



Maternal and Neonatal Outcomes in Maternity Mothers Who Received Oxytocin Induction

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ABSTRACT

Oxytocin induction of labour is widely used to stimulate uterine contractions during early labour, and its use has increased globally over the past decade. Although effective, oxytocin induction is associated with potential maternal and neonatal risks, including uterine tachysystole, postpartum haemorrhage (PPH), foetal distress, and emergency caesarean section. This retrospective case-control study was conducted at Dr. Koesnadi Hospital and involved 329 parturients who met the predetermined inclusion and exclusion criteria. Total sampling was applied, and data were analysed using the chi-square test with a significance level of $p < 0.05$. Oxytocin induction was routinely administered at a standard dose of 10 IU dissolved in 500 mL of D5% solution. Significant differences were observed in several outcomes compared to those who did not receive induction, including PPH ($p=0.004$), foetal distress ($p=0.017$), and perineal tears ($p=0.006$). No significant difference was found in the caesarean section rate between the two groups. In neonatal outcomes, the incidence of asphyxia ($p=0.024$) and the need for admission to the NICU ($p=0.046$) were significantly higher in the induction group. These findings suggest that oxytocin induction is associated with certain maternal and neonatal complications, although the observational study design limits causal conclusions. Potential confounding factors that were not fully controlled may influence this relationship, and further research with more robust analytical methods is needed to confirm these findings and support safer clinical decision-making.

Keywords: Induction, Oxytocin, Labor, Maternal, Neonatal.

ABSTRAK

Induksi persalinan dengan oksitosin secara luas digunakan untuk merangsang kontraksi rahim selama fase awal persalinan, dan penggunaannya telah meningkat secara global dalam dekade terakhir. Meskipun efektif, induksi oksitosin terkait dengan risiko maternal dan neonatal potensial, termasuk takisistole rahim, perdarahan postpartum (PPH), distress janin, dan operasi caesar darurat. Studi kasus-kontrol retrospektif ini dilakukan di Rumah Sakit Dr. Koesnadi dan melibatkan 329 ibu hamil yang memenuhi kriteria inklusi dan eksklusi yang telah ditentukan. Sampling total diterapkan, dan data dianalisis menggunakan uji chi-square dengan tingkat signifikansi $p < 0.05$. Induksi oksitosin diberikan secara rutin dengan dosis standar 10 IU yang dilarutkan dalam 500 ml larutan D5%. Perbedaan yang signifikan diamati pada beberapa hasil dibandingkan dengan mereka yang tidak menerima induksi, termasuk PPH ($p=0,004$), gangguan janin ($p=0,017$), dan robekan perineum ($p=0,006$). Tidak ditemukan perbedaan signifikan dalam tingkat operasi caesar antara kedua kelompok. Pada hasil neonatal, insidensi asfiksia ($p=0.024$) dan kebutuhan rawat inap di NICU ($p=0.046$) secara signifikan lebih tinggi pada kelompok induksi. Temuan ini menunjukkan bahwa induksi oksitosin terkait dengan komplikasi maternal dan neonatal tertentu, meskipun desain studi observasional membatasi kesimpulan kausal. Faktor-faktor perancu yang tidak sepenuhnya terkontrol mungkin memengaruhi hubungan ini, dan penelitian lebih lanjut dengan metode analitis yang lebih kuat diperlukan untuk mengonfirmasi temuan ini dan mendukung pengambilan keputusan klinis yang lebih aman.

Kata Kunci: Induksi, Oksitosin, Persalinan, Maternal, Neonatal.

INTRODUCTION

High-quality maternal health services are essential for achieving the Sustainable Development Goals (SDGs), particularly SDGs 3.1, which aims to reduce maternal mortality, as well as the objectives of the World Health Organization (WHO) Thirteenth General Programme of Work, which emphasizes universal health coverage and safe childbirth (WHO, 2022). Improving the safety and quality of intrapartum care remains a global priority, as preventable complications during labor and delivery continue to contribute substantially to maternal and neonatal morbidity and mortality worldwide (WHO, 2022).

