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THE ROLE OF ULTRASONOGRAPHIC MEASUREMENT OF FETAL ADRENAL GLAND SIZE FOR THE PREDICTION OF SUCCESS OF INDUCTION OF LABOUR AMONG PRIMIGRAVIDA

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ABSTRACT
Aim: The goal of the current study is in order to evaluate the efficiency of using transvaginal cervical length, Bishop score, and ultrasound measurements of foetal adrenal gland size, particularly the foetal zone ratio (FZR), to predict the effectiveness of induction of labour (IOL) in first-time mothers women at term.
Methods: Hospital-based cross-sectional analytical research is performed over 12 months at Sree Balaji Medical College and Hospital's Obstetrics and Gynaecology Department, Chennai, comprising 130 primigravida women at 40 weeks of gestation, chosen by selective sampling. Ultrasonographic assessments of foetal adrenal gland size were conducted, and FZR is computed. Measurements of cervical length and Bishop score were evaluated before induction. Participants were classified into successful and unsuccessful IOL groups, and statistical analyses, including independent were performed, including t-tests and ROC curve analysis.
Results: The research revealed markedly greater foetal adrenal dimensions and foetal zone ratios in the effective induction of labour category when contrasted with the failed category ($p < 0.01$). A successful induction correlated with an elevated Bishop score, reduced cervical length, shorter intervals from induction to labour and from induction to delivery, and an increased rate of vaginal delivery. Despite ROC analysis indicating minimal independent predictive value, foetal adrenal markers demonstrated a robust correlation with induction results.
Conclusion: Ultrasonographic evaluation of foetal zone ratio, size of the unborn adrenal glands, in conjunction with traditional cervical assessment techniques, may provide a significant supplementary tool in forecasting the efficacy of labour induction in primigravida women, thereby enhancing clinical decision-making and optimising labour outcomes.

KEYWORDS: Induction of labour, Fetal adrenal gland, Fetal zone ratio, Ultrasonography, Cervical length.

1. INTRODUCTION

The induction of labour, also known as an IOL, is a common obstetric technique that aims to prevent complications throughout pregnancy and in the newborn baby. The likelihood of negative perinatal outcomes, including meconium aspiration syndrome, neonatal acidosis, diminished APGAR scores, and heightened hospitalisations to neonatal critical care units, increases with gestational age beyond 40 weeks. Contrary to its beneficial effects on the developing baby, inducing labour is linked to a greater incidence of maternal problems, including protracted labour, more frequent surgical vaginal deliveries, and caesarean sections, especially in first-time mothers. Therefore, understanding dependable indicators of effective labour induction is crucial for enhancing obstetric outcomes.

The bishop score has traditionally been used to evaluate cervical favorability; nevertheless, it is subjective and reliant on the examiner's judgement. Transvaginal ultrasonographic measurement of cervical length provides enhanced impartiality, although has inconsistent prediction accuracy. Prenatal endocrine preparation for labour, particularly the role that regulate the hypothalamic-pituitary-adrenal axis, has been the focus of recent research. Producing cortisol and dehydroepiandrosterone sulphate, which aid in placental oestrogen production and prostaglandin release thus inducing labor is a key function of the adrenal gland in utero, particularly in the foetal zone? The foetal adrenal glands and foetal zone may be measured using ultrasonography ratio as a novel, non-invasive, and objective indicator of the efficacy of induction of labour. This research assesses the significance of foetal adrenal gland measures in forecasting effective labour induction in primigravida women.

1.1 Induction of Labour (IOL): Clinical Background and Importance

The medical process known as induction of labour (IOL) starts uterine contractions before they normally begin, often using pharmacological or mechanical means to ensure the safe delivery of the infant. This is a vital obstetric procedure started when the hazards to mother or foetal health from prolonging the pregnancy outweigh those associated with delivery, as seen in hypertensive disorders of pregnancy, prelabor rupture of membranes (PROM), or postterm pregnancy (defined as after 41–42 weeks). Predicting in most cases, the bishop score is used to determine the chances of a successful delivery. This number is a clinical indicator for evaluating cervical readiness for labour. Although IOL may avert severe consequences including stillbirth, eclampsia, and maternal infection, it also entails dangers such as failed induction, caesarean delivery, uterine hyper stimulation, and foetal discomfort (Esther Namutosi, et al., 2025). The incidence of caesarean sections is reduced (18.6% vs. 22.2%), and there is no increase in bad newborn outcomes, when low-risk, nulliparous women elect to induce labour at 39 weeks, according to extensive, randomised trials that have greatly changed clinical practice.

Definitions

➢ IOL, or induction of labour, is a method of preparing for a vaginal delivery by starting the process of uterine contractions.

➢ Cervical ripening techniques are designed to facilitate and promote the softening, effacement, and initial dilatation of the cervix when it is deemed unfavourable for induction of labour (IOL).

Information to patients

While there are hazards associated with any medical procedure, inducing labour is generally a safe option and should be used when necessary:

1. Whenever a valid medical reason exists.
2. Following careful discussion with the mother as well as her partner, and after obtaining their informed agreement:

- When to use IOL, what it is for, and any potential side effects.
- Ways to alleviate discomfort as you undergo the procedure.
- Whether or whether a caesarean section will be necessary, as well as the anticipated success rate.
- 'Alternative management options'.

Risks associated with induction of labour

➢ Based on several randomised clinical trials, there is no increased risk of caesarean section with labour induction.

➢ The risks of uterine hyper stimulation, variations in foetal induced preeclampsia, uterine rupture, meconium aspiration syndrome, and cord prolapse after amniorrhexis labour compared to spontaneous commencement. Mechanical cervical ripening procedures, in conjunction with the correct dosages of oxytocin, reduce or eliminate these risks.

➢ It is still not clear if the risks of uterine rupture are inherent or connected to the induction process, so women with a history of caesarean sectionand/ any condition characterised by an enlarged uterus (such as macrosomia, grand multiparity, polyhydramnios, or numerous pregnancies) should be extra cautious.

'Contraindications for induction of labour'

Contraindications to labour induction include medical conditions that make vaginal delivery impossible. In our context, the most prevalent scenarios are as follows [2]:

Past history of:

- Two or more partial or full abortions
- Several caesarean sections that are not segmental or that use an inverted T-incision
- Entering the uterine cavity for myomectomy
- Uterine rupture Current pregnancy:
- One foetus in the transverse lying position
- Full vasa previa or placenta previa
- Stage II or higher foetal growth limitation indicates severe placental insufficiency.
- Active genital herpes.

1.1.1 Labour Induction: Reasons, Procedure

Labour induction is the technique by which a medical practitioner initiates labour in a pregnant woman. For instance, a typical pregnancy lasts around 9 months and 7 days; now, consider a woman who has completed this duration without experiencing any spontaneous labour pains.

Pregnancy that extends beyond the obstetrician's estimated due date is termed post-dated pregnancy, which has related risks. To prevent this, obstetricians may initiate labour. An obstetrician may initiate labour using certain medications or procedures to mitigate hazards to the foetus or mother.

Different Ways to Induce Labour

Here are some methods for bringing about labour:

Figure 1 Different Ways to Induce Labour

• **Cervical Ripening:**
When a woman's cervix ripens, she is prepared to give birth. Prostaglandin analogues and similar medications do this. In order to induce labour, prostaglandin analogues like misoprostol are usually given orally or vaginally to help the cervix ripen and the uterus soften.
• **Balloon Dilation:**
One way to induce labour is to put a catheter with a balloon tip into the cervix. Inflating the balloon with normal saline causes cervical dilatation, an essential step in the birthing process.
• **Artificial rupture of Membrane:**
Using forceps to pierce the foetal membranes releases the natural prostaglandins from the amniotic fluid, which cushions the baby, and initiates labour. This starts the process of inducing labour.
• **Membrane Stripping:**
Labour begins when the sac that encases the developing baby and the amniotic fluid around it separates.
• **Oxytocin Infusion:**
The softening of the cervix and assessment of cervical status are followed by the establishment of an IV line to initiate the infusion of synthetic oxytocin [3]. The mother's natural production of oxytocin, which causes the uterus to contract, occurs during spontaneous labour. Since we are inducing labour in this instance, synthetic oxytocin is administered.

When to Induce Labour
There are several reasons why an obstetrician could want to induce labour. These problems fall into one of two categories: It's either the mother or the infant that are in danger. It is essential to induce labour under these conditions:

Figure 2 When to Induce Labour

• **Post-dated pregnancy:**

The deadline or anticipated delivery date has now elapsed.

• **‘Pre-labour rupture of membrane or pre-term pre-labour rupture of membranes without contractions’:**

Preterm (before 37 weeks of pregnancy) or spontaneous labor-initiating membrane rupture, if any, occurs before to contractions. The purpose of inducing labour is to prevent infections, namely chorioamnionitis.

• **Gestational diabetes**

• **Preeclampsia:**

Hypertension and organ damage during pregnancy

• **Eclampsia:**

Hypertension accompanied with convulsions.

Placental abruption: When the placenta detaches from the mother's body too soon.

• **‘Oligohydramnios’:**

Cut down on amniotic fluid

• **‘Intrahepatic cholestasis of pregnancy’:**

Excessive itching on the hands, feet, or body is a symptom of elevated bile acid levels.

• **‘Infections like chorioamnionitis.**

• **Foetal growth restriction**

• **Heart or kidney diseases.**

• **Acute fatty liver of pregnancy, etc’.**

A caesarean section, not a vaginal birth, is necessary in the event that the foetus is in distress. Since a C-section is the preferred method of delivery, labour induction is omitted.

‘The procedure of Inducing Labour’

Discussion of inducing labour symptoms always leads to the question of how in order to bring about labour:

Figure 3 ‘The Procedure of Inducing Labour’

• **Step 1: Assessing cervical status:**

Determine the cervical status as a first step. Afterwards, an assessment is conducted using a grading method called Bishop's score. It is possible to start labour induction if the score falls within the desirable range.

• **Step 2: ‘Cervical ripening if unfavourable score’:**

The process of cervical ripening, as mentioned before, begins if the score falls outside of the desirable range.

• **Step 3: Start of IV oxytocin infusion:**

Intravenous oxytocin is administered after a positive bishop score. The hormone oxytocin causes the uterus to contract.

• **Step 4: Further Assessment of the cervix:**

Additional evaluation of cervical dilatation and effacement is performed after intravenous infusion.

The method we just covered is one of several that are used to induce labour. There is a chance of infection using other procedures, such as artificial membrane breach.

Risks of Inducing Labour

Although there are few hazards associated with inducing labour, the process is generally safe. Inducing labour has the following risks:

• **Preterm Birth:**

Inducing labour is mostly a safe procedure, however it does come with a few risks. The potential dangers of inducing labour are.

- **Term Birth:** Babies born between 37 and 0 days or 41 and 6 days gestation are considered term.
- **Failure of Labour induction:**

If the obstetrician is unable to induce labour the first time, she will try again; if the baby is in crisis, she will do a caesarean section.

- **Very Strong contractions:**

A cardiotocography (CTG) equipment is used in the delivery room to monitor the mother's uterine contractions. Foetal discomfort may occur in rare cases due to very intense contractions caused by a rapid rate of infusion.

- **Infection:**

Although the most common way of inducing labour is safer, there are other procedures that might cause infections, such as artificially rupturing the membranes or stripping the membranes.

- **Atonic uterus:**

Postpartum haemorrhage, or heavy bleeding after delivery, may occur if the uterus does not contract at all or loses its tone.

'Advantages and Disadvantages of Inducing Labour'

All things are Benefits and drawbacks. Let us examine the benefits and drawbacks of labour induction. Consider that the widespread use of labour induction suggests that its benefits surpass its drawbacks.

Advantages of Inducing Labour

- As we've already established, it keeps pregnancy-related problems like gestational diabetes, preeclampsia, oligohydramnios, etc. at bay.
- Gets around the issue of incomplete or non-existent unexpected delivery.
- 'Reduces intrauterine foetal death
- Reduces risk of C-section
- Cheap and Convenient'
- Non-invasive, unlike C-sections, which need general anaesthesia

Disadvantages of Inducing Labour

- For foetal monitoring, a medical admission is necessary.
- Is not always possible, for example, when the mother has active herpes genitals, a very big baby, or a very tiny pelvis (Cephalo-pelvic disproportionment).
- Uterine tachysystole occurs as a result of vigorous uterine contractions.
- Uterine infections
- Foetal distress
- Uterine rupture

1.1.2 Definition and indications 'of induction of labour'

The act of intentionally beginning labour is referred to as "induction of labour" (IOL). Although most women give birth naturally during the 42nd week of pregnancy, induction is necessary for around 20% of pregnancies.

When it's determined that giving birth would be safer for the mother and child than keeping the baby in the womb, IOL is often performed. On the other hand, it might be related to the mother's health.

The risks, benefits, processes, and indications of labour induction, as well as any contraindications, are discussed in this article.

Indications

If doctors determine that the mother and baby would be safer after the baby is born than if the baby remains in the womb, then induction of labour may be necessary.

Prolonged Gestation

Induction of labour (IOL) should be available to women with normal pregnancies between the ages of 40 weeks and 0 days and 40 weeks and 14 days. The goal is to reduce the chances of foetal death also linked to longer gestational periods and stillbirths, which are believed to be caused by the placenta ageing.

Should the patient refuse labour induction, it is recommended to increase the frequency of monitoring starting at 42 weeks. [4].

'Premature Rupture of Membranes'

Provide in cases of premature rupture of membranes (>37 weeks' gestation), induction of labour (IOL) or expectant care for no more than 24 hours should be considered, since prolonged this period increases the risk of ascending infection, particularly chorioamnionitis. Without medical intervention, 84% of labouring mothers will begin to push during the first hour.

Regarding preterm premature rupture of membranes (PPROM):

- **'<34 weeks' gestation** – postpone IOL' until signs of foetal distress or other obstetric complications suggest otherwise.
- **>34 weeks' gestation** There are advantages and hazards to postponing pregnancy later, such as an increased risk of infection, which determine when an IOL should be placed.

'Maternal Health Problems'

Issues that often impact the well-being of mums include high blood pressure, preeclampsia, diabetes, and obstetric cholestasis.

The mother's and the foetus's health will determine whether or not to induce the labour.

Fetal Growth Restriction
No. 2 on the list of causes for inducing labour is foetal growth limitation. Having the baby delivered before foetal discomfort occurs is the goal.
Intrauterine Fetal Death
In situations of intrauterine foetal mortality, it is recommended to induce labour if the mother is in good health and her membranes are intact.
Contraindications
Contraindications to inducing labour are often the same as those to giving delivery naturally. It is possible to classify them as either absolute or alternatives that are not recommended (Table 1).

