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Comparison of labour progress in nulliparous women: Spontaneous versus induced labour using the modified WHO partograph

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Abstract:
Induction of labour may influence labour progression, obstetric interventions and fetomaternal outcomes in nulliparous women. This observational cohort study compared 98 nulliparous women undergoing spontaneous (n = 49) or induced labour (n = 49), using the WHO-modified partograph for monitoring. Spontaneous labour showed smoother progression and fewer action-line crossings, whereas induced labour involved more Caesarean deliveries and greater use of labour augmentation. Maternal complaints, Apgar scores, birth weight and NICU admissions were comparable between groups. Thus, WHO-modified partograph monitoring with timely obstetric intervention may support safe management of induced labour with comparable maternal and neonatal outcomes.

Keywords: Spontaneous labour, induced labour, nulliparous women, labour progression, WHO modified partograph, Caesarean section

Background:
The World Health Organization (WHO) estimates that 140 million births occur every year all over the world; most of these are vaginal deliveries. Spontaneous labour is a physiological mechanism for expelling the fetus, placenta and membranes from the uterus after completion of pregnancy **[1]**. It is one of the most significant incidents in obstetrics that affects maternal and neonatal outcomes as progress and management of labour are responsible for obstetric outcomes. When labors are spontaneous in nature it refers to the regular onset of uterine contractions leading to progressive cervical dilatation and delivery without medical intervention. Induced labour refers to the artificial start of uterine contractions before spontaneous labour, with the aim of vaginal delivery **[2]**. This is done when there is an indication that it is unsafe for the mother (or baby) to continue with the pregnancy **[3]**. The rates of labour induction around the world have increased during the last few decades with better obstetric surveillance and fetal monitoring along with a rise in maternal complications like pregnancy-induced hypertension, diabetes mellitus, oligohydramnios and postdated pregnancy. Many tertiary care centres around the world report induction rates of 20% to 30% **[4]**. Abnormalities in the progression of labour continue to contribute significantly to maternal and neonatal morbidity and mortality in developing countries as monitoring and intervention may not be timely **[5]**. Induction of labour is an important obstetric intervention, but there are concerns regarding prolonged labour, increased need for augmentation, operative vaginal delivery and caesarean section **[6]**. Monitoring progress of labour is critical for early detection of abnormality in labour pattern. Many trials have compared spontaneous and induced labour for labour duration, operative delivery, maternal morbidity and neonatal outcomes. Nonetheless, the inconsistency of findings among nulliparous women is because women with underlying obstetric indications are often induced. As a result of the above, the present study was planned primarily to compare the labour progression and fetomaternal outcome of spontaneous and induced labour using WHO modified partograph as a standard method of monitoring only. One of the most efficient and cost-effective methods for monitoring labour is the partograph. The partograph is a single chart representing the graphical record of the progress of labour, the condition of the mother and fetus over time. The partograph was developed by Philpott in 1971 **[7]** and modified by WHO to assist healthcare workers in recognizing prolonged or obstructed labour for timely intervention **[8]**. With very little modification, the use of the WHO partograph is still recommended for use by most authors. The features contain cervical dilation, descent of fetal head, contractions and fetal heart rate, the status of membranes, the pulse, blood pressure, temperature and urine output of the mother. The alert and action lines incorporated in the partograph help the clinician to identify a slow progress of labour and act on it before complication arises. The modified WHO partograph, when used, will reduce prolonged labour, postpartum hemorrhage, obstructed labour and caesarean section in low- and middle-income countries **[9]**. Nulliparous women have been considered as high risk group as there capacity of childbearing has never been put to test. Multiple recent researches show that low-dose misoprostol is effective and fairly safe for induction in nulliparous women when used under the monitoring process **[10, 11]**. The pelvis and soft tissues of nulliparous women have not experienced birth before so their labour may take longer than multiparous women. In addition, in nulliparous women, induced labour is often associated with an unfavorable cervix which leads to failed induction or operative delivery. Therefore it is observed that there are more chances of failed induction and hence in turn caesarean section in nulliparous women. As induction has both advantages and disadvantages, it must be determined whether it is safe or not as

compared to spontaneous labour. LaQshya program of the Ministry of Health and Family Welfare mandates the use of partograph, so this study will be undertaken to compare progress in spontaneous versus induced labour in nulliparous women using modified WHO partograph **[8]**. Therefore, it is of interest to compare the labour progression and fetomaternal outcomes between spontaneous and induced labour in nulliparous women using the modified WHO partograph.

