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**Original Research Article**

# Comparative study of induced versus spontaneous labour in women to predict materno-fetal outcomes using a modified WHO partograph

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## ABSTRACT

**Background:** Labour outcomes differ significantly between induced and spontaneous onset, with implications for maternal and neonatal health. The modified WHO partograph provides an objective tool for monitoring labour progress and guiding timely intervention. This study aimed to compare induced versus spontaneous labour using the modified WHO partograph to predict maternal and foetal outcomes.

**Methods:** A prospective randomised clinical study was conducted on 300 patients with term pregnancies at ACS Medical College, Chennai, over six months. Patients were allocated to two groups: induced labour (n=150) and spontaneous labour (n=150). Labour was monitored using the WHO modified partograph, assessing the duration of labour phases, oxytocin augmentation, progress across alert/action lines, maternal complications and neonatal outcomes, including Apgar scores, meconium-stained liquor, NICU admissions and mortality.

**Results:** Induced labour was significantly associated with a significantly prolonged active phase (4.6 vs. 3.2 hrs, $p<0.001$) and second stage (38.4 vs. 30.2 min, $p=0.02$). Oxytocin augmentation (45.3% vs. 20.7%), alert line crossing (34.7% vs. 15.3%) and action line crossing (17.3% vs. 6.7%) were more frequent in the induced cases ($p<0.05$). Vaginal delivery was significantly more common in spontaneous labour (76.0% vs. 58.7%, $p=0.004$), whereas the caesarean delivery rate was higher in induced cases (34.0% vs. 18.7%, $p=0.004$). The incidence of meconium-stained liquor (12.7% vs. 6.0%, $p=0.04$) and NICU admissions (14.7% vs. 7.3%, $p=0.03$) were also significantly higher in the induced group.

**Conclusions:** Induction of labour is associated with prolonged labour, greater intervention needs, higher caesarean rates and increased neonatal complications compared to spontaneous labour. Spontaneous labour monitored with the modified WHO partograph showed more favourable outcomes.

**Keywords:** Apgar score, Delivery, Induced, Labor, Obstetric, Oxytocin, Pregnancy outcome

## INTRODUCTION

Labour is a critical phase for maternal and neonatal health and prolonged duration is linked to complications such as maternal exhaustion, sepsis, obstructed labour, uterine rupture, postpartum haemorrhage, perinatal asphyxia, neonatal sepsis and increased risk of stillbirth or mortality.[1,2] In resource-limited settings, continuous individual monitoring is often not feasible; therefore, the partograph was introduced as a simple tool to detect abnormal labour progress and prevent adverse outcomes.[1-3] The partograph is a charting tool that graphically records the progress of labour and highlights deviations that may threaten maternal or neonatal outcomes. In 2000, the World Health Organisation introduced the modified partograph and recommended its routine use for labour management across all levels of care. The clinical utility of the modified WHO partograph lies in its ability to facilitate early recognition of prolonged or obstructed labour, thereby reducing maternal and neonatal

morbidity.[1] Studies have shown that consistent application of the partograph is associated with reductions in prolonged labour, operative deliveries and adverse perinatal outcomes.[1,4]

Induction of labour is the technique of artificially stimulating uterine contractions before the natural onset of labour to achieve vaginal delivery of the fetoplacental unit.5 It is one of the most frequently performed obstetric procedures worldwide, with reported rates ranging from 12.1% in Asia, 22.5% in the USA, 5-13% in Sub-Saharan Africa, 18-23% in Nigeria and 3% in Sokoto.[6] Indications for induction include maternal complications such as hypertensive disorders or post-term pregnancy, as well as foetal conditions like growth restriction or oligohydramnios and when it is thought that induction provides better outcomes compared to spontaneous labour.

While induction can be life-saving, it has been associated with intrapartum vaginal bleeding, prolapse of the umbilical cord, regional anaesthesia failed to provide pain relief, postpartum endometritis, perineal lacerations, chorioamnionitis and PPH.[7] In contrast, spontaneous onset of labour is a low-risk, natural onset of labour requiring minimal or low interventions.[8] Therefore, a comparative evaluation of induced and spontaneous labour, through standardised tools such as the modified WHO partograph, is essential for evidence-based patient care.