Table 1 Contraindications for Induction of Labour

Absolute Contraindications	Relative Contraindications
'Cephalopelvic disproportion	Breech presentation
Major placenta praevia	'Triplet or higher order pregnancy
Vasa praevia	Two or more previous low transverse caesarean sections'
Cord prolapses	
Transverse lie	
Active primary genital herpes'	
Previous classical Caesarean section	

1.2 Ultrasonographic Predictors of Induction Outcome
Inducing labour is among the most common obstetrical procedures. More than 22 percent of births are induced. Safe vaginal birth for both the mother and the newborn is the goal of labour induction. It is normal practice to induce labour in order to improve health of the mother and child, as well as to forestall any potential problems like caesarean sections, unfavourable cervixes, protracted labour, postpartum haemorrhage, and traumatic delivery. The bishop score is a common technique to forecast the safety and length of induction labour. Expectant mothers who are about to undergo induction of labour have shown that this subjective assessment method is an inadequate labour predictor. In many research, ultrasonography is suggested as a helpful technique to track the course of labour and forecast the delivery manner [5].
One of the most used obstetric treatments today, inducement of labour (IOL), is linked to an increased risk of caesarean section. Despite its application in outcome forecasting, the Bishop score is subjective, lacks a clear correlation with results, and necessary technique causes pain [6]. Ultrasound has recently gained extensive use in obstetrics, and some parameters like cervical length and foetal head-perineal distance as well as qualitative features like dilatation, wedging pattern, or funnel have been suggested as potential indicators of the delivery method for induced labour. Compared to vaginal examinations, ultrasound is less subjective, more tolerable, and certain of its characteristics correlate well with results.
Ultrasound is being use in obstetrics for therapeutic purposes since 1978. Improvements in resolution brought about by technological advancements enable more accurate imaging of the foetus. This, together with new developments in screening for pregnancy problems, is altering the therapeutic use of ultrasonography in the routine care of low-risk pregnant women. Advancements in imaging technology, including as colour Doppler and pulsed wave ultrasound, have made it easier to monitor foetuses that are tiny for their gestational age and to differentiate between healthy and unwell foetuses. This has resulted in less disruption during typical pregnancies and better-timed assistance for foetuses experiencing real problems [7]. There are two main categories for ultrasonography usage in obstetrics: elective and reactive. Ultrasound is used in two ways: reactively, to help treat a clinical issue such suspected foetal development restriction, and electively, to scan for potential problems in a pregnancy that seems to be going well (screening).
One popular method for determining the outcome of a delivery is the bishop's score. The importance of transvaginal ultrasound (TVU) and cervical length (CL) in establishing the outcomes of a delivery, such as the mode of delivery, timing, need of induction, membrane rupture, and early ruptures of membrane, has been examined in recent research. TVU assessment of CL is a reliable tool for cervix evaluation. If the funnelling is less than 30% and the CL is more than 30 mm, the cervix is premature. In full-term pregnancies, TVUCL readings may indicate whether labour will be successfully induced. With the supravaginal section accounting up around half of the CL, TVU measures provide a comprehensive cervix assessment in contrast to physical examination. Individual differences make manual evaluation difficult and result in inconsistent estimations. TVU measurements, on the other hand, are precise and simple to repeat.
When an infection develops in the amniotic sac or lower genital canal, it may cause the membranes to rupture prematurely, which happens in 5–15% of pregnancies, usually during the term. Amniotic fluid in the vaginal canal is a common diagnostic tool. Labour induction with oxytocin is advised for term individuals with positive endometrial pregnancy markers and a healthy cervix, while those with an unfavourable cervix may benefit more from prostaglandin compounds. Expectant therapy may be considered in unique cases [8]. Effective preparation for prolonged latent stages and minimizing vaginal examinations during induction are essential. Transvaginal ultrasound (TVU) has proven to significantly enhance the accuracy of PROM prediction, thereby reducing complications. TVU is particularly reliable for assessing cervical length (CL), and its use can improve neonatal outcomes by decreasing prolonged and non-progressive deliveries that could result in undesired cesarean sections. Research highlights the efficacy of TVU and CL measurements in predicting spontaneous labor onset, revealing a strong correlation between a CL measurement of 10 mm and less and the likelihood of delivery within a week.

The subjective inaccuracies of digital pelvic exams are eliminate by the ongoing attempts to standardise labour prediction models utilising intrapartum ultrasonography. Numerous ultrasound-based prediction techniques are available to evaluate the success of labour induction, and ultrasonography may be used to examine all variables of the bishop score, including foetal head station, position, consistency, dilation, and cervical length. Furthermore, novel ultrasonography parameters, including foetal head orientation relative to the pelvic girdle, alignment of the foetal spine, angle of progression, head-to-symphysis and head-to-perineum distances, thoroughly investigate [9]. An essential component that decides the success or failure of the presentation is the distance of the component from the outlet in work. Typically, this is determined during a vaginal examination in order to determine how far away the patient's head is from the ischial spine. Nonetheless, digitally measured head position throughout the intrapartum period is often erroneous, incorrect, and not consistently repeatable by many examiners. Intrapartum ultrasound examination is more precise and demonstrates strong correlation across various sonographers, although there is considerable discordance between vaginal assessments and ultrasound evaluations. In order to better inform patients before inducing labour and to clarify the chances of a successful induction based on imaging findings, ultrasound is becoming an essential supplemental tool for obstetricians.

1.3 Fetal Adrenal Gland Assessment and Fetal Zone Ratio

The inside medulla of the adrenal glands originates from neural crest ectoderm, while the outside cortex develops from intermediate mesoderm. The two kinds of tissue that make up the adrenal glands are diverse and unique. The adrenal cortex tissue first appears 33 days after fertilisation. That it differs from its adult counterpart in having two areas, one outside the building and the other within foetal zone on the inside—is seen in Figure 4. Enzymatic activity occurs in the inner foetal zone, which supplies the placenta with adrenal androgens, which are utilised to make oestrogen. When seen cross-sectionally on an ultrasound, the developing adrenal gland looks lentiform or discoid, but when viewed longitudinally, it appears oval or pyramidal. It becomes seen at the end of Around the first trimester, but noticeable growth doesn't occur until about week twenty of gestation. From 12 to 17 weeks of gestation, the size increases at a linear rate. It presents as an echogenic core stripe encircled by a hypoechoic rim [10].

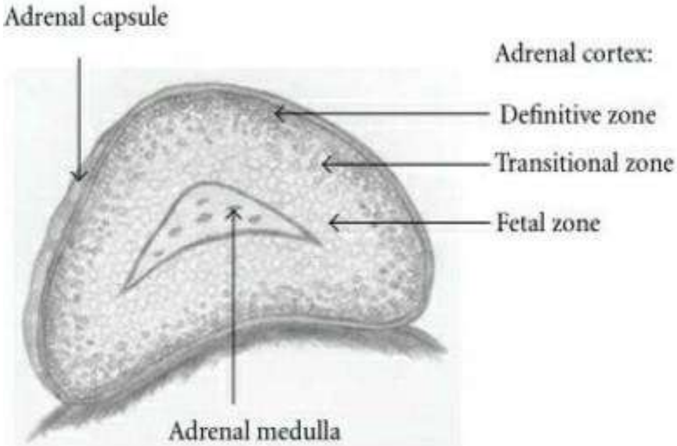


Figure 4 Fetal Adrenal Gland

The foetal zone generates 100–200 mg/dl of DHEAS, an androgen that is a precursor to oestrogens and androgens, and accounts for most of the cortical volume at midge station. Essential for the organ development during pregnancy, particularly the lungs' maturation, cortisol is also synthesised in the foetal zone. Cortisol causes prostaglandin and corticotrophin-releasing hormone (CRH) levels to rise via influencing the expression of many genes in the placenta. While prostaglandins play a crucial part in the process of giving birth, CRH helps the labour process along by doing a lot of other things, such stimulating smooth muscle contractions, dilating the uterine arteries, inducing myometrial contractions, and increasing the synthesis of PGF2a and PGE2. The foetal zone grows rapidly in response to hypothalamic-pituitary-adrenal axis stimulation, which indicates that the foetus is ready for birth; measuring this zone may help determine how well intrauterine procedures worked.

Preterm birth is remains the primary cause of neonatal death and morbidity in contemporary obstetrics, irrespective of how far medicine has come. Ten percent of all births occur before the expected time. Delivery occurring before to the 34th week of gestation is linked to an increased probability of serious illness and fatality. Babies delivered before to the 37th week of pregnancy account for 83% of neonatal mortality rates when these data are examined. The medical and obstetrical causes of preterm births account for around 20-30% of these births, or 1-4 percent of all births. The spontaneous idiopathic causes of preterm births, which may be connected or not, account for 70-80% of these births. Medical and obstetric reasons include preeclampsia, foetal discomfort, foetal growth retardation (FGR), placental abruption, and foetal mortality. Preterm birth prediction and prevention are two of the most pressing obstetric concerns. It would be most effective to decrease the number of preterm births by predicting and preventing them via the identification of risk factors. Ultrasound cervical length evaluation, biochemical markers, digital cervix examination, and risk score systems are some of the ways that preterm labour may be predicted. These days, the gold standard for predicting premature labour is an ultrasound of the cervical region.

The foetal adrenal gland consists of four zones throughout foetal development. The regions are listed in the following order: "Foetal Zone" (FZ), "Transitional Zone" (TZ), "Definitive Zone" (DZ), the "Foetal Adrenal Capsule" (C), and finally the "neocortex" (O). Week of gestation and cellular factors may affect how the foetal adrenal gland layers respond to the hypothalamic-pituitary axis rebuilding [11]. Appropriate parturition cannot begin until this foetal hypothalamic-pituitary-adrenal axis is activated and several endocrine signalling pathways involving the placenta and the foetal adrenal glands are examined. Because of biochemical stimulation, the foetal zone—the core portion of the adrenal gland—is responsible for more dehydroepiandrosterone sulphate (DHEAS) being produced. Given that enormous development in the central foetal zone, this finding points to a dimensional enlargement of the whole unborn adrenal gland.

Preterm labour (PTL), characterised by the initiation of labour before to 37 full weeks of gestation, is a predominant contributor to infant morbidity and death globally. According to the World Health Organisation (WHO), premature birth affects almost 15 million babies each year, or 10% of all live births worldwide [12]. The ramifications of preterm labour (PTL) beyond newborn death, since surviving preterm babies have an elevated risk of chronic health difficulties, including neurodevelopmental abnormalities, respiratory troubles, and diminished cognitive function. In spite of improvements in obstetric treatment, almost one million infants under the age of five die each year as a result of premature birth. With an estimated 3.5 million preterm deliveries annually, India bears the brunt of premature births. This represents about one-fourth of the worldwide preterm birth burden. The incidence of PTL in India is believed to be around 13%. In these contexts, the early prediction of PTL may enable prompt referral, suitable therapies, and improved newborn outcomes.

1.3.1 Anatomy and physiology ‘of the fetal adrenal gland’

Because of the dramatic difference between the adrenal glands' structure and function during foetal development and those throughout postnatal development and adulthood, the adrenal glands are one of the most fascinating human organs. While the adult adrenal glands are relatively small and have a two-layered cortex that synthesises The massive foetal adrenal glands develop shortly after conception to primarily generate adrenal androgen precursors, with mineralocorticoids (MC) in the zona glomerulosa (zG) and glucocorticoids (GC) in the zona fasciculate (zF). Thirdly, the zona reticularis (zR) matures progressively during childhood and enters functional activity in the synthesis of precursors for adrenal androgens during adrenarche, which typically occurs about the age of eight. Despite the relatively large size of foetal adrenals, which operate in a coordinated Connected to the mother and placenta, adrenal-deficient foetuses usually grow and develop properly all the way to delivery, excluding adrenal aplasia that is associated with abnormalities in other organ systems. [13]. The foetal Along with the placenta and the adrenal glands, a complex functional steroid unit is formed during gestation maternal circulating hormones; if this unit is disturbed, it may have negative effects for the mother and the baby, mostly because of an excess of androgens. Understanding human adrenal development and function has been greatly improved by studying genetic disorders. However, there are still many unknowns regarding the complex process of adrenal development from the time of conception to the time of delivery, as well as the zonation, maintenance, and regeneration of the cortex as we age.

1.4 Problem statement

Induction of labour is a frequent obstetric practice, especially among primigravida women at term, when continued pregnancy offers a danger to the mother or foetus. Despite its widespread usage, labour induction remains unpredictable, particularly in primigravida, when the risk of unsuccessful induction and extended labour is greater. Failed induction of labour is linked to greater maternal morbidity, more surgical vaginal deliveries and caesarean sections, longer hospital stays, and higher healthcare expenditures.

In the past, cervical favourability and induction outcomes were predicted using the Bishop score as well as transvaginal cervical length. However, these approaches are subjective, operator-dependent, and focus exclusively on maternal cervical variables, often failing to properly anticipate the foetus' physiological preparedness for delivery. As a consequence, relying only on these characteristics may result in ineffective induction timing and higher intervention rates.New evidence points to the foetal hypothalamic-pituitary-adrenal axis activation as a key factor in the start of spontaneous labour, specifically in prenatal endocrine development. Ultrasound assessments of the dimensions of the developing adrenal glands, coupled with a focus on the foetal zone ratio, have emerged as a promising, objective, and non-invasive indicator of foetal preparedness for delivery. However, there is minimal prospective data on its prognostic significance for the effectiveness of labour induction in primigravida women, especially in the Indian community.

Therefore, researching how ultrasonographic measurements of the size of the foetal adrenal glands might be used to forecast how successful it will be to induce labour in first-time mothers is necessary, as well as to compare its prediction accuracy to traditional evaluation techniques. Addressing this gap might improve induction methods and prevent negative maternal and perinatal outcomes.

Significance of the study

In the field of obstetrics and gynaecology, this study has significant consequences for public health, academia, and clinical practice. Clinically speaking, obstetricians may reduce needless inductions, extended labour, and emergency caesarean sections by tailoring treatment techniques for primigravida women based on an accurate prediction of effective induction of labour. Instead of depending just on maternal cervical characteristics, the inclusion of ultrasonographic evaluation of foetal adrenal gland size provides an objective, non-invasive, and repeatable method that represents foetal physiological preparedness for labour.

Reducing maternal morbidity may be possible with early identification of mothers at high risk of induction failure, foetal discomfort, and postnatal problems by enabling prompt decision-making about alternate treatment alternatives. Additionally, this might help reduce the total number of caesarean sections, which is still a significant issue in contemporary obstetric practice.