Materials and Methods:

An Observational Analytical Cohort Study was undertaken after the Institutional Ethics Committee approved the study. All procedures were conducted following the ethical principles laid down in the Declaration of Helsinki and the Indian Council of Medical Research (ICMR) guidelines. Study never revealed information about identified patient. All the participants gave their written informed consent before enrollment. Participation in the study was voluntary and patients could take withdrawn from the study at any point during the study. As the study involved procedures that were carried out as part of routine obstetric management, there was no added risk. The research was conducted at the Government Multispeciality Hospital, Sector-16, Chandigarh, in the Department of Obstetrics and Gynaecology, which is a tertiary care teaching institution that offers complete maternal and neonatal services. The study duration of study was from the time of ethical clearance to completion of sample size. Pregnant women who were admitted to the labour room during the study period were screened for eligibility. The Inclusion criteria were pregnant nulliparous women 18-35y with the gestational age between 37 and 41 weeks, a single live fetus, adequate pelvis and spontaneous/induced labour. Women who had multiparity, previous caesarean section, malpresentation, multiple pregnancy, intrauterine fetal death, gestational diabetes mellitus, Rh isoimmunization, severe preeclampsia, eclampsia, antepartum hemorrhage, or significant medical and surgical illness were excluded from the study. The calculation of sample size was done using standard statistical formulae with reference to confidence interval, power of study and expected proportion difference between the two groups. The study included a total sample size of 98 women. Those who went into spontaneous labour were put in Group A, whereas those who were induced were placed in Group B. Every group had a total of 49 participants. Women in the induced labour group were given induction with 25 micrograms of misoprostol either vaginally or sublingually every four hours with a maximum of five doses depending on the cervical favorability and institutional protocol **[12]**. The WHO modified partograph was used to monitor labour in both groups. The progress of normal labour was assessed by serial monitoring of cervical dilatation, descent of fetal head, uterine contractions, fetal heart rate, maternal pulse, blood pressure, temperature and urine output. At intervals of 3-4 hours, cervical dilatation was 'X' marked on the partograph or earlier as clinically indicated. The cervicograph had an "O" mark to indicate the descent of the fetal head. Every 30 mins, uterine contractions were noticed for their frequency and duration. Monitoring of fetal wellbeing was done through auscultation of fetal heart rate every 30 minutes in the first stage of labour and every 5 minutes during the second stage **[13]**. The state of the membranes and liquor was also noted. Liquor was labelled as "C" for clear, meconium stained as "M" and intact membranes as "I". Fetal heart patterns and liquor characteristics must be monitored as fetal distress and meconium-stained liquor are significant markers of intrapartum compromise. The mother's health was continuously monitored throughout labour. Maternal pulse was noted down after every 30 minutes; blood pressure after every four hours and temperature after every two hours. Periodic assessment of the urine volume, protein and acetone. Oxytocin augmentation and intravenous fluids, when given, are recorded in the partograph. If labour progress was inadequate, oxytocin and/or amniotomy according to institutional protocol was performed. Oxytocin augmentation is often done in cases of slow labour to improve uterine contractions. The primary objective, progress of labour was major study outcome measured using modified WHO Partograph, using the cervical dilatation rate, the descent of fetal head and the movement of the labour curve concerning the alert and action lines as objective measures. Women who labored beyond the alert or action lines were offered a close assessment for intervention. Additional outcomes analyzed included need for augmentation, delivery method, maternal complications and neonatal outcomes. The type of delivery was classified as normal vaginal delivery, instrumental vaginal delivery or caesarean section. Documented were maternal complications like postpartum hemorrhage, prolonged labour and fetal distress. Neonatal outcomes comprised of birth weight, APGAR at one and five minutes, the need of neonatal intensive care unit admission and neonatal complications if present. All of the outcomes are mentioned in **Figure 1.** Values represent percentage of women undergoing augmentation, crossing the action line, caesarean delivery and normal vaginal delivery. Data collected were entered in Excel and analyzed through IBM SPSS (Statistical Package for Social Sciences) version 20. Quantitative variables were expressed as mean and standard deviation. Categorical variable was expressed as frequency and percentage. Statistical comparisons were done using independent t-test for continuous and chi-square test for categorical variables between the two groups. A p-value below 0.05 indicates a significant statistic.