Studies suggest that induced labour often requires more frequent augmentation with oxytocin, is associated with longer active phases and has a higher chance of operative interventions, including caesarean delivery.[3,5] In contrast, spontaneous labour is more likely to progress without intervention and is associated with lower rates of operative delivery.[6] Infants born following induction may be at increased risk of low Apgar scores, neonatal intensive care admission or meconium aspiration, particularly in cases of prolonged labour or operative delivery.

In contrast, when labour is spontaneous and monitored effectively with the partograph, neonatal outcomes are often more favourable, as timely intervention prevents prolonged or obstructed labour.[6,9] However, a study suggests that when induction is appropriately indicated and managed, maternal and neonatal morbidity may not differ significantly from that observed with spontaneous labour.[4]

Although many studies have evaluated induced and spontaneous labour separately, few have compared their outcomes using the modified WHO partograph. Such comparisons can clarify labour dynamics, intervention needs and associated risks, thereby guiding clinicians in optimising maternal and neonatal care. Therefore, our study aimed to compare induced and spontaneous labour and predict the maternal and foetal outcomes using the modified WHO partograph. The purpose is to assess the indications for induction, rate of induction, mean duration of labour, requirement of augmentation with oxytocin, eventual mode of delivery and foetal outcomes.

## METHODS

This prospective, randomised clinical study included 300 nulliparous women and was conducted in the Department of Obstetrics and Gynaecology, ACS Medical College and Hospital, Chennai, from July 2024 to January 2025. Ethical approval (No.1198/2024/IEC/ACSMCH Dt 04.07.2024) was obtained from the institutional review board and all participants provided written informed consent.

### *Inclusion criteria*

Women with singleton pregnancies at term (37-41 weeks) with spontaneous onset of labour or those undergoing labour induction were included.

### *Exclusion criteria*

The exclusion criteria were preterm labour (spontaneous/induced), elective caesarean section and pregnancies complicated by medical disorders.

### *Methods*

Eligible patients were divided into two groups: induced labour (n=150) and spontaneous labour (n=150) using a computer-generated random number table, with allocation concealed in sealed opaque envelopes. Induction was performed using prostaglandin E1 (misoprostol), prostaglandin E2 (dinoprostone gel) or oxytocin once cervical dilatation reached ≥4 cm, while the spontaneous group included women in active labour with cervical dilatation ≥4 cm. Baseline demographic and obstetric variables, including age, gestational age and parity, were recorded. Labour progress was monitored using the WHO modified partograph, documenting cervical dilatation and whether labour crossed the alert or action lines. The mean duration of the active phase and second stage of labour, along with the requirement for oxytocin augmentation, were compared between the two groups.

Maternal outcomes included mode of delivery (vaginal, instrumental or caesarean), postpartum complications such as haemorrhage and perineal tears and the overall need for intervention. The foetal and neonatal outcomes studied including, birth weight, Apgar scores at 1 and 5 min, presence of meconium-stained liquor, requirement for NICU admission with its duration and cause and neonatal mortality.

## RESULTS

The mean age was similar in both the induced and spontaneous groups (24.8±3.6 vs. 24.2±3.4 years); similarly, the mean gestational age was also comparable (39.3±1.1 vs. 39.1±1 weeks). Both groups had comparable numbers of primigravida and multigravida patients (64 vs.

60.7% and 36 vs. 39.3%, respectively), but none of these differences were significant (p>0.05) (Table 1).

The mean duration of the active phase was prolonged in induced labour (4.6 vs. 3.2 hrs); similarly, the second stage was longer in induced women (38.4 vs. 30.2 min). Oxytocin augmentation requirement (45.3 vs. 20.7%), crossing of the alert (34.7 vs. 15.3%) and action lines (17.3 vs. 6.7%) on the partograph were associated with induced labour. All differences across the groups were significant (p < 0.05) (Table 2).