From a scientific and academic perspective, this study adds to what is already known about the role of foetal endocrinology in the beginning of labour. In an Indian tertiary care situation, where there is presently a dearth of regional data, it offers useful information on the suitability of foetal adrenal gland measures in predicting induction results among primigravida. Improved induction success prediction may result in better use of resources, shorter hospital stays, and less financial strain on patients and institutions from the standpoint of the healthcare system. In conclusion, this study has the potential to add foetal adrenal gland measurement to the list of standard parameters, which might lead to more evidence-based obstetric practices and improved outcomes for both mothers and babies.

1.5 Aim and Objectives

Aim

- 'To Study the role of ultrasonographic fetal adrenal gland enlargement for the prediction of success of labour induction among primigravida at 40 weeks of gestation.

Objectives

- To measure the ultrasonographic fetal adrenal gland dimensions and to measure the minimum cut off value of fetal zone enlargement or fetal zone ratio (FZR) required for the prediction of IOL.
- To compare fetal zone ratio, transvaginal cervical length and bishops score for successful IOL'

2. LITERATURE REVIEW

Prior research is thoroughly investigating the determinants affecting the effectiveness of labour induction, especially in primigravida women, who exhibit elevated rates of induction failure and surgical delivery. The bishop score is historically been used to forecast induction results; nevertheless, several research have shown its shortcomings stemming from subjectivity and inter-observer variability. Transvaginal ultrasonographic assessment of cervical length is suggested as an alternative, with some studies indicating enhanced predictive usefulness; nevertheless, the findings are inconsistent.

The foetal adrenal gland is garnered attention for its crucial involvement in the onset of labour. Anatomically, it comprises an outside definitive zone and an inner foetal zone, which exhibits heightened activity during late gestation. The foetal zone generates substantial quantities of dehydroepiandrosterone sulphate and cortisol, which promote placental oestrogen synthesis, prostaglandin production, and myometrial contractility. Extensive research has shown that when Pregnancy stimulates the hypothalamic-pituitary-adrenal axis, which in turn stimulates the adrenal foetal zone becomes much larger. Recent ultrasonographic studies have shown a correlation between the start of spontaneous labour and a successful induction and the ability to precisely measure foetal adrenal gland size and foetal zone ratios. When compared as measured by the bishop's score and cervical length, the foetal zone ratio seems to have a higher predictive accuracy. Still, further studies like this one are needed to fill the gaps in our knowledge about the usefulness of standardised cut-off values in populations of first-time mothers.

2.1 Ultrasonographic Assessment of Fetal Adrenal Gland

[14] Assessed the significance of foetal In forecasting the onset of labour, the adrenal gland volume and cervical length may be used in conjunction with a comparison of the observed results. The purpose of this study was to determine the threshold values for these two factors for the determination of PTB. Thirty pregnant women with a clinical diagnosis of labour who were either preterm (280/7-366/7 weeks of gestation) or term (≥37 weeks of gestation) were included during this comparative observational cross-sectional research. The female participants in this study underwent trans-abdominal ultrasonography. Then, using the dimensions of the adrenal glands and the estimated weight of the foetus, the researchers calculated cFAGV, the volume of the foetal adrenal glands. The findings were analysed using receiver operating characteristic curve analysis. A cFAGV cut-off of With a sensitivity and specificity of 90% at 421 mm^3/kg, term mums had considerably higher levels than term mums (449.31 ± 64 mm^3/kg vs 347.46 ± 58 mm^3/kg; $p < 0.001$). Term mums had a significantly shorter cervical length (CL) than term mums (mean value 2.36 cm ± 0.26 vs 3.25 cm ± 0.51; $p < 0.001$). A cut-off value of 2.75 cm was set, showing 86.7% sensitivity and 90% specificity.

[15] Sought to prove that measuring the volume of the foetus's adrenal glands (FAGV) is a reliable predictor of how well oxytocin can induce birth. There were 103 term nulliparous women who participated in this prospective cohort research. After the decision to use oxytocin to induce birth was made, the right and left adrenal glands of the foetus were measured. Out of 103 pregnant ladies, 89 (86.4%) had a successful induction. Statistical analysis revealed that the successful labour induction group had significantly larger compared to the group that did not succeed in inducing labour, the total volumes of the foetal adrenal glands on both the right and left side, as well as the foetal zone volumes (FZV) ($p < 0.001$). The threshold for foetal adrenal gland volume (cFAGV) was defined as an area under the curve (AUC) value of 0.872 for the right total adrenal glands in predicting induction success, which was >230.2 mm^3/kg. An AUC of 0.891 The cut-off value for cFAGV, which is >236.7 mm^3/kg, was determined by using the left total adrenal gland. The cut-off for cFAGV was established at >12.6 mm^3/kg, based on an area under the curve (AUC) of 0.952 for right FZV. An AUC value of 0.884 was used to set the threshold for cFAGV, which is more than 7.8 mm^3/kg.

[16] Assessed the ultrasonic measures of fetal adrenal glands in instances of causes of preeclampsia (PE), including but not limited to foetal growth restriction (FGR), involving 191 pregnant women. Participants were categorized into 3 categories: Numbers of subjects included: 63 for PE, 63 for PE+FGR, and 65 for healthy controls. Analysed were measures of total breadth, medulla width, predicted cortex width, as well as adrenal gland ratios. Experiment results showed that compared to healthy controls, groups receiving PE or PE+FGR had significantly larger adrenal gland dimensions. A ratio of adrenal glands ≥2.8 had a statistically significant correlation between PE and PE+FGR., indicating

its potential as a dependable noninvasive diagnostic biomarker for the early identification and treatment of these disorders. [10] Investigated the significance using ultrasound-confirmed foetal adrenal gland hypertrophy as a predictor of labor induction in primigravida after 40 weeks of gestation. This study aimed to enrol low-risk primigravidas who were 40 weeks along in their pregnancies and were due for an induction of labour. For the purpose of foetal adrenal gland dimensions, ultrasound machines fitted with curved array probes ranging from 3.5 to 5 MHz and linear array probes from 7.5 to 10 MHz, for example the General Electric Logiq P6 Pro and the Philips HD 7XE abdominal probe, have been used. Both the successful and failed induction groups showed statistically significant differences for the developing adrenal gland in terms of both size and ratio. The threshold foetal zone ratio above 0.36 was a strong predictor of effective labour induction, with a sensitivity of 90%, specificity of 89%, positive predictive value of 93%, and negative predictive value of 75%. A bigger foetal zone (foetal zone ratio > 0.36) is a major predictor of effective induction of labour, even more so than transvaginal length (TVL) and Bishop's score. Potential applications include identifying high-risk women for induction failure, hence preventing the harmful consequences associated with labor induction.

[17] The network governing human adrenal growth was intricate. Studies on people whose adrenals don't develop normally due to genetic disorders have shown that transcription factors DAX1, SF1, and GLI3 are critical for proper adrenal development. Mutations in any of the genes involved in adrenocortical hypoplasia—POMC, PC1, TPIT, MC2R, MRAP, or ALADIN—strike at the very core of adrenal differentiation and its reliance on adrenocorticotropic hormone (ACTH). Though more variables linked in adrenal development have been found in knockout mice, some of these factors in humans (e.g., WT1, WNT4) either did not show any adrenal phenotype when mutated (unlike rodents) or, conversely, no human mutations have been found as of yet. The analysis of both adult and foetal adrenal gland tissue revealed 69 genes that are involved in adrenal development. Although the bulk of the genes remained uncharacterized, they encoded enzymes that produce steroids, factors that control gene expression, molecules that send signals, molecules that control the cell cycle, proteins involved in angiogenesis, and other matrix proteins.

2.2 Fetal Adrenal Gland Measurements as Predictors of Labour and Induction Outcome

Ultrasound (US) examination was [18] suggested due to the limitations using the Bishop score to evaluate labour induction (IOL). In order to confirm that WE and other maternal parameters may be used as indications and predictors of effective induction, this research used a Tran's abnormal strategy. This research computed reproductive factors and the distance between the foetus's head and the perineum with Trans perineal ultrasound (US) prior to 100 pregnant women who were sent for induction had full-term, single-child pregnancies. intrauterine growth restriction (IOL). Both vaginal births (68%) and caesarean sections (32%) were classified after induction. Additionally, the anticipated time to delivery was noted. The following maternal variables did not show statistical significance: variables such as maternal age, parity, BMI, gestational age, and foetal weight (P-values: 0.75, 0.75, 0.69, and 0.81, respectively). Nevertheless, foetal HPD and the period from induction to birth were identified as highly significant variables (<0.0001) by one-way ANOVA. An increased probability of vaginal birth and a decreased delivery interval were associated with a shorter HPD (<47.65±1.66 mm), whereas a longer HPD (>52.56±1.93 mm) showed a decreased chance of delivery via a vagina and a longer gap between deliveries. If these findings hold, they may be useful as a forecasting tool for selecting the delivery method.

This research [19] aimed to assess if ultrasonography measurements of foetal Sudden term birth might be predicted by the size of the adrenal glands. Researchers in this prospective cohort study looked at how well three-dimensional ultrasound measurements of the length, width, foetal zone, and total length of the foetal adrenal glands predicted the primary outcome of spontaneous term labour in pregnant women in their third trimester. Vaginal birth, labour length, and mother and neonatal morbidities were the secondary outcomes. We eliminated three patients from the 43 we enrolled. Eleven (25.6%) had spontaneous labour, whereas twenty-nine (67.4%) needed labour induction. The patient demographics were comparable among all participants, with the exception of the entry cervical examination and the use of oxytocin. We created a receiver operating characteristic curve to see how predictable the tests were. The examined factors were ranked by their accuracy in predicting spontaneous labour. Among them, the weighted breadth of the foetal adrenal gland had the highest accuracy rate (0.674, p= 0.93). With a weight-to-weight ratio greater than with a sensitivity of 91.0% and a specificity of 44.8%, as well as a positive predictive value of 38.5% and a negative predictive value of 92.3%, the results were 0.41. The unplanned and induced labour groups had similar rates of maternal and infant morbidities.

It was necessary to have a sensitive, specific, noninvasive, and cost-effective marker to predict premature labour. This research [20] proposed that adrenal gland volume measurements may fulfil this function. Although 268 pregnant women were enrolled, 204 women whose pregnancies were classified as 28–34 weeks were the ones analysed in the end. The adrenal zone features and corrected foetal adrenal gland volume (cFAGV) were measured using 2D ultrasonography in each participant. Every 37 to 39 weeks, the group was reviewed for cFAGV and related parameters, and the follow-up period lasted until term. Researchers found that cFAGV was significantly greater in women who went into term with symptoms (ln comparison to those who had no symptoms throughout pregnancy and proceeded into term at a rate of 241.35 mm^3/kg body weight. At a 271.16 mm^3/kg body weight, the specificity was 81.9% and the sensitivity was 90% threshold. In terms of sensitivity (96.67% and 86.2%) and specificity (cFAGV, 96.67% and 83%, respectively), the foetal adrenal gland width ratio was the gold standard. Thus, 2D ultrasound measures of foetal adrenal gland characteristics are recommended as a feasible marker for predicting term birth, while cFAGV measurements at term may also be used to determine the chance of spontaneous labour commencement.

One common method in obstetrics is induction of labour (IOL). The [21] purposed was to assess vaginal delivery predictions in postdate pregnancies that were induced with prostaglandins. Carried out analytically-powered retrospective cross-sectional studies. After the 41st week of gestation, 145 women were admitted to the hospital for labour induction

using a vaginal pessary that produces prostaglandins. This produced a vaginal or caesarean delivery as the end outcome. Researchers looked at a wide range of maternal and foetal variables. Many logistic regression studies, including Kaplan-Meier curves, were run. Once the induction was complete, 80.7% of the women in the cohort gave delivery naturally. Vaginal birth was shown to be protected by multiple pregnancies and an elevated Bishop score prior to induction of labour (IOL), however the chance of caesarean section rose with maternal age exceeding 35 years and foetal birth weight surpassing 3500 g.
The study [22] evaluated the effectiveness of distant ultrasonography in predicting spontaneous term birth (TB) by monitoring the adrenal glands developing in asymptomatic women who are not pregnant. It utilized a prospective multicentre observational nested cohort analysis, focusing on singleton pregnancies. Credentialed ultra-sonographers measured the width, length, and depth of the fetal zone of the adrenal gland between 22 to 30 weeks of gestation, adjusting for variations in size based on gestational age through measurement ratios (w/W, l/L, d/D). The predictive accuracy of these ratios for SPTB before 37 weeks (SPTB37) and before 34 weeks (SPTB34) was assessed using the use of area under the curve (AUC) and receiver operating characteristic (ROC) curves. The study analysed data from 1,697 women, finding SPTB37 in 82 participants (4.8%) and SPTB34 in 6 participants (0.4%). However, the measurements of the fetal adrenal gland did not effectively differentiate between spontaneous term births, as reflected in the AUC values: 0.51 for w/W, 0.50 for l/L, and 0.52 for d/D concerning SPTB37, while AUCs for SPTB34 were 0.52 and 0.55 for w/W and l/L ratios respectively. Additionally, the mean gland dimensions did not vary significantly between the term and spontaneous term deliveries ($p > 0.05$).
[23] Purposed of this study was to determine if A useful screening method for spontaneous term delivery is sonographic three-dimensional measurements of the foetal adrenal gland (TB), given the relevance of the gland in releasing hormones essential to labour. For the purpose of prospective screening, 128 healthy singletons were measured for foetal adrenal gland volume at the prenatal ultrasonography intervals of 24–36 weeks. There were a comparison and evaluation of the labour and delivery outcomes based on adrenal volume. Even after accounting for predicted foetal weight, the adrenal glands of the eleven women (or 9% of the total) who gave birth after SPTB were smaller (Comparatively, 0.33 cm3/kg and 0.57 cm3/kg) compared to those of the control group ($p = 0.006$). In terms of SPTB delivery method, there was no difference between the two groups (0.34% vs. 0.33%, $p = 0.79$). In this study, a smaller adrenal gland was discovered (0.32 cm3/kg vs 0.53 cm3/kg, $p = 0.06$) in women afflicted by SPTB compared to non-SPTB affected women. Foetal adrenal glands were considerably smaller in term deliveries. Asymptomatic population and previous research indicate that there are many paths that lead to SPTB.
[24] A number of screening tests and characteristics pertaining to the mother and the foetus might indicate the likelihood of a successful labour induction. Maternal characteristics such as parity, age, weight, height, and BMI are significant, but infant characteristics such as gestational age and birth weight are factors pertaining to the foetus. Foetuses with lower birth weights and longer gestational ages, as well as younger, parous mums who are taller and lighter, tend to have better success rates with induction. There was heavy reliance on the modified Bishop score, especially its dilation component, which was a strong predictor of the cervix's initial status. Through meta-analyses of research done from 1990 to October 2005, other predictors such biochemical markers like foetal fibronectin (fFN) and transvaginal ultrasound (TVUS) were investigated. The likelihood ratios for TVUS and the Bishop score to predict successful induction were 1.82 and 2.10, respectively. Predictive value was also shown by fFN and the Bishop score, with likelihood ratios of 1.49 and 2.62, respectively. Having said that, the Bishop score has not been surpassed by either TVUS or fFN. These factors and the possible Insulin-like growth factor binding protein-1's (IGFBP-1) role as a biochemical indicator necessitated more investigation.