Results:

Initially, a total of 98 nulliparous women were included in the study and were equally divided into two groups. Women with spontaneous labour were classified as Group A, whereas women with induced labour were classified as Group B. The WHO modified partograph was used to monitor labour progress in both groups and compare maternal and neonatal outcomes. The mean age of the participants in Group A was 23.55 ± 3.49 years and that of Group B was 24.92 ± 3.85. The two groups did not differ significantly ($p=0.069$) with respect to the age of the mother making them comparable. The median age was found to be 23 years for the spontaneous labour group and 24 years for the induced labour group. The age category of 21-25years was

most represented in both study groups **(Table 1).** Most women in both groups delivered between 39 and 41 weeks of gestation with respect to gestational age at delivery. In Group A, 13 women had an early term delivery until 38 weeks and in Group B, 20 women had an early term delivery till 38 weeks, which was statistically non-significant (p=0.136). In terms of gestational age distribution, spontaneous labour and induced labour were fairly similar **(Table 2).** In line with the world health organization modified partograph, progress of labour was assessed by cervical dilatation, descent of fetal head, uterine contractions and whether or not the labour curve was moving beyond the alert and action lines. Women in the spontaneous labour group experienced a relatively smoother labour than women in the induced labour group. Most women, whose onset of labour is spontaneous, remained to the left of the alert line indicating satisfactory progress of labour. On the contrary, there were a greater proportion of women in the induced labour group who crossed the alert line and who approached or crossed the action line, suggesting that labour progressed in a slower fashion in this latter group. But it was not statistically significant between the two groups **(Table 3, 4).** A comparison of labour outcomes (n = 49 for each group) between the spontaneous labour and the induced labour is shown in the bar graph. Women in the induced labour group had higher percentage crossing the action line, requiring an augmentation with oxytocin and undergoing caesarean section than women from the spontaneous labour group. The results suggest a relatively better labour progression and delivery results among women who experienced spontaneous labour. There was no significant difference between two groups in terms of augmentation of labour. There was a significant difference in LSCS and NVD in two groups. Spontaneous labour patients had significantly more NVDs as compared to induced patients. Incidence of episiotomy and perineal injury in two groups was also statistically similar **(Table 5, 6 and Figure 2).** The assessment of neonatal outcomes was carried out by birth weight, APGAR score at one and five minutes, fetal distress and NICU admission. The mean birth weight of neonates in both groups was similar and most babies attained a satisfactory APGAR. There were 2 cases of Meconium aspiration syndrome and 1 case of respiratory distress in Spontaneous labour Group whereas in Induced labour Group there were 5 cases of respiratory distress. Fetal heart rate recordings showed intermittent occurrences of fetal distress in both study groups but were reported more in the induced labour group. The liquor meconium-stained was noted more frequently in case of induced labour which might be due to prolonged uterine contractions, hyperstimulation due to the induction agents. While some neonates in the induced labour group were admitted to the NICU transient respiratory distress, or fetal distress, there was no significant difference between the two groups in neonatal outcomes. Monitoring fetal heart rate (FHR) continuously helps to detect fetal compromise at the earliest for effective obstetric intervention and neonatal outcome **(Table 7).**