Vaginal delivery was more frequent in spontaneous labour (76.0 vs. 58.7%, p=0.004), whereas the caesarean section rate was higher among induced cases (34.0 vs. 18.7%, p=0.004). Instrumental deliveries (7.3 vs. 5.3%), PPH (6.0 vs. 2.7%) and perineal tears (8.0 vs. 6.7%) occurred usually in induced labour, but the differences were not significant (p>0.05). The mean birth weights were similar in both groups (2.82 vs. 2.76 kg), while Apgar scores <7 at 1 and 5 min (14.0 vs. 8.0% and 4.7 vs. 2.0%) were frequent in the induced labour group, but the difference was not significant. The incidence of meconium-stained liquor and NICU admissions (12.7 vs. 6.0% and 14.7 vs. 7.3%, p<0.05) was significantly higher in the induced group. Neonatal mortality was higher in the induced group (1.3 vs. 0.7%), however, the difference was not significant (Table 3).

**Table 1: Baseline characteristics.**

| Categories | Induced | Spontaneous | P value |
|---|---|---|---|
| **Age (in years)** | 24.8±3.6 | 24.2±3.4 | 0.210 |
| **Gestational age (in weeks)** | 39.3±1.1 | 39.1±1 | 0.180 |
| **Primigravida** | 96 (64%) | 91 (60.7%) | 0.540 |
| **Multigravida** | 54 (36%) | 59 (39.3%) | 0.540 |

**Table 2: Labour progress and interventions.**

| Categories | Induced | Spontaneous | P value |
|---|---|---|---|
| **Mean duration of active phase (hours)** | 4.6±1.8 | 3.2±1.4 | <0.0001 |
| **Mean duration of 2nd stage (mins)** | 38.4±12.1 | 30.2±10.8 | 0.02 |
| **Oxytocin augmentation** | 68 (45.3%) | 31 (20.7%) | <0.0001 |
| **Crossing alert line** | 52 (34.7%) | 23 (15.3%) | <0.0001 |
| **Crossing the action line** | 26 (17.3%) | 10 (6.7%) | 0.01 |

**Table 3: Maternal and neonatal outcomes.**

| Outcome | Induced | Spontaneous | P value |
|---|---|---|---|
| **Vaginal delivery** | 88 (58.7%) | 114 (76.0%) | 0.004 |
| **Instrumental delivery** | 11 (7.3%) | 8 (5.3%) | 0.470 |
| **Cesarean section** | 51 (34.0%) | 28 (18.7%) | 0.004 |
| **PPH** | 9 (6.0%) | 4 (2.7%) | 0.120 |
| **Perineal tear** | 12 (8.0%) | 10 (6.7%) | 0.680 |
| **Mean birth weight (kg)** | 2.82±0.36 | 2.76±0.34 | 0.180 |
| **APGAR <7 at 1 min** | 21 (14.0%) | 12 (8.0%) | 0.090 |
| **APGAR <7 at 5 min** | 7 (4.7%) | 3 (2.0%) | 0.180 |
| **Meconium-stained liquor** | 19 (12.7%) | 9 (6.0%) | 0.040 |
| **NICU admission** | 22 (14.7%) | 11 (7.3%) | 0.030 |
| **Neonatal mortality** | 2 (1.3%) | 1 (0.7%) | 0.560 |

## DISCUSSION

Induction of labour is highly used worldwide; however, it has been associated with prolonged labour, higher intervention rates and variable maternal and neonatal outcomes. In contrast, spontaneous labour is generally considered to have a more favourable course with fewer complications. In this study, we compared the labour characteristics, maternal complications and neonatal outcomes between induced and spontaneous labour to highlight clinically relevant differences that can guide obstetric practice. The mean age and gestational age were similar in both groups. The distribution of primigravida and multigravida women was similar across the two groups. Similar to our findings, Shalini et al, reported comparable mean age and gestational age between the induced and spontaneous groups (23.7±4.84 years and 39.38±1.02 weeks vs. 23.15±3.09 years and 38.52±1.08

weeks).10 Priyadarshini et al, also reported a similar mean age across both groups (24.2±4.15 vs. 23.8±4.01 years), with no significance.[11] Rajoriya et al reported that 41.5% were primigravida and 58.4% were multigravida, but there was no significant difference.[12] Thus, the baseline parameters were comparable between both groups and our findings are similar to those of previous studies.