2.3 Conventional 'Predictors of Successful Induction of Labour'

This research [25] aimed to comprehensively identify and critically evaluate models created in recent years that use universally available clinical and demographic parameters to forecast labour induction's efficacy 26 publications covering 24 prediction models developed between 1966 and 2021 were found via research. Models differed in technique, scope, and performance. Prior to endorsing any predictive model for clinical application, it has become crucial to establish risk thresholds at which intervention should be withheld, determine which subgroups are best suited to use predictive models, and evaluate the collaborative decision-making, clinical results, caesarean rates, parental satisfaction, and cost-effectiveness implications of these models in the clinic. Together with tactics for encouraging the proper utilisation of prediction models and suggestions for more study, this collection offers ways to improve model performance and use.
This research [26] looked for clinical models that might predict the efficacy of labour induction based on easily available demographic and clinical data, and then compared them. A thorough examination of many datasets identified 16 publications detailing 14 prediction models from 1966 to 2018, each exhibiting substantial methodological and performance deficiencies. Of these, six models underwent internal validation, while three were externally verified, with performance indicated by area under the receiver operating characteristic curve values between 0.61 and 0.79. The research demonstrated a diverse risk of bias, with compliance to PROBAST criteria ranging from 36% to 86%. The evaluation determined that no models are presently endorsed for clinical application and proposed enhancements in model efficacy, along with more exploration of stakeholder perspectives and clinical ramifications prior to advocating for these models in labour induction success.
This study [27] evaluated data from the Cervical Length Education and Review programme to assess the quality of transvaginal cervical length ultrasonography performed by qualified imagers. The experience was a retrospective observational analysis where candidates participated in online lectures, examinations, and submitted image batches for

evaluation. To pass, batches had to meet specific criteria, including an overall score of 80% or higher and adherence to seven out of nine assessed criteria. Among 687 candidates, mostly ultrasonographers, 105 batches (15%) failed to pass. with performance shown by values spanning from 0.61 to 0.79 for the area under the receiver operating characteristic curve. Additionally, 256 images (7%) were deemed inadequate. This underscores the need for standardized training and certification in cervical length imaging.

To provide the [28] pretested health results for themselves and their unborn children, all pregnant women should ideally go into spontaneous labour at the safest possible moment. Regrettably, this wasn't consistently the case, compelling obstetric clinicians to evaluate the maternal and foetal risks associated with ongoing expectant management vs labour induction. There are a lot of variables that might affect the induction success rate. These include things like the following: maternal parity, body mass index, age, health conditions, gestational age of the foetus, anticipated weight, medical facility, and provider practices. Recent studies indicated that the choice A woman's chances of having a safe and successful delivery were greatly affected by her ability to induce or sustain expectant management before giving birth.

[29] Using a meta-analysis, we examine the reliability of transvaginal ultrasound (TVU) cervical length (CL) as a labour start predictor in term singleton pregnancies. Search relevant material using online databases. In this meta-analysis, researchers looked at studies that employed term recruitment to see how well TVU CL predicted spontaneous labour in single-ton pregnancies with vertex presentation. The most important outcome was CL's 7-day accuracy rate for predicting spontaneous labour. We calculated the combined specificities and sensitivities. There were five studies that encompassed 735 pregnancies with a singleton. For In terms of predicting spontaneous labour within 7 days for a cervical length less than 30 mm, the overall sensitivity was 64% and specificity was 60%. A lower CL shows more specificity while a higher CL shows greater sensitivity. Women whose first trimester was at full period and had a TVU CL of 30 mm or lower likely to give birth within 7 days than those whose TVU CL was 10 mm, who had an increased risk of more than 85%. There is just a moderate correlation with term spontaneous labour and TVU CL. A woman whose TVU CL is 10 mm or less is likely to deliver within a week.

[30] The prediction of induction success must be made among women undergoing elective induction in order to be used as a tool to reduce the frequency of first caesarean deliveries. Additionally, it needs to determine which women, when induced instead being managed naturally, are at a higher risk of undergoing a caesarean section. This is review incorporates the data that establishes a link between elective labour induction and caesarean birth, together with the variables or lack thereof that may be used to determine which induced women eventually give birth vaginally.

2.4 Research Gap

Despite many studies examining cervical length and Bishop's score are the conventional indicators of a successful induction of labour. literature review revealed that their predictive accuracy was inconsistent and often subjective. Recent evidence suggests that the maturation foetal adrenal gland has a part in the beginning of labour. However, there is a dearth of research on the use of ultrasound to assess the dimensions about the adrenal gland in utero, in particular the foetal zone ratio. The majority of existing research are either performed in diverse populations, including both multigravida and primigravida women, or fail to provide direct comparisons with recognised clinical and sonographic predictions. Moreover, there has been a paucity of institution-based research in the Indian setting that systematically assesses and contrasts foetal adrenal characteristics with cervical length and Bishop's score using rigorous statistical techniques, including ROC curve analysis. Thus, a distinct deficiency persists in the establishment of standardised cut-off values and the validation of the predictive efficacy of foetal adrenal gland measures for effective labour induction in primigravida at term, which this work aims to rectify.

3. METHODOLOGY

3.1 Introduction

The research technique provides a structured approach to planning, execute, and assess a scientific inquiry in an organised and objective fashion. It includes the research design, sample methodologies, data collecting instruments, measurement protocols, and statistical techniques used to guarantee that the study goals are satisfied in a valid and reliable manner. A well-defined technique is crucial for upholding scientific integrity, reducing bias, and guaranteeing that the findings can be reliably reproduced and generalizable. The selection of an effective technique directly affects the precision of observations, the reliability of findings and the quality of the study as a whole. This research used a cross-sectional observational design to assess the efficacy of ultrasonographic monitoring of foetal adrenal gland size in forecasting the effectiveness of labour induction in primigravida women at term gestation. Ultrasonographic factors including foetal adrenal gland size and foetal zone ratio may be evaluated using this methodological approach just before labour induction. These parameters can then be correlated with the outcomes of labour. Ultrasonography functions as a non-invasive, objective, and dependable instrument for foetal evaluation, making it appropriate for assessing physiological indicators of labour preparedness. This research seeks to determine possible cut-off values and predicting accuracy for effective labour induction by systematically collecting and assessing ultrasonographic parameters in conjunction with clinical outcomes. The approach aims to guarantee measurement consistency, minimise observer variability, and enable significant statistical analysis. The results obtained from this systematic methodological approach are anticipated to provide significant evidence for enhancing the prediction of induction outcomes and facilitating informed clinical decision-making in obstetric practice.

3.2 Research Design

This research aimed in order to determine if inducing labour at 40 weeks' gestation is associated with better outcomes for primigravida women based on ultrasound assessments of the size of the foetal adrenal glands. The research took place in a hospital environment and was designed as a cross-sectional analytical study. Researchers from Sree Balaji Medical College and Hospital spent a year documenting Obstetrics and Gynaecology department in Chennai. The study's significant variables include the following: transvaginal cervical length, Bishop Score before induction of labour, and foetal adrenal gland dimensions such as total adrenal length, foetal zone width, foetal zone ratio, and foetal zone length. The outcome variables related to labour that have been considered include the interval between induction and active labour, interval between induction and delivery, and mode of delivery.

3.3 Sample Design

For this study, the sample included 130 women in their first pregnancy, 40 weeks pregnant, and scheduled for induced labour. They were purposively selected from the research setting using the set inclusion criteria. Based on the results of previous research, we used the formula for determining the sample size for this one:
In order to calculate the sample size, we used data from Richa Sharma's 2023 research. The prevalence the research
This research's sample size was determined following the standard procedure for descriptive research.

$$n = \frac{Z^2.p.q}{e^2}$$

$$n = \frac{3.8416\ x\ 0.25}{0.0064}$$

$$n = \frac{0.9604}{0.0064} = 150.06$$

The estimated sample size was around 150. The final sample size for the research was modified to 130 individuals, taking into account practicality, time limitations, and potential non-response.

3.4 Data collection

Information gathering was completed over a 12-month study period using a structured and systematic approach. After obtaining informed consent, eligible participants were enrolled prior to induction of labour. Baseline demographic and obstetric details, including maternal age and gestational age, were recorded using a pre-designed proforma. All participants underwent ultrasonographic evaluation to measure fetal adrenal gland parameters, such as FZR, total adrenal length, FZW, and FZL. Ultrasonography was performed using standardised techniques to ensure measurement accuracy and reproducibility. Furthermore, before induction, the Bishop score was used for clinical evaluation of cervical favorability and ultrasonography was used to measure transvaginal cervical length. Method of delivery, length of time from induction to active labour, and other labor-related factors were recorded prospectively. Statistical analysis was performed on all gathered data in order to compare groups with successful and unsuccessful inductions and to determine the accuracy of the foetal adrenal gland prediction measures by ROC curve analysis.

3.5 Sampling Technique

'Cross-Sectional Study'

Researchers in the fields of medicine, sociology, biology, and epidemiology often used cross-sectional studies—also called transversal studies, prevalence studies, or cross-sectional analyses—to examine a population or subgroup at a certain moment in time.

In economics, cross-sectional research often uses cross-sectional regression to ascertain that a significant dependent variable at a given moment is being affected by an independent variable, and the strength of that effect. Analysis of time series, which is a subset of changes in a number of economic aggregates over a period of time, is distinct from these.

Unlike case-control studies, which frequently only include people with a particular ailment and compare them to a matched sample, which is often a small fraction of the community, cross-sectional studies aim to provide data on the whole population under investigation in medical research at large. Neither experimental nor longitudinal, cross-sectional studies just describe a phenomenon. The prevalence risk ratio (PRR), odds ratio, and absolute and relative risks from prevalences are all measurable in these investigations, in contrast to case-control studies. They cannot establish cause and effect, but they may be used to characterise certain aspects of the population, such the frequency of a disease. The difference between the two has that longitudinal studies make a number of observations on study population members throughout time.

3.6 Inclusion and Exclusion Criteria

'Inclusion Criteria'

- A first-trimester pregnancy with a single baby, a head-first arrival at 40 weeks, and a membrane that is still intact
- Regular menstrual cycle
- Women who are certain in their due dates and who had an ultrasound during the first trimester

Exclusion criteria

- Foetal discomfort, bleeding during or after induction of labour, cord prolapse, and meconium-stained liquid
- Fear of the uterus (after a prior h/o C-section or myomectomy), placenta abruptio, chronic pelvic pain, and placenta previa
- DM, asthma, tuberculosis, anaemia, epilepsy, and hypertensive diseases during pregnancy
- Macrosomia, foetal growth restriction, congenital flaws

3.7 Tools and Techniques

Tools:

Stata, a statistical programme for the social sciences, will be used in this research.

Techniques:

Independent 'sample T-TEST'

The T-test is a statistical method for determining statistical significance between two sets of data. I am a consequence, it's easier to tell whether the disparities among the groups are just due to chance or indicate something more substantial. When evaluating hypotheses, T-tests are often used for comparing data from samples and extrapolate results to the population as a whole.

$$t = \frac{\bar{x_1} - \bar{x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where:

$\bar{x_1}, \bar{x_2}$ = group 2's sample mean and group 1's sample mean

s_1^2, s_2^2 = variations in the samples from groups 1 and 2, respectively

n_1, n_2 = sizes of the samples in groups 1 and 2, correspondingly

4. OBSERVATIONS AND RESULTS

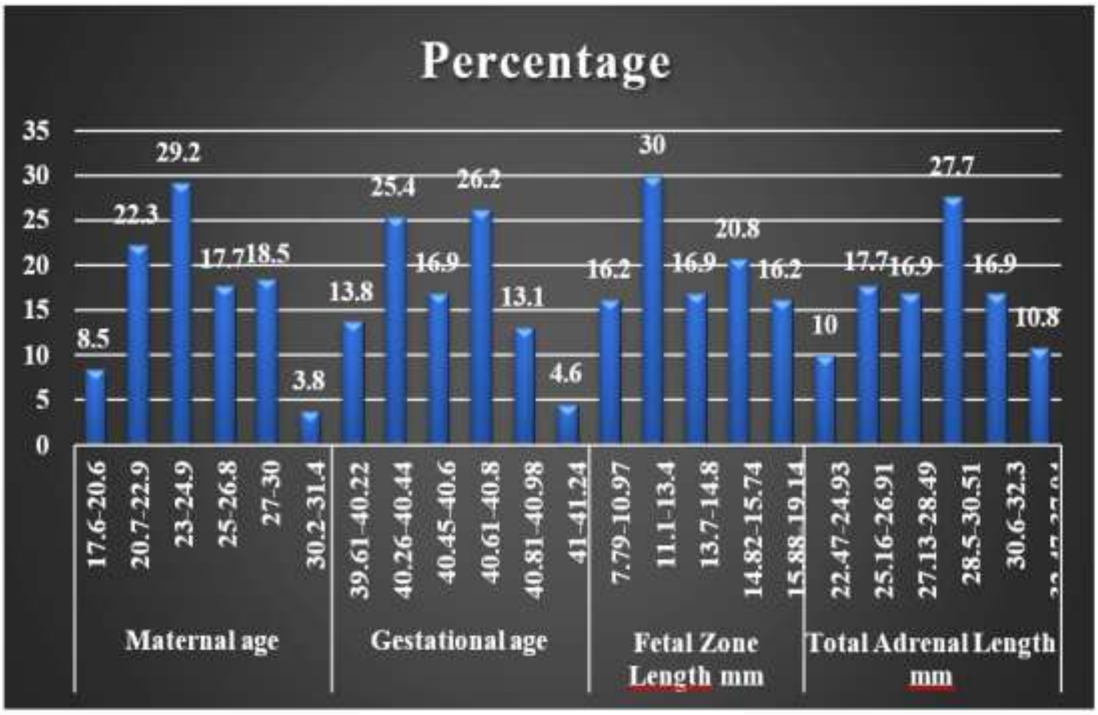
A total of 130 primigravida Two categories of women were identified based on the findings of induction of labour: those who were successful and those who were unsuccessful. There were 100 women whose induction of labour was successful and 30 whose was unsuccessful out of the whole sample. In the Results section, metrics such as foetal adrenal gland measures, cervical length, Bishop score, induction intervals, and method of birth were compared between the two result groups using this grouping.