Table 1: Maternal characteristics of study participants

Parameter	Group A	Group B	P value	Significance
Mean Age(in Years)	23.55	24.92	0.07	Non-Significant
Gestational age at delivery			0.14	Non-Significant
Early term (end of 38th week)	13	20		
Term (39-41 weeks)	36	29		

Table 2: Distribution of medical conditions

Medical conditions	Group A	Group B	P value	Inference
IHCP	6	10	0.274	Non-significant
Oligohydramnios	1	0	>0.05	Non-significant
PIH	6	13	0.073	Non-significant
IUGR	1	3	0.617	Non-significant
Chorioamnionitis	1	0	>0.05	Non-significant
HCV	0	1	>0.05	Non-significant

Table 3: Indications for induction of labour

Reason of induction	No of subjects
IHCP	8
IUGR	1
PIH	10
Post-datism	13
PROM	17
Total	49

Table 4: Comparison of labour progress

Parameter	Spontaneous labour (%)	Induced labour (%)
Crossed Alert Line	20.4%	14.2%
Crossed Action Line	20.4%	51.0%

Table 5: Obstetric interventions and maternal outcomes

Obstetric Interventions / Complication	Group A (number)	Group B (number)	P Value	Significance
Augmentation of labour	24	30	0.223	Not Significant
Type of Delivery				
LSCS	03	10	0.037	Significant
NVD	45	38	0.049	Significant
Forceps Delivery	01	01	NA	
Episiotomy	40	33	0.104	Not Significant
Perineal Injury	04	06	0.504	Not Significant

Table 6: Reasons for caesarean section

Reasons for LSCS	Group A	Group B
Meconium-stained liquor	3	2
Fetal distress	2	6
Non progression of labour	0	1
Deep transverse arrest	0	5

Table 7: Comparison of neonatal outcomes

Outcome/Complication	Group A	Group B	P Value	Significance
NICU Admissions	03	05	0.46	Not Significant
APGAR Score (Mean)				
1 minute	7.67	7.71	0.81	Not Significant
5 minutes	9.02	9.20	0.29	Not Significant
Birth Weight (Mean in Kg)	2.80	2.78	0.83	Not Significant

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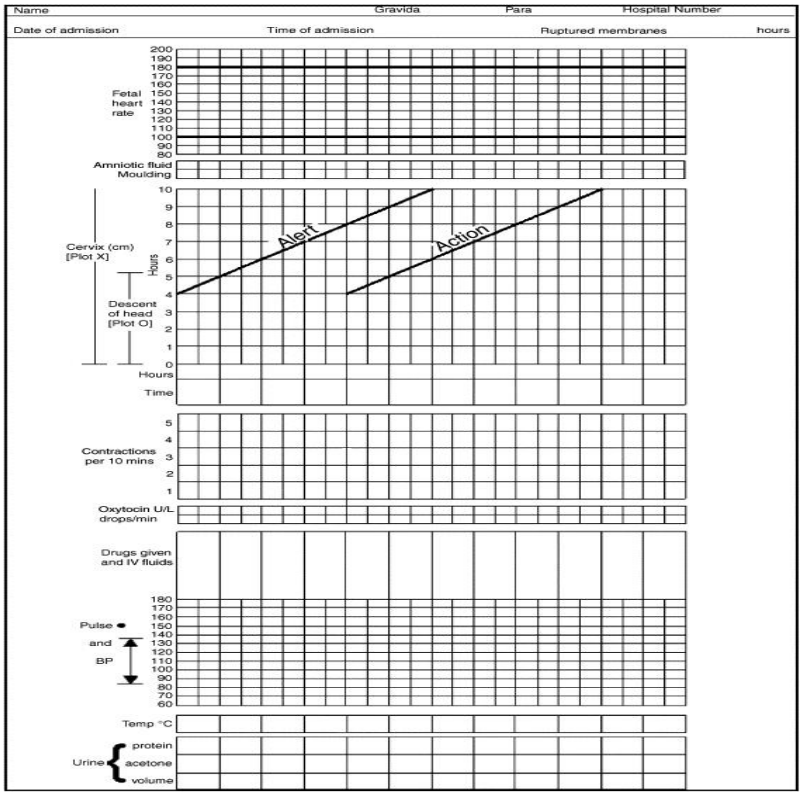