In Indonesia, maternal mortality remains a major public health challenge (Ahmed & Fullerton, 2019; Mahmood et al., 2021; Suparji et al., 2024; Syairaji et al., 2024; Utomo et al., 2025). National surveillance data consistently identify hypertensive disorders of pregnancy and obstetric hemorrhage as leading causes of maternal death, indicating persistent gaps in the quality of intrapartum and immediate postpartum care (Kementerian Kesehatan Republik Indonesia, 2024). Postpartum hemorrhage, in particular, represents a critical outcome because it is closely related to uterine contractility and intrapartum interventions, including labor induction and augmentation (WHO, 2022).

One of the most commonly used intrapartum interventions is induction of labor, especially through the administration of intravenous oxytocin, which is recommended when the risks of continuing pregnancy outweigh the benefits of expectant management (WHO, 2022). Globally, the use of labor induction has increased over the past decade due to changes in clinical indications and institutional policies. Data from a WHO multicountry survey involving more than 300,000 births across 24 countries indicate that approximately 10% of deliveries worldwide involve labor induction, with substantially higher rates reported in high-income countries and increasing trends observed in low- and middle-income settings (WHO, 2022; Vecchioli et al., 2020).

Oxytocin is an endogenous hormone synthesized in the hypothalamus and released by the posterior pituitary gland, playing a central role in stimulating rhythmic uterine contractions during labor (Arrowsmith & Wray, 2014). However, when administered exogenously, synthetic oxytocin may override physiological feedback mechanisms, particularly if given at high doses or for prolonged durations, leading to excessive uterine activity and impaired uterine relaxation (Austin McEvoy, 2022; Espada-Trespalcacios et al., 2021). This pharmacological effect provides a biological basis for several maternal and fetal complications associated with oxytocin use.

Evidence from international studies demonstrates that oxytocin induction is associated with increased maternal risks, including uterine tachysystole, postpartum hemorrhage, suspected intrauterine infection, and a higher likelihood of emergency cesarean delivery due to labor dystocia or non-reassuring fetal status (Erickson & Carlson, 2020; Braund et al., 2024). A large propensity score–matched analysis reported significantly higher odds of postpartum hemorrhage among women undergoing oxytocin induction, particularly with prolonged exposure exceeding seven hours (Braund et al., 2024). These findings highlight the importance of cautious dosing and strict intrapartum monitoring.

Neonatal outcomes may also be affected by oxytocin-induced labor, primarily as a consequence of uterine hyperstimulation that compromises uteroplacental perfusion. Reported neonatal complications include abnormal fetal heart rate patterns, metabolic acidemia, need for resuscitation, and admission to the neonatal intensive care unit (NICU) (Espada-Trespalcacios et al., 2021). Reduced umbilical cord arterial pH has been reported more frequently among neonates born following oxytocin induction, indicating an increased risk of intrapartum hypoxia (WHO, 2022).

These risks are particularly relevant in the Indonesian clinical context, where labor induction is frequently performed in referral hospitals managing high-risk pregnancies. Variations in oxytocin titration protocols, availability of continuous cardiotocography (CTG), and midwife-to-patient ratios may influence the safety of induced labor and the early detection of complications (Kementerian Kesehatan Republik Indonesia, 2024; Baker et al., 2023). Furthermore, outcomes of oxytocin induction are influenced by several clinical factors, including parity, Bishop score, hypertensive disorders, premature rupture of membranes (PROM), oligohydramnios, and fetal growth restriction, which may act as confounding variables if not adequately considered (WHO, 2022; Vecchioli et al., 2020).