4.1 Demographic variables

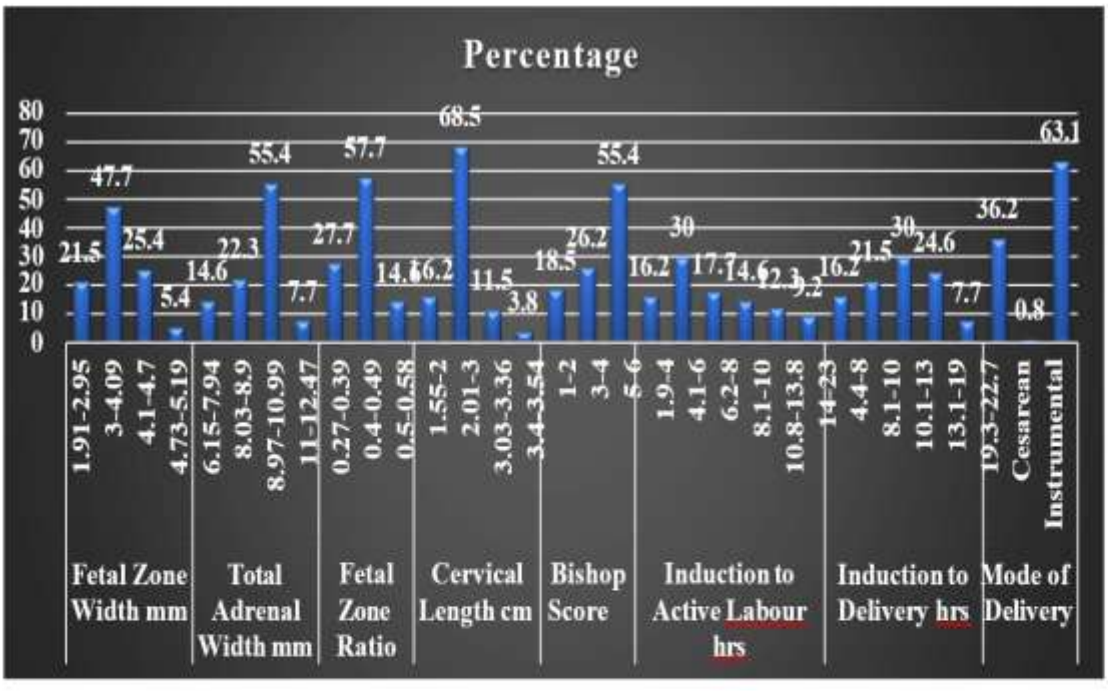
Table 2 Demographic Variables

Demographic Variables		Frequency	Percentage
Maternal age	17.6-20.6	11	8.5
	20.7-22.9	29	22.3
	23-24.9	38	29.2
	25-26.8	23	17.7
	27-30	24	18.5
	30.2-31.4	5	3.8
	Total	130	100
Gestational age	39.61-40.22	18	13.8
	40.26-40.44	33	25.4
	40.45-40.6	22	16.9
	40.61-40.8	34	26.2
	40.81-40.98	17	13.1
	41-41.24	6	4.6
	Total	130	100
Fetal Zone Length mm	7.79-10.97	21	16.2
	11.1-13.4	39	30
	13.7-14.8	22	16.9
	14.82-15.74	27	20.8
	15.88-19.14	21	16.2
	Total	130	100
Total Adrenal Length mm	22.47-24.93	13	10
	25.16-26.91	23	17.7
	27.13-28.49	22	16.9
	28.5-30.51	36	27.7
	30.6-32.3	22	16.9
	32.47-37.04	14	10.8
	Total	130	100
Fetal Zone Width mm	1.91-2.95	28	21.5

Demographic Variables		Frequency	Percentage
	3-4.09	62	47.7
	4.1-4.7	33	25.4
	4.73-5.19	7	5.4
	Total	130	100
Total Adrenal Width mm	6.15-7.94	19	14.6
	8.03-8.9	29	22.3
	8.97-10.99	72	55.4
	11-12.47	10	7.7
	Total	130	100
Fetal Zone Ratio	0.27-0.39	36	27.7
	0.4-0.49	75	57.7
	0.5-0.58	19	14.6
	Total	130	100
Cervical Length cm	1.55-2	21	16.2
	2.01-3	89	68.5
	3.03-3.36	15	11.5
	3.4-3.54	5	3.8
	Total	130	100
Bishop Score	1-2	24	18.5
	3-4	34	26.2
	5-6	72	55.4
	Total	130	100
Induction to Active Labour hrs	1.9-4	21	16.2
	4.1-6	39	30
	6.2-8	23	17.7
	8.1-10	19	14.6
	10.8-13.8	16	12.3
	14-23	12	9.2
	Total	130	100
Induction to Delivery hrs	4.4-8	21	16.2
	8.1-10	28	21.5
	10.1-13	39	30
	13.1-19	32	24.6
	19.3-22.7	10	7.7
	Total	130	100
Mode of Delivery	Cesarean	47	36.2
	Instrumental	1	0.8
	Vaginal	82	63.1
	Total	130	100



Mothers in the age groups of 23-24.9 (29.2%), 20.7-22.9 (22.3%), and 27-30 (18.5%) made up the bulk of the study's 130 participants, indicating that most were in their early to mid-twenties based on demographic and clinical data. A significant percentage of pregnancies were noted at gestational ages of 40.26–40.44 weeks (25.4%) and 40.61–40.8 weeks (26.2%), indicating that the majority of participants were at full or late-term gestation. The foetal zone length primarily varied from 11.1 to 13.4 mm (30%), whereas the overall adrenal length was most often noted between 28.5 and 30.51 mm (27.7%), indicating substantial variability in foetal adrenal dimensions. Approximately 47.7% of the subjects had a foetal zone width ranging from 3 to 4.09 mm, whereas the majority, 55.4%, revealed a total adrenal width between 8.97 and 10.99 mm. The foetal zone ratio mostly fell within the range of 0.4–0.49 (57.7%), indicating a relative homogeneity in adrenal gland proportions. Cervical length measurements indicated that the majority of women (68.5%) had cervical lengths ranging from 2.01 to 3 cm. Regarding cervical preparedness, more than half of the subjects (55.4%) exhibited a Bishop score ranging from 5 to 6, indicating conducive circumstances for labour induction. The induction-to-active-labor interval was predominantly noted between 4.1–6 hours (30%), and the induction-to-delivery period typically ranged from 10.1–13 hours (30%), indicating a usually progressive labour pattern. The major method of birth was vaginal delivery at 63.1%, followed by caesarean section at 36.2%, while instrumental delivery was negligible at 0.8%. The statistics indicate a mostly term population with advantageous cervical and labour attributes, leading to an increased incidence of vaginal births.



4.2 Descriptive Statistics

'Table 3 Descriptive Statistics'

Variables	Mean	Std. Deviation
Maternal age	3.269	1.32822
Gestational age	3.13	1.41634
Fetal Zone Length mm	2.907	1.34364
Total Adrenal Length mm	3.561	1.48378
Fetal Zone Width mm	2.146	0.81755
Total Adrenal Width mm	2.561	0.8353
Fetal Zone Ratio	1.869	0.63963
Cervical Length cm	2.03	0.65814
Bishop Score	2.369	0.77897
Induction to Active Labour hrs	3.046	1.55947
Induction to Delivery hrs	2.861	1.18619
Mode of Delivery	2.269	0.96278

The descriptive statistics of the study variables reveal considerable heterogeneity across maternal, foetal, and labour-related factors. With an average mother's age of and a standard deviation of 1.33 3.27, most participants fell into the middle age bracket, while there was considerable fluctuation across the other age groups. The majority of pregnancies occurred around the time of full gestation, as shown by the relatively constant gestational age (mean 3.13, standard deviation 1.42). Foetal adrenal measurements indicated mean values of 2.91 (SD = 1.34) for foetal zone length and 3.56 (SD = 1.48) for overall adrenal length, demonstrating significant variability in adrenal gland size among the foetuses. The mean values for foetal zone width and total adrenal width were 2.15 (SD = 0.82) and 2.56 (SD = 0.84), respectively, indicating a smaller variability compared to length measures. The mean foetal zone ratio is 1.87 and the standard deviation is 0.64. adrenal glands showed a rather constant proportional connection across the sample. The mean cervical length was 2.03 (SD = 0.66), indicating substantial variability in measurements at the time of evaluation. The relatively stable cervical features were indicated by a mean Bishop score of 2.37 as well as a standard deviation of 0.78. Labour progression indicators indicated that the mean length from induction to active labour was 3.05 (SD = 1.56), but the mean period from induction to delivery was 2.86 (SD = 1.19), suggesting diversity in labour duration across participants. The standard deviation of the delivery method was 0.96 and the mean was 2.27, reflecting diversity in delivery outcomes, however vaginal birth persisted as the predominate method. These results indicate balanced distributions with modest variability among essential obstetric and foetal factors in this study population.

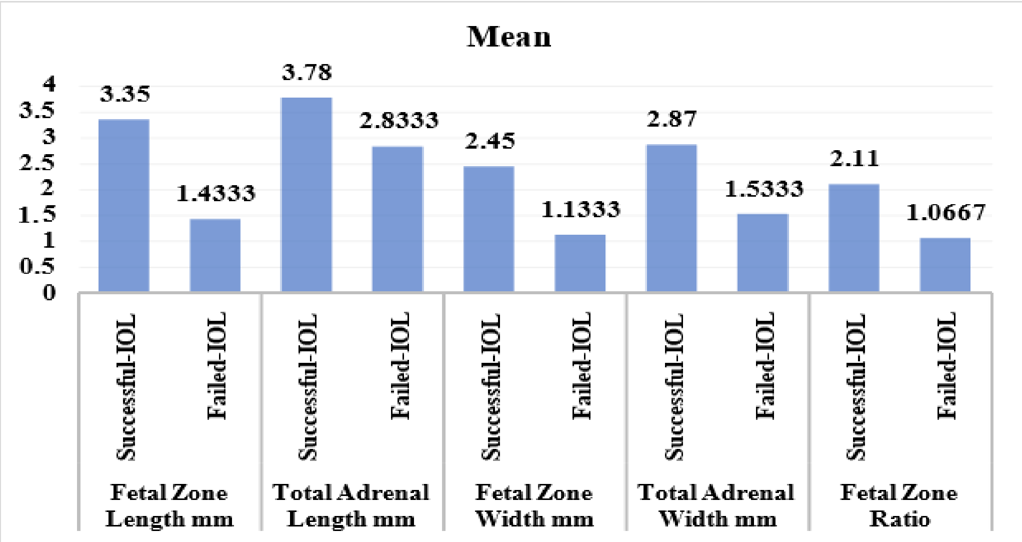
Comparison of Fetal Zone 'Length mm, Total Adrenal Length mm, Fetal Zone Width mm, Total Adrenal Width mm, Fetal' Zone Ratio in Successful and Failed Induction Groups

'Table 4 Group Statistics'

Constructs	Group	N	Mean	Std. Deviation	Std. Error Mean
Fetal Zone Length mm	Successful-IOL	100	3.3500	1.18386	.11839
	Failed-IOL	30	1.4333	.56832	.10376
Total Adrenal Length mm	Successful-IOL	100	3.7800	1.44656	.14466

	Failed-IOL	30	2.8333	1.39168	.25409
Fetal Zone Width mm	Successful-IOL	100	2.4500	.65713	.06571
	Failed-IOL	30	1.1333	.34575	.06312
Total Adrenal Width mm	Successful-IOL	100	2.8700	.59722	.05972
	Failed-IOL	30	1.5333	.68145	.12441
Fetal Zone Ratio	Successful-IOL	100	2.1100	.51040	.05104
	Failed-IOL	30	1.0667	.25371	.04632

The comparison of fetal adrenal gland characteristics between the successful induction of labour (IOL) and failed IOL groups reveals distinct and persistent differences across all assessed variables. A greater average foetal zone length was seen in the group that successfully underwent induction of labour (Mean = 3.35, SD = 1.18) compared to the group that failed (Mean = 1.43, SD = 0.57), indicating that the foetal zone grew more effectively in the former case. After implantation of the IOL, the total adrenal length was longer in the group that succeeded (Mean = 3.78, SD = 1.45) than in the group that failed (Mean = 2.83, SD = 1.39). The results of the width measurements showed similar trends; the group that had successful IOLs had much wider foetal zones '(Mean = 2.45, SD = 0.66) and total adrenals (Mean = 2.87, SD = 0.60) than the group that had failed IOLs (Mean = 1.13, SD = 0.35 and Mean = 1.53, SD = 0.68, respectively)'. The foetal zone ratio was significantly elevated in women with successful induction (Mean = 2.11, SD = 0.51) relative to those with unsuccessful induction (Mean = 1.07, SD = 0.25), suggesting that in successful cases, the foetal zone contributes more proportionally to overall adrenal development. The data suggest that increased foetal adrenal dimensions and elevated foetal zone ratios correlate with effective labour induction, underscoring the potential significance of fetal adrenal maturation in forecasting induction results.