Figure 1: Comparison of labour outcomes between spontaneous and induced labour

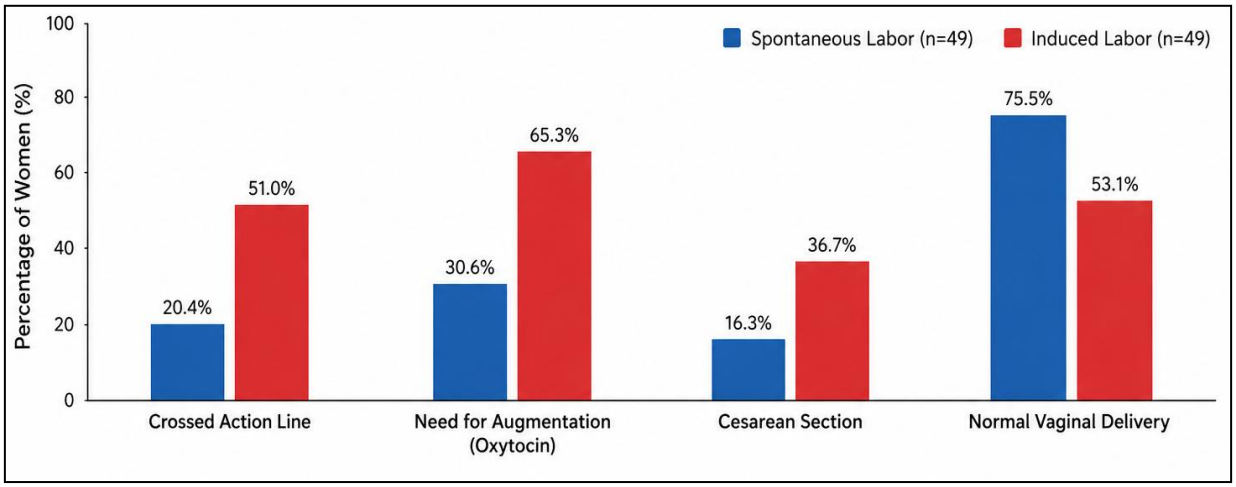


Figure 2: Maternal labour outcomes in spontaneous versus induced labour

Discussion:

It has been observed that for all intents and purposes failed induction is commoner among primigravida and nulliparous women especially those with unfavorable cervix prior to induction **[14]**. Due to this there is often a great aversion for induction of labour among nulliparous women in our environment because if the induction fails the next option is caesarean section which may adversely affect the mode of delivery in subsequent pregnancies **[15, 16]**. In an environment with great aversion for caesarean section most women prefer spontaneous labour due to the presumed belief that it is associated with better feto-maternal outcome **[16]**. IOL is generally undertaken with the aim of decreasing maternal and fetal morbidity or mortality *i.e.* the risks of continuing the pregnancy to either mother or fetus are considered greater than the risks associated with planned birth. For example, women are commonly induced for post-term pregnancy to reduce the risk of stillbirth **[17]**. Women with premature rupture of membranes are