Although international evidence has extensively documented the maternal and neonatal risks associated with oxytocin induction, evidence from Indonesian referral hospitals remains limited, particularly regarding outcomes under real-world clinical protocols and resource constraints. Existing studies from high-income countries may not be directly generalizable to the Indonesian setting due to differences in patient characteristics, monitoring capacity, and clinical practice patterns (Espada-Trespalacios et al., 2021; Kementerian Kesehatan Republik Indonesia, 2024).

Therefore, this study aims to evaluate the association between oxytocin induction and maternal as well as neonatal outcomes in a referral hospital in Indonesia. Generating context-specific evidence is essential to strengthen evidence-based intrapartum care, support safer clinical decision-making, and contribute to national efforts to reduce preventable maternal and neonatal morbidity and mortality.

RESEARCH METHODS

This study employed a retrospective analytic cross-sectional design using medical record data of maternity patients at dr. Koesnadi Hospital from January to June 2025. This design was selected because both the exposure (oxytocin induction) and the outcomes (maternal and neonatal complications) were obtained simultaneously from existing records without follow-up. The study population included all women who delivered with singleton pregnancy, cephalic presentation, gestational age ≥ 37 weeks, and a live fetus at the onset of labor, while preterm birth, multiple gestation, stillbirth, congenital anomalies, and incomplete records were excluded.

Exposure was categorized into oxytocin induction and non-induction groups. Oxytocin was administered following the hospital protocol (10 IU in 500 mL D5%, starting at 8 drops/min and increased every 30 minutes up to 40 drops/min). Operational definitions included postpartum hemorrhage (PPH) ≥ 500 mL for vaginal delivery or ≥ 1000 mL for cesarean section; fetal distress defined as fetal heart rate < 120 or > 160 beats/min or abnormal CTG patterns; neonatal asphyxia defined as Apgar < 7 ; and NICU admission guided by the Level 3 NICU protocol. A total of 329 eligible records were analyzed, consisting of 272 induction cases and 57 non-induction cases.

A total sampling technique was applied to include all eligible records within the study period. The unequal distribution between groups occurred naturally due to the retrospective design, where researchers did not control the number of subjects but included all real-world clinical cases. During the study period, oxytocin induction was more frequently performed according to clinical indications, resulting in a proportionally larger induction group. This imbalance reflects actual obstetric practice rather than selection bias and was statistically controlled through logistic regression to ensure validity. Data extraction followed strict quality control procedures, including trained extractors, clinical supervision, 10% cross-checking, and exclusion of inconsistent records.

Statistical analyses included descriptive and inferential tests. Chi-square tests assessed bivariate associations between oxytocin induction and maternal or neonatal outcomes. Variables with $p < 0.25$ or clinical relevance were entered into multivariable logistic regression to adjust for confounders. Results were reported as adjusted odds ratios (AORs) with 95% confidence intervals, with significance set at $p < 0.05$. Analyses were conducted using SPSS version 26.0. Ethical approval was obtained from the Health Research Ethics Committee of STIKES Bhakti Husada Mulia Madiun (No. 008/E-KEPK/STIKES/BHM/X/2025). All patient identifiers were removed, and data handling adhered to confidentiality principles.

RESULTS

Table 1. Frequency Distribution of Maternity Characteristics at Dr. Koesnadi Hospital.

Characteristics	with oxytocin n (%)	Without oxytocin n (%)	p- value
Mother's Age			
<20 years old	27 (61.4)	17 (38.6)	0.000
20-35 years old	224 (86.5)	35 (13.5)	
> 35 years old	21(80.8)	5 (19.2)	
Parity			

Primiparous	118 (82.5)	25 (17.5)	0.947
Multiparouswomen	154 (82.8)	32 (17.2)	
BMI (Body Mass Index)			
Normal	215 (82.7)	45 (17.3)	0.249
Underweight	24 (75)	8 (25)	
Obesity	33 (89.2)	4 (10.8)	

Based on Table 1, most of the mothers who received induction were 20-35 years old, as 86.5%. The results of the p-value of the chi-square test showed that the age p-value (0.000 was less than $\alpha=0.05$, which means there is a relationship between maternal age and induction of childbirth, while parity p-value = 0.947 means that there is no relationship between parity and induction of labor and BMI p-value = 0.249 greater than $\alpha=0.05$ means there is no relationship between BMI and induction of childbirth.