'Table 5 Independent Samples Test'

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Differenc e
Fetal Zone Length mm	'Equal variances assumed'	26.154	0.000(<0.01)	12.175	102.677	0.000(<0.01)	1.91667
Total Adrena l Length mm	Equal variances assumed	0.001	0.971(>0.05)	3.171	128	0.002(<0.01)	0.94667
Fetal Zone Width mm	Equal variances assumed	32.763	0.000(<0.01)	14.450	93.683	0.000(<0.01)	1.31667
Total Adrena l Width mm	Equal variances assumed	5.473	0.021(<0.05)	9.686	43.232	0.000(<0.01)	1.33667
Fetal Zone Ratio	Equal variances assumed	8.567	0.004(<0.001)	15.137	99.293	0.000(<0.01)	1.04333

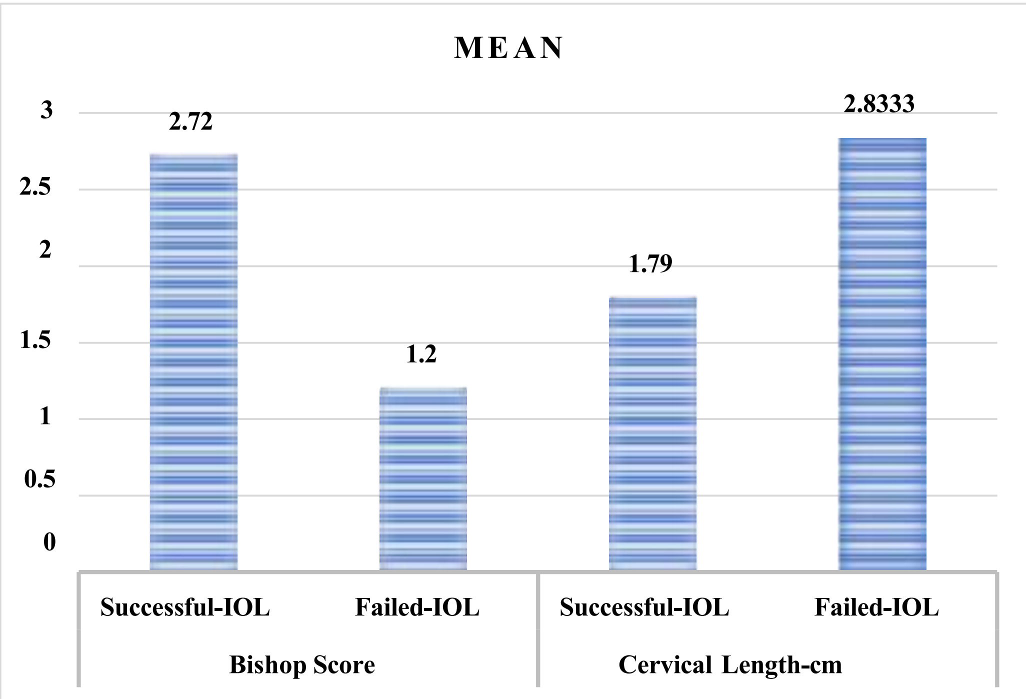
Using a t-test for independent samples, we compared the features of the adrenal glands in the developing foetus in the groups that had successful and failed induction. The findings showed statistically significant disparities across all assessed factors. Levene's test demonstrated unequal variability in fetal zone length between groups ($F = 26.154$, $p < 0.001$); having said that, the t-test revealed a rather notable disparity in average values between the two categories (t = 12.175, p < 0.001), the foetal zone length was higher in the group that successfully underwent induction, as shown by a mean difference of 1.92 mm. Likewise, a statistically significant variation was also found in overall adrenal length (t = 3.171, p = 0.002), with a mean difference of 0.95 mm, suggesting that longer adrenals were associated with better induction outcomes. There was a notable variation in the foetal zone width among the groups, with an average difference of 1.32 mm (t = 14.450, p < 0.001), underscoring its robust discriminating capacity between successful and unsuccessful inductions. This study further supports the association between larger adrenal dimensions and effective induction. The overall adrenal width showed a statistically significant difference with a mean difference of 1.34 mm (t = 9.686, p > 0.001). The groups showed a very significant variation in the foetal zone ratio (t = 15.137, p < 0.001), with an average difference of 1.04, showing that the proportionate expansion of the fetal zone was much bigger in the successful induction group. Results show that foetal zone ratio and foetal adrenal gland measurements are strongly associated with induction results, suggesting that these parameters can be useful for predicting whether or not an induction attempt will be successful.

'Estimation and Comparison of Bishop's score and Cervical Length'-cm

'Table 6 Group Statistics'

Construct	Group	N	Mean	Std. Deviation	Std. Error Mean
Bishop Score	Successful-IOL	100	2.7200	.45126	.04513
	Failed-IOL	30	1.2000	.40684	.07428
Cervical Length-cm	Successful-IOL	100	1.7900	.40936	.04094
	Failed-IOL	30	2.8333	.69893	.12761

Group results comparing cervical favourability and Bishop's score between those whose induction attempts were successful and those whose attempts were unsuccessful show statistically significant differences. The average Bishop's score was much higher in the group that successfully underwent induction of labour (IOL) (mean = 2.72, SD = 0.45) in comparison to the failed IOL group (mean = 1.20, SD = 0.41), suggesting that women with successful induction had more advantageous cervical characteristics at baseline. In contrast, cervical length had an inverse correlation, with the successful IOL group presenting a lower mean cervical length (mean = 1.79 cm, SD = 0.41) compared to the failed IOL group (mean = 2.83 cm, SD = 0.70). The comparatively low standard errors in both groups indicate reliable mean estimations. These data indicate that an elevated Bishop's score and reduced cervical length are significantly correlated with effective labour induction, underscoring their clinical importance as indicators of induction results.



'Table 7 Independent Samples Test'

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Bishop Score	'Equal variances assumed'	3.631	0.059(>0.05)	17.489	52.272	0.000(<0.01)	1.52000

Cervical Length-cm	Equal variances assumed	14.100	0.000(<0.01)	-7.785	35.167	0.000(<0.01)	-1.04333

The cervical length and Bishop's score of the study groups were compared using an independent samples t-test. The premise of equal variances is validated by Levene's test for Bishop's score, which proved homogeneity of variances ($F = 3.631$, $p = 0.059 > 0.05$). The t-test findings demonstrated a statistically significant difference across the groups, with a mean difference of 1.52. ($t = 17.489$, $p < 0.01$), demonstrating that the successful induction group had a markedly higher Bishop's score than the unsuccessful induction group. This discovery highlights the significance of cervical favourability, as indicated by the Bishop's score, in forecasting induction results. Cervical length exhibited substantial variance inequality ($F = 14.100$, $p < 0.01$); Regardless, a remarkable disparity between the groups was shown by The results of the t-test showed a significant difference of -1.04 cm ($t = -7.785$, $p < 0.01$). The cervical length of the successful group was noticeably shorter after induction compared to the one that failed, as shown by the negative mean difference. Consistent with these findings, a shorter cervical length and an increased Bishop's score are strongly associated with successful induction of labour, underscoring their clinical importance as dependable predictors of induction outcomes.

Comparison of Induction to Active Labour hrs, Induction to Delivery hrs, Mode of Delivery for Induction of Labour

'Table 8 Group Statistics'

Constructs	**Induction of Labour**	**N**	**Mean**	**Std.Deviation**	**Std. Error Mean**
Induction to Active Labour hrs	Successful-IOL	100	2.37	1.02154	0.10215
	Failed-IOL	30	5.3	0.65126	0.1189
Induction to Delivery hrs	Successful-IOL	100	2.47	0.96875	0.09688
	Failed-IOL	30	4.1667	0.87428	0.15962
Mode of Delivery	Successful-IOL	100	2.65	0.75712	0.07571
	Failed-IOL	30	1	0	0

The group statistics comparing labour outcomes between the successful and failed induction of labour (IOL) groups demonstrate distinct and clinically significant differences. The average time from The successful induction of labour (IOL) group had a considerably lower induction to active labour (Mean = 2.37 hours), SD = 1.02) compared to the failed IOL group (Mean = 5.30 hours, SD = 0.65), suggesting that women with effective induction advanced to active labour more swiftly. The group who had effective IOLs had a much shorter induction-to-delivery duration (Mean = 2.47 hours, SD = 0.97) compared to the failed induction group (Mean = 4.17 hours, SD = 0.87), indicating more efficient labour progression and prompt delivery after successful induction. Concerning the mode of delivery, the successful IOL group displayed a higher mean score (Mean = 2.65, SD = 0.76), indicating a predominance of vaginal deliveries, while the failed IOL group exhibited a mean of 1.00 with no variability, suggesting uniform delivery outcomes, likely associated with caesarean sections. These data indicate that effective induction of labour associated with reduced labour durations and improved delivery outcomes, highlighting the significance of variables that enhance induction effectiveness in optimising maternal and neonatal results.

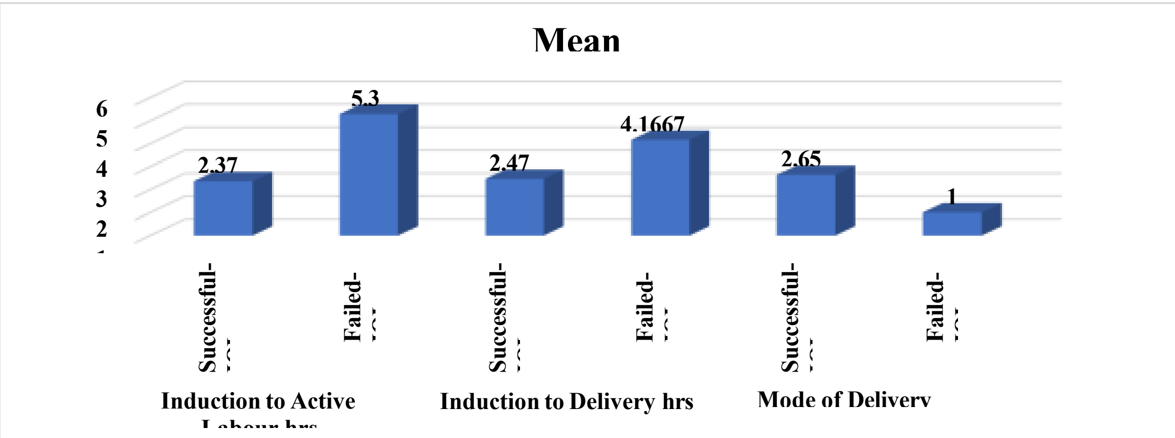


Table 9 Independent Samples Test'

		Levene's Test for Equality of Variances		**t-test for Equality of Means**			
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**
Induction to Active Labourhrs	Equal variances assumed	8.652	0.004(<0.01)	-18.691	75.552	0.000(<0.01)	-2.93000

Induction to Delivery hrs	Equal variances assumed	6.924	0.010(<0.01)	-9.087	52.223	0.000(<0.01)	-1.69667
Mode of Delivery	Equal variances assumed	40.888	0.000(<0.01)	21.793	99.000	0.000(<0.01)	1.65000

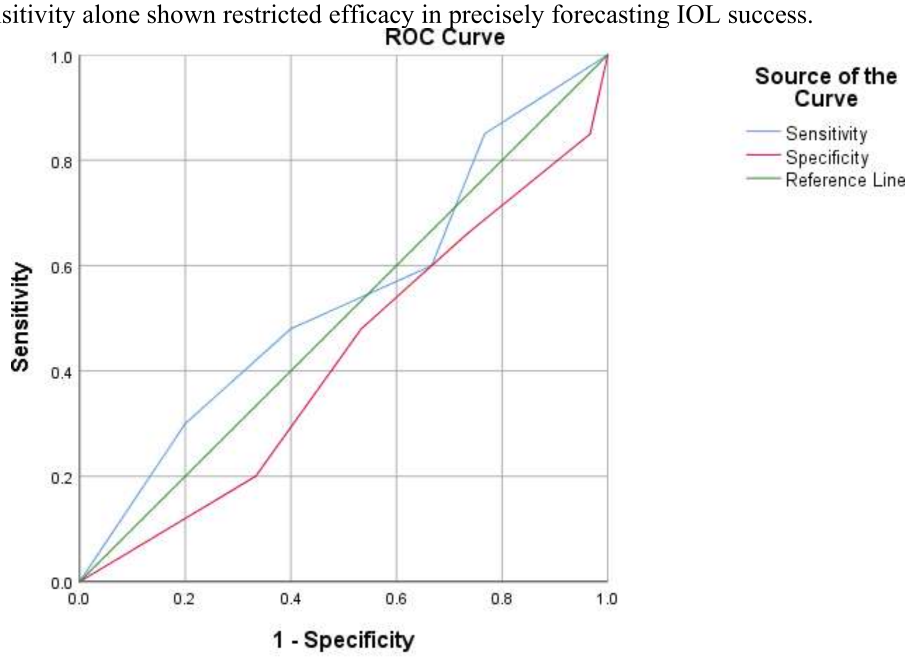
To compare the two groups' labour progress and delivery outcomes after an induction that worked and one that didn't, researchers used an t-test for independent samples. Levene's test examines induction to active work showed uneven variances ($F = 8.652$, $p < 0.01$), A statistically significant difference was shown by the t-test between the categories., with an average difference of -2.93 hours ($t = -18.691$, $p < 0.01$). This signifies that individuals in the successful induction cohort attained active labour more rapidly than those in the unsuccessful induction cohort. The time from induction to delivery exhibited considerable variation ($F = 6.924$, $p < 0.01$), and there were significant differences in the means of −1.70 hours ($t = -9.087$, $p < 0.01$), indicating that the total labour length was reduced in the successful induction group relative to the unsuccessful group. Concerning the mode of delivery, the uneven variances were confirmed The results of Levene's test ($F = 40.888$, $p < 0.01$) and the t-test ($t = 21.793$, $p < 0.01$) both demonstrated a very significant difference, with a mean difference of 1.65, suggesting a higher occurrence of vaginal deliveries in the successful induction group relative to caesarean or instrumental deliveries. These findings indicate that reduced induction-to-labor intervals, abbreviated total labour duration, and advantageous delivery methods are significantly correlated with successful labour induction, underscoring the clinical significance of tracking labour progression indicators in forecasting induction results.

'Receiver-Operating Characteristic (ROC) Curve for the prediction of successful' and failed induction of labour groups

'Table 10 Area Under the Curve'

Test Result Variable(s)	Area	Std. Error	Asymptotic Sig.	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Sensitivity	.540	.059	.504	.425	.656
Specificity	.422	.059	.198	.307	.538
'The test result variable(s): Sensitivity, Specificity has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.					
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5'					

To determine if sensitivity was a reliable indicator of whether the induction of labour was effective or not. outcomes, ROC analysis was used. The calculated AUC was 0.540 and the corresponding standard error was 0.059, suggesting a somewhat superior discrimination compared to chance. The asymptotic significance was 0.504, and the 95% confidence interval spanned from 0.425 to 0.656, indicating that the predictive capacity of sensitivity is not statistically significant. The study revealed at least one connection between the good and bad result groups, perhaps introducing some bias in the data. Overall, sensitivity alone shown restricted efficacy in precisely forecasting IOL success.



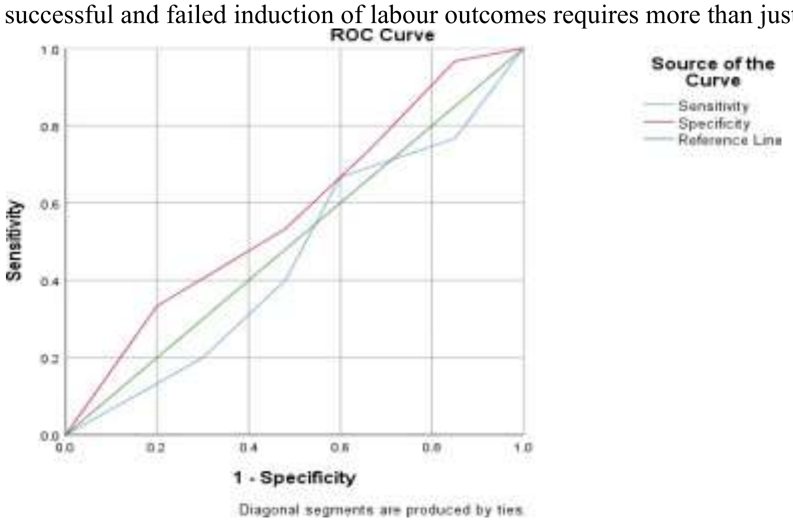
Diagonal segments are produced by ties.