The mean duration of the active phase in the study was significantly prolonged in induced labour (p<0.0001), similarly, the second stage was longer in induced women (p=0.02). Supporting the findings, Sharma et al analysed 400 vaginal delivery cases and reported that the mean duration for the first stage was 3.58 hours and it was 35.01 minutes for the second stage.[13] In contrast, Madan et al found that the active phase and second phase were longer in spontaneous labour (6.9 vs. 4.07 hours and 38.15 vs. 25.25 min).[14] Thus, suggesting that induced labour is associated with prolonged active and second stages, but these durations can vary according to the population characteristics and management protocols.

In our study, the requirement for oxytocin augmentation was higher in the induced group than in the spontaneous group (p<0.001). Similarly, most women in the induced group crossed the alert (p<0.001) and action lines (p=0.01) on the partograph. Sharma et al found that most cases in the induced group required augmentation (43 vs. 54.7%).[13] Orji et al and Olabode et al reported that the majority of spontaneous labour cases significantly moved between the alert and action lines (27.9 vs. 9.6%, p<0.001), while the majority of induced labour cases reached or crossed the action line (33.1 vs. 16.9%, p=0.002).[15] These findings highlight that induced labour requires more intervention and has a high chance of deviating from the normal progress on the partograph compared to spontaneous labour.

Study shows that a greater number of induced labours crossed the alert line on the partograph (52, 34.7%) compared to spontaneous labours (23, 15.3%, p<0.0001). Crossing of the action line was also more frequent in the induced group (26, 17.3%) than in the spontaneous group (10, 6.7%, p=0.01). Similarly, Orji et al and Olabode et al found that neonates in the induced group were less often delivered between alert and action lines (13, 9.6%) than in the spontaneous group (38, 27.9%, $\chi^2$=15.083, p<0.001) but more frequently after crossing the action line (45, 33.1% vs. 23, 16.9%, $\chi^2$=9.490, p=0.002).[15] Yadav et al found that in the induced labour group, a higher proportion of women reached or crossed the action line compared to the spontaneous group (35% vs. 16.7%, p=0.022). In contrast, more women in spontaneous labour moved between the alert and action lines (23.3% vs. 10%, p=0.049).[16]

Therefore, induced labour often causes deviations from normal progress due to stronger contractions; careful monitoring and timely interventions are recommended. In the study, vaginal delivery was more common in spontaneous labour, whereas the caesarean section rate was higher in induced cases (p=0.04 for both). Instrumental deliveries, postpartum haemorrhage and perineal tears were slightly higher in induced labour, although these differences were not significant. Birth weights were comparable between the groups, whereas lower Apgar scores at one and five minutes were more frequent in induced labour. However, meconium-stained liquor (p=0.04) and NICU admissions (p=0.03) were significantly higher in the induced group. Supporting our study, Orji et al, reported that the majority of spontaneous labour cases underwent vaginal delivery (72.1 vs. 64.7%) and the APGAR scores were better for babies in the induced labour group at both 1- and 5-min.[15]

Parveen et al reported that the caesarean rate was higher in the induced labour group (15.4 vs. 10.7%). Additionally, the NICU admission rate was 9.4% for the induced group and only 3.5% for the spontaneous group.[17] Yadav et al concluded that the maternal complications were more in the induced group, whereas the neonatal outcomes were similar in both groups.[16] These findings suggest that spontaneous labour is associated with better maternal and neonatal outcomes, while induced labour has a risk of caesarean and short-term neonatal complications. These findings emphasise that the induction of labour is associated with prolonged labour duration, increased need for augmentation, higher caesarean section rates and greater neonatal complications compared to spontaneous labour. Future larger multicentre studies and long-term follow-up of neonatal outcomes are needed to validate these results and optimise the use of partographs in guiding interventions.

This was a single-centre study with a relatively small sample size and short follow-up period, which may limit the generalisability of the findings. Additionally, variations in the induction methods and labour management protocols were not stratified, which could have influenced the outcomes.

## CONCLUSION

Induced labour is associated with a prolonged active phase, higher need for oxytocin augmentation, higher rates of caesarean delivery and increased short-term neonatal complications such as meconium-stained liquor and NICU admission compared to spontaneous labour. Spontaneous labour, when monitored using the modified WHO partograph, showed more favourable maternal and neonatal outcomes. Future multicentre studies stratifying induction methods and assessing long-term neonatal outcomes may help refine induction practices and optimise maternal-foetal care.

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