Table 2. Analysis of differences in maternal outcomes with oxytocin induction at Dr. Koesnadi Hospital.

Maternal Outcome	With oxytocin (n)	f(%)	Without oxytocin (n)	f(%)	p-value
Cesarean Sections					
Yes	48	17.7	9	15.8	0.736
No	224	82.3	48	84.2	
Postpartum Hemorrhage					
Yes	52	19.1	2	3.5	0.004
No	220	80.9	55	96.5	
Fetal Distress					
Yes	34	12.5	1	1.8	0.017
No	238	87.5	56	98.2	
Perineal Laceration					
1 st Degree	21	9.3	6	10.5	0.006
2 nd Degree	150	67	41	72	
3 rd Degree	52	23.2	1	1.75	
4 th Degree	1	0.5	0	0	

Table 2 shows that there are significant differences in the variables of postpartum hemorrhage, fetal severity, and perineal tear in women who were given oxytocin induction and not given oxytocin induction, with a p-value $< \alpha$ (0.05). In the cesarean sections, there was no significant difference in women who were given oxytocin induction and not given oxytocin induction at dr. Koesnadi Hospital.

Table 3. Analysis of the difference in neonatal outcomes with oxytocin induction at Dr. Koesnadi Hospital.

Hospital:					
Neonatal Outcome	with Oxytocin (n)	f %	without Oxytocin (n)	f %	p-value
Asphyxia					
Yes	58	21.3	5	8.8	0.024
No	214	78.7	52	9.2	
NICU					
Yes	18	6.6	0	0	0.046
No	254	93.3	57	100	

Table 3 shows that there is a significant difference in the variables of asphyxia and NICU in maternity mothers who were given oxytocin induction and not given oxytocin induction with a p-value $< \alpha$ (0.05) at dr. Koesnadi Hospital.

DISCUSSION

The results of this study involving 272 mothers with oxytocin induction at a dose of 10 IU in 500 ml D5% fluid showed that oxytocin induction had significant differences in several maternal and neonatal outcomes, including postpartum hemorrhage ($p=0.004$), fetal emergency ($p=0.017$), perineal tear ($p=0.006$). Meanwhile, for cesarean section, no significant difference was found between those who received induction and those who were not given oxytocin induction. In neonatal outcomes, neonatal asphyxia also showed significant differences related to oxytocin induction ($p=0.024$), and care needs in the NICU ($p=0.046$). The results of this study underscore the need for caution in the administration of oxytocin induction because it can be at risk of certain complications.

Oxytocin is a hormone released by the hypothalamus and released by the posterior pituitary gland, playing an important role in triggering uterine contractions during labor. The basic mechanism of this hormone works through oxytocin receptors in the uterine smooth muscles, which increases intracellular calcium levels and triggers rhythmic contractions to accelerate cervical dilatation (Heesen & Orbach-Zinger 2022). However, excessive or prolonged use of oxytocin can cause oxytocin receptors to become down-regulated and the uterine muscles to become fatigued. This muscle fatigue, known as uterine atonia, is the main cause of HPP. Induction of labor is generally recognized as a risk factor for postpartum hemorrhage due to the potential for secondary atonia due to continuous uterine stimulation (McEvoy A 2022). The correlation between oxytocin induction and postpartum hemorrhage in this study was supported by the results of Braund et al. (2024), which showed an increased risk of PPH with the use of oxytocin (aOR 1.56). Tachystolic and uterine hyperactivity due to oxytocin can lead to serious complications such as uterine rupture and the need for emergency cesarean sections. Therefore, the need for close surveillance and proper dosing protocols is essential to reduce this risk (Baker et al. 2023).