Table 11 'Area Under the Curve'

Test Result Variable(s)	Area	Std. Error	Asymptotic Sig.	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Sensitivity	.460	.059	.504	.344	.575

Specificity	.578	.059	.198	.462	.693
‘The test result variable(s): Sensitivity, Specificity has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.					
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5’					

Using specificity as a predictor of successful as well as failed IOL, the ROC analysis yielded AUC = 0.460 with a corresponding standard error of 0.059. IOL, indicating a discriminatory capacity inferior to random chance. The asymptotic significance was 0.504, and the 95% confidence interval spanned from 0.344 to 0.575, indicating a lack of statistically significant predictive capacity. The results showed that there was at least one equal and opposite end of the spectrum outcome groups, which might have influenced the results (similar to sensitivity). The results show that distinguishing between successful and failed induction of labour outcomes requires more than just specificity.



5. DISCUSSION, SUMMARY AND CONCLUSION

5.1 DISCUSSION

Using established clinical components, including transvaginal cervical length and Bishop score, sought to determine whether foetal zone ratio (FZR), an ultrasonographic foetal adrenal gland measurement was a better predictor of the success of labour induction (IOL) in primigravida women. This study's results provide significant insights into the physiological and clinical factors influencing effective labour induction.

The demographic profile of the research population indicates a largely young, term primigravida group, with the majority of women aged 23 to 25 years and at gestational ages exceeding 40 weeks. The uniformity in maternal and gestational traits reduces confounding factors and enhances the validity of the correlations identified between foetal adrenal measures and induction results. The vaginal birth rate of 63.1% suggests that the research cohort was mostly amenable to labour induction. The size of the foetal adrenal glands differs significantly between the groups who were able to induce labour successfully and those that were not, according to this study. The measurements of foetal zone length, foetal zone width, total adrenal length, and total adrenal breadth were considerably greater in the successful induction group. The foetal zone ratio proved to be a significant discriminator, with substantially elevated mean values in women who had effective induction. This substantiates the scientific hypothesis that foetal adrenal maturation is important to the onset of labour. A higher rate of dehydroepiandrosterone sulphate production is associated with an enlarged foetal adrenal foetal zone (DHEAS), which acts as a precursor for placental oestrogen production, thereby facilitating cervical ripening and myometrial contractility. Independent A statistically significant association was also discovered between the development of the adrenal glands in the foetus and the effectiveness of induction. With the largest group-to-group mean difference, foetal zone ratio emerged as a promising ultrasonographic biomarker for IOL outcome prediction. These results align with prior research indicating that foetal endocrine preparedness is a vital factor in both spontaneous and induced labour.

Bishop score and cervical length shown significant correlations with induction success when compared to conventional predictors. Women who had effective induction exhibited markedly elevated Bishop scores and reduced cervical lengths, so confirming the recognised influence of cervical favourability on labour outcomes. These indicators indicate maternal cervical state rather than foetal preparedness. The inclusion of foetal adrenal measures offers a supplementary, fetus-focused prediction method, which may be especially beneficial in instances when the Bishop score is negative. Analysis of labour outcomes indicated that effective induction correlated with markedly reduced intervals from induction to active labour and from induction to delivery, together with an increased probability of vaginal delivery. These data highlight the therapeutic significance of precise pre-induction predictors, since unsuccessful induction correlates with extended labour, elevated surgical delivery rates, and greater mother morbidity. ROC curve analysis demonstrated little predictive value when sensitivity and specificity were evaluated separately, with AUC values of 0.5. This implies that sensitivity or specificity in isolation may not serve as adequate measures of induction success. This does not undermine the importance of foetal adrenal measures; instead, it underscores the need for composite prediction models that amalgamate foetal adrenal data with cervical and clinical markers to enhance diagnostic precision. Findings suggest that foetal adrenal gland measurements, especially the foetal zone ratio, have a high correlation with successful labour induction and could be a useful adjunct to more conventional forms of assessment[21].

[31] The study indicates that foetal adrenal gland measurements obtained by prenatal ultrasonography serve as an effective non-invasive technique for forecasting preterm delivery. This prospective research analysed 250 pregnant women, of whom 35 delivered preterm and 215 delivered at term. The results unequivocally demonstrate that characteristics of the adrenal gland in utero, namely the foetal zone depth ratio, foetal zone width ratio, and adjusted foetal adrenal gland volume, were elevated in women who had preterm delivery. This corroborates the biological hypothesis that the hypothalamic-pituitary-adrenal axis activation throughout foetal development and heightened steroidogenic activity of the foetal adrenal zone facilitate the initiation of labour. The foetal adrenal depth ratio had the highest predictive value among all assessed metrics, demonstrating exceptional sensitivity as well as specificity followed by the width ratio and adjusted amount of adrenal glands formed in the womb. The adrenal length ratio of the foetus did not have substantial predictive value, indicating that increases in depth and breadth are superior to length measures as predictors of impending premature delivery. The ROC analysis further substantiates that these ultrasound-derived measures provide good diagnostic accuracy, particularly FAZD/FAGD, which attained the highest AUC value. The research emphasises that regular third-trimester ultrasonographic assessment of foetal adrenal gland enlargement may identify women at increased risk of preterm delivery, allowing prompt monitoring, counselling, and therapeutic intervention to mitigate unfavourable maternal and newborn outcomes. [32]foetal adrenal gland biometry serves as an effective ultrasonography marker for forecasting preterm delivery. Women who had preterm delivery exhibited much greater corrected foetal adrenal gland volume, foetal zone depth, and foetal zone enlargement in contrast to those who had birth on schedule. The modified adrenal gland volume exhibited the most robust predictive capability, with elevated sensitivity and specificity, hence making it more dependable than foetal zone expansion alone. These results endorse the significance of foetal adrenal activity in early labour and propose that evaluating the foetal adrenal gland may serve as a straightforward, non-invasive, and economical screening method, particularly for women presenting late in gestation.[33]ultrasonography characteristics of the foetal adrenal gland differ significantly in pregnancies that are affected by foetal growth restriction. Foetuses with a smaller foetal zone and reduced adrenal gland capacity were associated with foetal growth restriction width, while the middle adrenal artery pulsatility index was elevated, indicating modified adrenal shape and increased vascular resistance attributable to placental insufficiency. These results suggest the prospective use of foetal adrenal assessment as a supplementary ultrasonography indicator in the evaluation of FGR. Nevertheless, due to the study's limited single-center case–control design as well as the use of size-adjusted adrenal measurements in lieu of absolute ones,the findings should be regarded as preliminary and need confirmation before to widespread clinical application.[34] ultrasonography assessment of the foetal adrenal gland was ineffective in predicting spontaneous preterm delivery in asymptomatic nulliparous women. While earlier research indicated that adrenal hypertrophy might forecast impending preterm birth in symptomatic women, this extensive multicentre investigation revealed no substantial disparity in foetal adrenal gland ratios between subjects who gave birth before their due date and those who gave birth on time. The subpar ROC findings further indicate inadequate prediction accuracy. Consequently, foetal adrenal gland biometry may serve as a more effective short-term indicator close to birth rather than as an early screening method in low-risk, asymptomatic pregnancies.

5.2 SUMMARY

The present study offers a thorough assessment of the significance of ultrasonographic foetal adrenal gland measurement as a prognostic instrument for the efficacy of term first-time mothers undergoing induction of labour (IOL). The onset of labour is contingent not only on maternal cervical preparedness but also heavily impacted by foetal physiological and endocrine maturity, especially the opening of the hypothalamic-pituitary-adrenal (HPA) axis in the developing foetus. In a developing adrenal gland, particularly the foetal zone, is essential for the production of dehydroepiandrosterone sulphate (DHEAS) and cortisol, which facilitate placental oestrogen synthesis, prostaglandin release, and the ensuing cervical ripening and uterine contractions. Consequently, assessing the size the adrenal gland throughout foetal development, particularly in the foetal zone ratio (FZR) provides an innovative, objective, and non-invasive indicator of foetal preparedness for labour.

The study used a hospital-based cross-sectional analytical design, including 130 primigravida women at 40 weeks of gestation who are having labour induction. Participants underwent ultrasound to evaluate foetal adrenal characteristics, including foetal zone length, breadth, and ratio, in conjunction with conventional predictors such as the bishop score and transvaginal cervical length. The traits in question were then linked with labour outcomes, including the period from induction to active labour, the time it takes to get from conception to birth, and the method of delivery. Statistical methods, including independent t-tests and ROC curve assessment, were used to ascertain predictive accuracy.

The results indicate that women who had effective induction exhibited markedly elevated foetal adrenal gland measures, especially FZR, in conjunction with advantageous Bishop scores and reduced cervical lengths. These women had reduced durations from induction to active labour and delivery, together with an increased probability of vaginal delivery compared to those experiencing unsuccessful induction. Despite ROC analysis indicating poor independent predictive capability of foetal adrenal markers, their robust connection with effective labour outcomes underscores their therapeutic significance when used with conventional approaches. The dissertation finds that ultrasonographic evaluation of the adrenal glands in the foetus, especially the ratio of the foetal zone, may be a significant complement to traditional predictors in determining the probability of effective labour induction. Integrating this measure into standard obstetric assessments may increase predictive accuracy, enable prompt and personalised treatment choices, decrease the rates of unsuccessful inductions and unwarranted caesarean sections, and ultimately better mother and newborn outcomes.

5.3 CONCLUSION

Findings show a strong correlation between the efficacy of labour induction in first-time mothers and ultrasonographic evaluation of dimensions of the adrenal glands in the developing foetus, specifically the ratio of the foetal zone to the total foetal diameter. Babies whose induction was successful had bigger adrenals and higher foetal zone ratios frequently seen, reinforcing the notion that fetal endocrine maturity is crucial for the onset of labour. Foetal adrenal measurements improve cervical assessment in mothers by providing an objective, non-invasive, and fetus-centered metric in contrast to traditional predictions such as the bishop degree and the length of the cervical spine as measured transvaginally. The induction success rate is related to the bishop score and cervical length, which are strong markers. However, in borderline or unfavourable cervical conditions, the foetal zone ratio might be a useful additional prognostic indication. Accurate pre-induction evaluation is therapeutically significant since a successful induction was associated with shorter labour and more vaginal deliveries. Despite the low discriminating ability of ROC analysis focussing just on sensitivity and specificity, the overall results indicate that foetal adrenal characteristics should be evaluated within a comprehensive multidimensional framework rather than in isolation. In conclusion, foetal adrenal gland ultrasonography serves as a promising instrument for forecasting the results of labour induction. Integrating foetal zone ratio assessment into standard pre-induction evaluations may enhance patient selection, decrease unsuccessful inductions, and improve maternal and newborn outcomes. Additional extensive, multicentric investigations are advised to determine standardised cut-off values and to confirm the clinical relevance of foetal adrenal measures in obstetric practice.

5.4 LIMITATIONS

1. Ultrasound evaluation of the developing adrenal gland in a foetus is highly operator dependent. Differences in proficiency, methodology, probe placement, and interpretation may affect measurement precision and consistency.
2. Accurate visualisation of the foetal adrenal gland may be impeded by variables such maternal obesity, suboptimal foetal positioning, oligohydramnios, or advanced gestational age, which may result in measurement inaccuracies or data omissions.
3. The study, done at a singular tertiary care facility, may exhibit restricted generalisability to alternative populations, healthcare environments, or geographies with varying demographic and clinical attributes.
4. Despite being statistically acceptable, the sample size may be insufficient to include all changes in foetal adrenal gland size and its correlation with induction results, hence limiting the ability to identify lower effect sizes.
5. The cross-sectional methodology limits the study of temporal variations in foetal adrenal gland size and precludes the assessment of causal links between adrenal gland measures and the efficacy of labour induction.
6. Factors include maternal age, body mass index, cervical status, use of various induction drugs, foetal weight, and placental function may affect induction results and cannot be entirely regulated.
7. The investigation depends on a solitary ultrasonographic measurement instead of sequential evaluations, perhaps constraining the comprehension of dynamic alterations in foetal adrenal gland development before labour.
8. The therapeutic use of foetal adrenal gland size in predicting the efficacy of labour induction is hindered by the absence of a universally accepted reference range or cut-off value.
9. The inclusion of just primigravida women at term restricts the applicability of findings to multigravida women, term inductions, or high-risk pregnancies.
10. The efficacy of induction may be influenced by physician judgement, timing of intervention, and hospital procedures, thus introducing bias in outcome evaluation.

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ANNEXURES

PARTICIPANT INFORMATION SHEET

You are requested to participate in the scientific study titled “**THE ROLE OF ULTRASONOGRAPHIC MEASUREMENT OF FETAL ADRENAL GLAND SIZE FOR THE PREDICTION OF SUCCESS OF INDUCTION OF LABOUR AMONG PRIMIGRAVIDA** ”. The study is done to predict the success of induction of labour using the fetal adrenal gland size as a predictor of induction of labour .we will do the ultrasonography to measure the fetal adrenasl gland size & cervical length at term before the induction of labour .and observe the outcome. The information shared by you is completely confidential and any access we might have to your information can be used only for scientific purposes without your identity being revealed. In no point in the study your identification details or individual details will be shared with third parties, disseminated or published in any manner. You are also free to withdraw from the study or the confidentiality of your data. If you are convinced after reading all this information, kindly give your consent in the form below to participate in the study.

பங்கேற்பாளர் தகவல் தாள்

"முதல் கர்ப்பிணிப் பெண்கள் மத்தியில் பிரசவத் தூண்டுதலின் வெற்றியை முன்னறிவிப்பதற்காக, கருவின் அட்ரீனல் சுரப்பி அளவை அல்ட்ராசோனோகிராஃபி அளவீட்டின் பங்கு" என்ற தலைப்பிலான அறிவியல் ஆய்வில் பங்கேற்குமாறு கேட்டுக் கொள்ளப்படுகிறீர்கள்.