induced to decrease incidence of maternal sepsis and neonatal infection secondary to chorioamnionitis **[18]**. Women with preeclampsia are induced to reduce the risk of stillbirth and severe maternal morbidity (renal failure, liver failure, coagulopathy, pulmonary oedema, eclamptic seizures) **[19]** and women with diabetes are induced to minimize macrosomia associated birth complications and stillbirth risk. While some indications for IOL are supported by high level evidence others are not. A systematic review of the evidence of indications by Patel *et al.* conducted in 2017 found that the evidence at the time was insufficient to support IOL for women with common indications such as diabetes, twin gestation, suspected fetal macrosomia and oligohydramnios **[20]**. The review called for further research to obtain a clearer picture of the risks and benefits associated with IOL. There is no agreed external standard and clinical guidelines vary considerably both nationally and internationally. The recent ARRIVE trial **[21]** which compared outcomes for low risk nulliparous women associated with IOL at 39 weeks (between 39+0 and 39+4) versus expectant management seems to have further divided the maternity community in relation to IOL timing **[22]**. While this trial did not find any differences between the two groups for its primary outcome that is a composite of perinatal death and severe neonatal complications, it did find that IOL was associated with a reduction in caesarean section (CS) rate by 4%. This is at odds with some population studies that show that IOL is associated with a rise in CS rate **[23]**. Regardless of whether IOL is associated with a rise or reduction in CS rates it is associated with increasing rates of early term birth and its negative impact on child development. Furthermore IOL is often associated with a less positive birth experience for women compared to spontaneous onset of labour **[24]**. As such the circumstances in which to offer a woman an IOL should be informed by the best available evidence. We in our study tried to assess if induced labour can have similar outcomes as spontaneous labour if monitoring and interventions are done based on simple tool like WHO modified partograph. In the current study, the average maternal age of both groups was comparable and there was no statistically significant difference between spontaneous and induced labour groups. The majority of the women were in the age group of 21-25 years which is in conformity with the reproductive age group reported in obstetric studies. The study conducted by Orji *et al.* **[25]** and Vogel *et al.* **[26]** shows a similar pattern of distribution of maternal age among nulliparous women in spontaneous and induced labour. Similar demographic features of groups enhance reliability of present comparative analysis. Fatema *et al.* **[27]** also reported a higher rate of spontaneous vaginal delivery in women with spontaneous labour than in those with induced labour (86.25% versus 78.75%), along with a significantly longer second stage in the induced group (17.65 versus 14.78 minutes; $p = 0.001$). The distribution of the gestational age also did not show a statistically significant difference in the two groups with the majority of the women delivering between 39-41 weeks of gestation. These findings are in line with those of previous studies **[25, 26 and 28]**. Who studied the spontaneous and induced labour outcome in nulliparous women and found similar gestational age at delivery. It is essential to have uniformity in the gestational age because labour progression and neonatal outcomes are significantly impacted by fetal maturity and cervical readiness. The present study found that labour progression was smoother and faster in spontaneous labour as compared with induced labour. Usually, women with spontaneous onset of labour were left of the alert line on the WHO modified partograph indicating satisfactory progress of labour. In comparison, more cases of induced labour crossed the alert line and approached the action line, which means that labour is delayed. The results were consistent with those obtained by Vogel *et al.* **[26]**, who also found that more cases of induced labour crossed the action line than cases of spontaneous labour. The reason why induced labour progresses more slowly are that the spontaneous onset of labour begins with complex hormonal activities that prepares the cervix and uterus to contract effectively. Similarly, Priyadarshini *et al.* **[29]** reported a longer active phase of labour in the induced group than in the spontaneous group, supporting the observation of slower labour progression following induction. Induced labour depends on pharmacological stimulation, which may not always mimic the natural physiology of labour. According to Coates *et al.* **[30]**, nulliparous women who had induced labour experienced a longer active phase than those who had spontaneous labour. We observed that since there is more crossing of alert line therefore Induced labour requires more monitoring as it is associated with prolonged active labour and more obstetric intervention. An elevated requirement for augmentation during induced labour may be related to poor cervical favorability and inadequate uterine contractions. This is especially true for nulliparous women. The present study also showed that spontaneous labour had a higher rate of spontaneous vaginal delivery, whereas induced labour had a comparatively higher rate of cesarean section. The rise in the cesarean section rate associated with induced labour may result from factors such as failure to progress, fetal distress and arrested labour. According to Orji *et al.* the likelihood of cesarean section among nulliparous women increased with induced labour **[25]**. Similarly according to Vogel *et al.* cesarean section rates were higher in induced labour compared to spontaneous labour **[26]**. The current study findings corroborated by report that the incidence of operative delivery was significantly more in the case of induced labour as compared to spontaneous labour **[31]**. Nonetheless, lower cesarean section rates in women with elective induction at 39 weeks compared with expectant management in the ARRIVE trial **[21]**. Disparities in research may be related to the studied population, protocols used to induce labour, cervical favorability and obstetric practices. Spontaneous labour is more efficient than induced labour in nulliparous women, the present findings show. According to the WHO, the partograph allows for a standardized monitoring of labour but does not determine clinical outcome. The alert and action lines provided helped in recognizing delayed labour progression and enabled prompt actions. The systematic utilization of the WHO modified partograph can improve labour monitoring and prevent