In addition to postpartum bleeding, maternal outcomes that also showed significant differences were fetal distress ($p\text{-value}=0.017$), which is a common indication for ending labor. Fetal complications of oxytocin induction are often clinical manifestations of the previously described uterine hyperstimulation, in which fetal distress is caused by a disruption of the retroplacental circulation. In a clinical context, this critical fetal detection is often the main reason for induction failure that forces doctors to perform rescue measures by cesarean section, although in this study the association with cesarean sections was not significant.

Meanwhile, the results of the study on maternal outcomes of perineal tears were found to have a value ($p\text{-value}=0.006$) indicating a greater risk of birth canal trauma in induced labor. Oxytocin that triggers contractions that are too strong, frequent, and sudden can cause the labor process to take place quickly (*partus precipitatus*). Hasty and uncontrolled labor gives little time for the mother's soft tissues, including the perineum, to gradually stretch, thus increasing the potential for more extensive spontaneous birth canal tears, including stage III and IV ruptures. An observational case-control study in Istanbul by Kartal et al. (2023) found that women who underwent oxytocin induction had a rate of 1-2 degree perineal tears of 47.7% and 3-4 degrees of tears of 11.4%, much higher than the non-induction group (20.5% of 1-2 tears and 2.3% of 3-4 tears). In addition, the induction group also experienced greater postpartum bleeding. Research by Kartal et al. (2023) also shows that oxytocin induction can increase perineal trauma without affecting postpartum breastfeeding outcomes (Kartal, Kaya, & Yazici 2023). Research by Dos Santos et al. (2021) reported a similar thing that the use of oxytocin increased the likelihood of perineal tears by up to 8.3 times.

There was a significant association between oxytocin induction and an increased risk of neonatal asphyxia ($p=0.024$). Research conducted by Farhatussalihah and Kurniasari (2024) in Indonesia shows that oxytocin induction during childbirth is strongly related to the incidence of asphyxia in full-term neonates. This risk emphasizes that labor induction measures that are not balanced with strict monitoring can threaten the safety of the baby (Farhatussalihah & Kurniasari 2024). An increased risk of asphyxia can occur because induction of exogenous oxytocin, especially in high doses or without adjusting to the level of sensitivity of the uterus, can cause uterine rupture. Too strong and frequent contractions, without sufficient periods of relaxation, will interfere with blood flow through the intervilli space of the placenta. This disorder of uteroplacental circulation results in a reduced supply of oxygen and nutrients to the fetus, which ultimately

triggers fetal hypoxia and the onset of asphyxia at birth (Uvnäs-Moberg, 2024). The direct impact of asphyxia and fetal distress is the increased need for intensive care/postpartum NICU. The results of this study obtained a significant difference in NICU needs ($p=0.046$) in the group of induced maternal mothers. Infants with asphyxia often require extensive resuscitation, close monitoring, and advanced medical interventions, so they are treated in the NICU (Liu et al., 2025). This is in line with a retrospective study that explicitly mentioned that oxytocin induction risks triggering low APGAR scores and asphyxia, which ultimately requires more invasive measures and treatments.

CONCLUSION

Oxytocin induction in maternity at dr. Koesnadi was significantly associated with an increased risk of postpartum bleeding, fetal severity, perineal tear, neonatal asphyxia, and NICU care needs. However, oxytocin induction did not have a significant effect on the incidence of cesarean section. Therefore, the induction administration of oxytocin should pay attention to dosing protocols and strict monitoring to reduce the risk of complications. It is important for health workers to prioritize the safety of mothers and babies by using proper indications in the induction of oxytocin in maternal mothers. The results of this study provide an important overview of the effects of oxytocin induction on maternal and neonatal outcomes. However, keep in mind that these results can also be influenced by a variety of other factors that were not studied in this study. Therefore, it is recommended that more comprehensive follow-up research be conducted to identify and understand these factors in order to strengthen the findings and provide more appropriate recommendations in clinical practice.

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