of active labor, h	11.7 (19.8) (n=334)	14.0 (20.4) (n=220)	20.5 (24.1) (n=100)	21.4 (23.3) (n=70)	.01 ^a

Data are presented as median (interquartile range).

BMI, body mass index.

^a Independent-samples median test.

Source: Bladfält. Higher maternal body mass index is associated with increased oxytocin requirements during induction of labor. *Am J Obstet Gynecol MFM* 2026.

findings provide stronger clinical evidence for reduced oxytocin responsiveness with increasing maternal BMI.

A positive association between increasing BMI and higher cumulative oxytocin doses and infusion rates has been reported in smaller studies. Roloff et al²⁰ demonstrated a positive association between BMI and cumulative oxytocin dose during labor induction but not during spontaneous labor. Hill et al¹⁶ compared maximum oxytocin infusion rates in 27 women with class III obesity and induced vaginal labors with matched controls (BMI < 28 kg/m²) and found that women with obesity independently require higher oxytocin rates than lean women. Maeder et al reported higher cumulative oxytocin doses in women with obesity than among overweight women and linked lower infusion rates to prolonged labor and increased cesarean delivery. In contrast to our study, their cohort was restricted to post-term inductions.²¹ Similarly, in a larger cohort of nulliparous women and spontaneous labor onset, Ramö Isgren et al²⁴ described higher cumulative doses and infusion rates in women with increasing BMI, although these associations were attenuated after adjustments for intrapartum factors.

In our cohort, women with obesity class II to III initiated oxytocin infusion at a less advanced stage of cervical dilation, suggesting that both physiological and clinical factors contribute to increased oxytocin requirements. Previous research has shown that women with obesity experience a prolonged first stage of labor and longer induction-to-delivery intervals, while the second stage is not prolonged.^{18,27,28} Our results confirm these observations, with induction-to-delivery time increasing significantly across BMI categories. Although the present study was not designed to investigate determinants of second-stage labor duration, an interesting finding is the observed shorter second stage among women with obesity, also in line with previous literature.²⁹

However, a shorter second stage among women with obesity is unlikely to explain the observed association

between increasing BMI and higher cumulative oxytocin dose. If anything, one might expect a shorter second stage to reduce total oxytocin exposure, which would tend to attenuate rather than strengthen the association observed in our study.

The observed association between higher BMI and increased oxytocin requirements is biologically plausible. Experimental data indicate that obesity is associated with impaired myometrial contractility and reduced uterine responsiveness.^{18,30} Myometrial samples from women with obesity have demonstrated decreased contraction amplitude and frequency for spontaneous myometrial contractions, compared with normal-weight controls.³¹

Pharmacologic factors may also contribute. Increased adiposity may alter oxytocin pharmacokinetics and pharmacodynamics, potentially affecting distribution volume, clearance, and receptor-level drug activity.⁷ Obesity-related hormonal alterations, including dysregulated adipokine signaling, may impair oxytocin receptor function and downstream intracellular pathways.^{15,19,32} In parallel, chronic low-grade inflammation associated with obesity may disrupt calcium signaling and smooth muscle excitability.^{31,33} These converging mechanisms provide a coherent biological framework for diminished oxytocin responsiveness in women with obesity.

Clinical implications

Current oxytocin dosing regimens generally do not incorporate maternal BMI. Our findings raise the possibility that uniform dosing strategies may result in relative underexposure among women with obesity, thereby contributing to prolonged labor, arrest disorders, and cesarean delivery.

Whether BMI-adapted oxytocin protocols would improve labor efficiency without increasing uterine tachysystole or fetal compromise warrants prospective evaluation. Until such evidence is available, clinicians should recognize that higher oxytocin requirements in women with obesity may reflect physiological differences rather than treatment

failure, while maintaining vigilance regarding hyperstimulation risk.

Research implications

These data support the need for prospective studies evaluating BMI-stratified oxytocin dosing strategies during IOL. Randomized trials are required to determine whether individualized regimens improve induction success and reduce cesarean delivery without compromising maternal or neonatal safety. Further translational research should investigate obesity-related alterations in oxytocin receptor density, signaling pathways, inflammatory mediators, and myometrial calcium handling to clarify the biological basis of reduced oxytocin responsiveness.

Strengths and limitations

Strengths include the large, population-based sample; restriction to nulliparous women undergoing IOL; and a multicenter design operating under standardized national guidelines, limiting practice variability. Objective recording of cumulative oxytocin doses from infusion pump logs enhanced measurement precision. Stratification into four BMI categories, including two obesity classes, reflects contemporary obstetric risk frameworks. Early-pregnancy BMI was used, consistent with standard obstetric risk assessment and avoiding misclassification inherent in delivery BMI.

A substantial proportion of the women had missing oxytocin dosage data. This may partly be explained by the fact that measuring cumulative oxytocin dose was not part of routine clinical practice, making these data more susceptible to incomplete documentation. Limitations include potential selection bias due to missing oxytocin dose data. Women with missing oxytocin dose data had higher emergency CS rates, suggesting that missingness was likely associated with factors related to labor management or clinical course rather than occurring completely at random. Data on duration at maximum infusion rate was unavailable, limiting assessment of peak exposure patterns. Finally, generalizability may differ in settings applying alternative labor

management models, such as the WHO Labour Care Guide,³⁴ in which definitions of active labor and thresholds for intervention vary.

Conclusions

Women with obesity undergoing IOL require higher cumulative oxytocin doses and higher infusion rates than women of normal weight. The observed association between increased BMI and oxytocin requirements suggests that current oxytocin dosing guidelines may warrant reconsideration and potentially individualization to optimize labor induction outcomes among women with obesity. Clinicians should balance the need for adequate oxytocin stimulation against the risks of uterine hyperstimulation, while recognizing that insufficient dosing may contribute to labor dystocia and unnecessary emergency CS. Tailoring oxytocin protocols to maternal BMI could improve both safety and effectiveness of labor induction in women with obesity.

■ CRediT authorship contribution statement

Nathalie Bladfält: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft. **Anna Ramö Isgren:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing. **Marie Blomberg:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing. **Sara Carlhäll:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.ajogmf.2026.102110](https://doi.org/10.1016/j.ajogmf.2026.102110).

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Data availability: The datasets generated and/or analyzed during the current study are not publicly available due to restrictions in Swedish law (Offentlighets- och sekretesslag (SFS 2009:400)/Public Access to Information and Secrecy Act (SFS 2009:400)) but are available from the corresponding author on reasonable request.

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Tweetable statement: Nulliparous women with obesity and induced labor require higher oxytocin doses and infusion rates and are less likely to deliver at comparable oxytocin exposure, supporting BMI-related differences in oxytocin responsiveness.

Conflicts of interest: The authors report no conflict of interest.

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