prolonged labour, obstructed labour and maternal complications which is especially vital in less resourceful settings **[9]**. In the current investigation, prolonged labour, postpartum hemorrhage, fetal distress and maternal exhaustion were maternal complications. The rate of complications was a little more but there was no statistical difference between the two groups for any major complication. Similarly, Gupta and Jain **[32, 33]** reported comparable maternal and neonatal outcomes between spontaneous and induced labour groups, although caesarean delivery and postpartum haemorrhage were numerically more frequent following induction. Identification of labour abnormalities with a partograph and timely obstetric intervention may have helped to avoid serious maternal morbidity. Orji *et al.* Similarly concluded that when labour is monitored with the WHO modified partograph, induced labour is not associated with serious maternal complications **[25]**. The current study found similar neonatal outcomes in both spontaneous and induced labour groups. Most of the neonates had satisfactory APGAR score at one minute and five minutes and very few required admissions to NICU for temporary respiratory distress or fetal distress. According to Orji *et al.* and Vogel *et al.* findings, if one maintains proper intrapartum monitoring, then induced labour does not significantly affect neonatal outcomes **[25, 26]**. Induction may increase length of labour and operative interventions, but the fetus is still safe with good monitoring. The present study noted a higher incidence of fetal distress in cases of induced labour. This could be attributed to hyperstimulation of the uterus due to induction agents, including misoprostol and oxytocin. Therefore, monitoring fetal heart during labour and obstetric intervention is important for the fetus. The American College of Obstetricians and Gynecologists (2021) states that fetal surveillance needs to be done carefully during labour induction. An important strength of the present study was the use of the WHO modified partograph as a standardized and evidence-based labour monitoring tool. By using the partograph, recording of maternal and fetal parameters was systematic and clinical decision making improved. Nonetheless, there were some limitations to the study. As the study was conducted in a tertiary care hospital and with a small sample, a proper generalization cannot be done. In addition, this research paper did not conduct an extensive analysis of other potential factors that could affect labour progression, such as maternal body mass index (BMI), cervical Bishop Score, fetal position and pain management practices. Going forward, it is hoped that multicentric studies having larger sample sizes and including more obstetric variables could provide more understanding of the progression of labour in spontaneous and induced labour.

Conclusion:

Induced labour in nulliparous women showed less smooth labour progression and a greater need for operative delivery than spontaneous labour, while augmentation was more frequent but not significantly different. Maternal and neonatal outcomes, including complications, NICU admission, Apgar scores and birth weight, were comparable between groups. Induction of labour may therefore be undertaken safely in nulliparous women with vigilant monitoring using the modified WHO partograph and timely obstetric intervention.

Advancement to knowledge:

In nulliparous women, induced labour was associated with less favorable labour progression and more Caesarean delivery, but structured monitoring with the WHO modified partograph was associated with comparable maternal and neonatal outcomes.

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