ஒரு குறிப்பானாக, உழைப்பைத் தூண்டுவதற்கு முன் நாங்கள் அல்ட்ராசோனோகிராஃப் பரிசோதனையைச் செய்வோம் மற்றும் நீங்கள் பகிர்ந்துள்ள தகவல்களைக் கவனிப்போம்.நீங்கள் பகிரும் அணைத்து தகவல்களும் ரகசியமாக வைக்கப்படும். இந்த தகவல்களை அறிவியல் நோக்கங்களுக்காக மட்டுமே உபயோக படுத்த படும். எந்த சமயத்திலும் உங்கள் அடையாளம் வெளியிட படாது. அறிவியல் நோக்கங்களுக்காக உங்கள் நேர்காணல்கள் ஆடியோ பதிவு செய்ய படும். இந்த நேர்காணல்களில் உங்கள் வயது, தொழில், கல்வி நிலை, பொருளாதார நிலை, குடும்ப விவரங்கள் போன்ற பொதுவான தகவல்களை கேட்போம். எந்த நேரத்திலும் உங்களுக்கு இந்த ஆராய்ச்சியிலிருந்து விலகிக்கொள்ளவேண்டும் என்று நினைத்தால் எந்த விளைவுகளும் இல்லாமல் விலகி கொள்ளலாம். இந்த ஆய்வில் தங்களுக்கு ஏற்படும் எவ்விதமான சந்தேகங்களையும் எங்கள் ஆராய்ச்சி குழுவினர் தெளிவு செய்வர். நீங்கள் இந்த தகவல் தாளை படித்து, புரிந்து இந்த ஆய்வில் பங்கேற்க வேண்டும் என்று முடிவெடுத்தால் கீழ்கண்ட ஒப்புதல் தாளில் கையொப்பம் இடவும்

CERTIFICATE OF CONSENT

Title of the project: THE ROLE OF ULTRASONOGRAPHIC MEASUREMENT OF FETAL ADRENAL GLAND SIZE FOR THE PREDICTION OF SUCCESS OF INDUCTION OF LABOUR AMONG PRIMIGRAVIDA .

Name Age

Sex

The details of the study have been provided to me in writing and explained to me in my own language.

I confirm that I have understood the above study and had the opportunity to ask questions.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

I have been given an information sheet giving details of the study. I fully consent to participate in the above study

Signature of participant Signature of Investigator

THE ROLE OF ULTRASONOGRAPHIC MEASUREMENT OF FETAL ADRENAL GLAND SIZE FOR THE PREDICTION OF SUCCESS OF INDUCTION OF LABOUR AMONG PRIMIGRAVIDA .

பங்கேற்பவரின் பெயர்:
பங்கேற்பவரின் வயது:
பங்கேற்பவரின் எண்:

மேலே குறிப்பிடப்பட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டுள்ளன. நான் இவ்வாய்வில் தன்னிச்சையாக பங்கேற்கிறேன். எந்த காரணத்தினாலோ அல்லது எந்த சட்டச் சிக்கல்களுக்கும் உட்படாமல், நான் இவ்வாய்விலிருந்து விலகிக்கொள்ளலாம் என்பதையும் அறிந்துகொண்டேன்.

இந்த ஆய்வு தொடர்பாகவோ அல்லது இதனைச் சார்ந்து மேற்கொள்ளப்படும் மேலதிக ஆய்வுகளுக்காகவோ, இவ்வாய்வில் பங்கேற்கும் மருத்துவர் எனது மருத்துவ அறிக்கைகளைப் பார்ப்பதற்கு தனியான அனுமதி தேவையில்லை என்பதை அறிந்துகொள்கிறேன். இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையோ முடிவுகளையோ பயன்படுத்துவதற்கு நான் மறுப்பில்லை.

இவ்வாய்வில் பங்கேற்க நான் ஒப்புக்கொள்கிறேன். மேலும், இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணியுடன் உண்மையுடன் ஒத்துழைப்பேன் என்றும் உறுதியளிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம்:

இடம்:
தேதி:

பங்கேற்பவரின்/ஆய்வாளரின் கையொப்பம்:

ஆய்வாளரின் கையொப்பம்

STUDY PROFORMA

THE ROLE OF ULTRASONOGRAPHIC MEASUREMENT OF FETAL ADRENAL GLAND SIZE FOR THE PREDICTION OF SUCCESS OF INDUCTION OF LABOUR AMONG PRIMIGRAVIDA

1. Name-
2. Age-
3. Op no-Height % Weight
4. Address-
5. Socioeconomicstatus-
6. Menstrual history- -

Regularity of cycle- If irregular explain- LMP-

7. Marital history (if applicable)- Married since- years Consanguinity-
8. Obstetric history(if applicable)- Parity-History of abortion
9. Presenting complaint-
10. History of Anaemia, preeclampsia, prolonged immobility, dehydration, hyperemesis, multiple pregnancy
11. Other Past history-

h/o TB/ epilepsy/bronchial asthma/drug intake, prolonged surgery

12. Treatment history-
13. Allergy history-EXAMINATION:

1. Height
2. Weight

3. BMI
4. Blood pressure

INVESTIGATIONS

1. Ultrasonography for measuring fetal adrenal gland size , cervical length .
2. Complete Blood count including Haemoglobin , Platelet count and Coagulation profile.

INFORMED CONSENT

I, Mrs.………………………………………… Age of...w/o
……………………………… from ………………………………….
………………………………………………………………………………….
Hereby give my informed consent to participate, as a subject, in the research work being carried out as described under.

Research work:

ROLE OF ULTRASONOGRAPHIC MEASUREMENT OF FETAL ADRENAL GLAND SIZE FOR THE PREDICTION OF SUCCESS OF INDUCTION OF LABOUR AMONG PRIMIGRAVIDA.

It has been explained to me that this study will involve the collection of data from antenatal women attending the Obstetrics and Gynaecology outpatient department at Sree Balaji Medical College and Hospital for delivery, and that I will not incur any expenses related to participation in this study.

Study conducted by:

DR.P.S.POOJITHA, Junior Resident, Dept of OBG SBMCH

Guided by:

DR. MEENA T.S, Professor and HOD, Dept of OBG SBMCH

Co- Guided by :

DR. RESHMI, Assistant Professor , Dept of OBG SBMCH

I have been fully informed, in the language I understand, regarding my role in this research work in detail. I agree to give my consent to participate in the above mentioned research work.

Subject:

Witness No: 1 Signature :

Witness No: 2 Signature :

Name and signature of investigator with date :

DR.PS POOJITHA

1ST YEAR POST GRADUATE

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EMAIL ID : meenats@gmail.com

Name and signature of HOD with date :

MASTER CHART

Induction of Labour	Maternal age	Gestational age	Fetal Zone Length mm	Total Adrenal Length mm	Fetal Zone Width mm	Total Adrenal Width mm	Fetal Zone Ratio	Cervical Length cm	Bishop Score	Induction to Active Labour hrs	Induction to Delivery hrs	Mode of Delivery	Sensitivity	Specificity
1.00	5.00	3.00	3.00	5.00	3.00	4.00	2.00	2.00	3.00	2.00	3.00	1.00	5.00	5.00
1.00	4.00	1.00	5.00	5.00	2.00	4.00	2.00	2.00	2.00	4.00	2.00	3.00	3.00	4.00
1.00	1.00	1.00	2.00	3.00	3.00	3.00	2.00	2.00	3.00	2.00	1.00	1.00	5.00	1.00
1.00	3.00	4.00	4.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	2.00	3.00	2.00	2.00
1.00	4.00	3.00	2.00	3.00	2.00	4.00	2.00	2.00	3.00	2.00	3.00	3.00	4.00	1.00
1.00	2.00	2.00	1.00	4.00	3.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	5.00	2.00
1.00	3.00	2.00	5.00	6.00	3.00	3.00	3.00	2.00	3.00	2.00	1.00	3.00	3.00	5.00
1.00	3.00	4.00	3.00	4.00	2.00	3.00	3.00	1.00	3.00	3.00	4.00	3.00	2.00	2.00
1.00	3.00	4.00	2.00	4.00	2.00	3.00	2.00	1.00	3.00	1.00	2.00	3.00	2.00	2.00
1.00	3.00	2.00	2.00	1.00	2.00	3.00	2.00	1.00	2.00	1.00	1.00	3.00	2.00	4.00
1.00	4.00	3.00	3.00	6.00	2.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	5.00	2.00
1.00	5.00	2.00	5.00	2.00	2.00	3.00	2.00	1.00	3.00	3.00	4.00	3.00	4.00	5.00
1.00	2.00	6.00	4.00	6.00	1.00	3.00	2.00	2.00	3.00	3.00	3.00	1.00	5.00	4.00
1.00	5.00	2.00	3.00	3.00	4.00	3.00	3.00	2.00	3.00	3.00	2.00	3.00	5.00	3.00
1.00	3.00	2.00	2.00	5.00	2.00	3.00	2.00	2.00	3.00	1.00	4.00	3.00	3.00	2.00
1.00	4.00	2.00	3.00	5.00	2.00	3.00	2.00	1.00	3.00	1.00	3.00	3.00	1.00	4.00
1.00	1.00	2.00	2.00	4.00	3.00	2.00	2.00	2.00	3.00	2.00	2.00	3.00	4.00	4.00
1.00	3.00	3.00	5.00	4.00	3.00	3.00	3.00	2.00	3.00	4.00	2.00	3.00	2.00	4.00
1.00	5.00	3.00	4.00	2.00	2.00	3.00	3.00	2.00	3.00	1.00	3.00	3.00	4.00	3.00
1.00	2.00	1.00	5.00	4.00	2.00	3.00	3.00	2.00	3.00	3.00	4.00	3.00	2.00	1.00
1.00	1.00	2.00	2.00	5.00	3.00	3.00	2.00	1.00	3.00	2.00	3.00	3.00	1.00	4.00
1.00	1.00	1.00	5.00	4.00	3.00	3.00	3.00	2.00	2.00	3.00	1.00	1.00	2.00	1.00
1.00	3.00	5.00	5.00	2.00	2.00	3.00	1.00	2.00	3.00	1.00	2.00	3.00	2.00	2.00
1.00	6.00	6.00	2.00	6.00	3.00	3.00	2.00	1.00	3.00	1.00	4.00	3.00	5.00	3.00
1.00	5.00	5.00	3.00	2.00	3.00	3.00	2.00	2.00	2.00	2.00	1.00	1.00	5.00	2.00
1.00	5.00	3.00	4.00	4.00	2.00	3.00	2.00	2.00	2.00	4.00	4.00	3.00	4.00	5.00
1.00	3.00	5.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	1.00	3.00	3.00	1.00	1.00
1.00	5.00	3.00	3.00	2.00	3.00	3.00	3.00	2.00	3.00	3.00	2.00	3.00	5.00	2.00
1.00	3.00	6.00	4.00	5.00	3.00	2.00	2.00	1.00	2.00	1.00	3.00	3.00	3.00	2.00
1.00	4.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00	3.00	5.00	2.00

Induction of Labour	Maternal age	Gestational age	Fetal Zone Length mm	Total Adrenal Length mm	Fetal Zone Width mm	Total Adrenal Width mm	Fetal Zone Ratio	Cervical Length cm	Bishop Score	Induction to Active Labour hrs	Induction to Delivery hrs	Mode of Delivery	Sensitivity	Specificity
1.00	3.00	2.00	2.00	1.00	2.00	2.00	3.00	2.00	3.00	2.00	1.00	3.00	1.00	4.00
1.00	2.00	1.00	4.00	3.00	3.00	2.00	3.00	2.00	3.00	2.00	3.00	3.00	4.00	3.00
1.00	3.00	2.00	4.00	5.00	2.00	2.00	2.00	2.00	3.00	2.00	3.00	3.00	4.00	4.00
1.00	2.00	3.00	4.00	2.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	5.00	3.00
1.00	5.00	1.00	3.00	6.00	3.00	3.00	1.00	1.00	3.00	2.00	3.00	3.00	2.00	4.00
1.00	3.00	2.00	4.00	5.00	4.00	3.00	2.00	1.00	3.00	2.00	3.00	3.00	3.00	4.00
1.00	4.00	5.00	3.00	4.00	3.00	2.00	2.00	1.00	3.00	4.00	2.00	3.00	5.00	5.00
1.00	3.00	3.00	2.00	6.00	2.00	3.00	2.00	2.00	3.00	4.00	2.00	3.00	1.00	3.00
1.00	5.00	6.00	2.00	6.00	2.00	3.00	2.00	2.00	3.00	1.00	3.00	3.00	1.00	3.00
1.00	2.00	5.00	5.00	1.00	2.00	3.00	3.00	2.00	3.00	2.00	3.00	3.00	5.00	3.00
1.00	4.00	2.00	1.00	6.00	2.00	3.00	2.00	2.00	3.00	2.00	2.00	3.00	5.00	3.00
1.00	2.00	1.00	4.00	5.00	3.00	3.00	2.00	2.00	3.00	3.00	4.00	3.00	3.00	3.00
1.00	2.00	3.00	2.00	3.00	2.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	1.00	4.00
1.00	2.00	2.00	2.00	5.00	2.00	3.00	3.00	2.00	2.00	2.00	4.00	3.00	3.00	1.00
1.00	2.00	4.00	2.00	4.00	2.00	3.00	2.00	2.00	2.00	1.00	3.00	3.00	5.00	5.00
1.00	3.00	5.00	3.00	3.00	2.00	3.00	3.00	1.00	3.00	2.00	2.00	3.00	5.00	2.00
1.00	3.00	1.00	5.00	6.00	2.00	4.00	2.00	2.00	2.00	2.00	4.00	3.00	2.00	1.00
1.00	3.00	2.00	2.00	4.00	2.00	3.00	3.00	2.00	3.00	4.00	3.00	3.00	5.00	4.00
1.00	4.00	3.00	5.00	6.00	2.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	5.00	1.00
1.00	3.00	5.00	5.00	3.00	2.00	3.00	2.00	2.00	2.00	3.00	2.00	3.00	5.00	1.00
1.00	3.00	4.00	3.00	1.00	2.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	2.00	4.00
1.00	3.00	4.00	3.00	4.00	2.00	3.00	2.00	2.00	3.00	1.00	1.00	3.00	2.00	5.00
1.00	2.00	5.00	2.00	3.00	3.00	3.00	2.00	2.00	2.00	4.00	2.00	2.00	2.00	3.00
1.00	4.00	4.00	4.00	2.00	3.00	3.00	1.00	1.00	3.00	4.00	3.00	3.00	1.00	4.00
1.00	4.00	2.00	3.00	1.00	2.00	3.00	1.00	2.00	3.00	2.00	1.00	1.00	4.00	4.00
1.00	3.00	3.00	5.00	5.00	4.00	3.00	2.00	2.00	2.00	2.00	1.00	3.00	1.00	2.00
1.00	6.00	2.00	2.00	6.00	2.00	3.00	2.00	2.00	3.00	3.00	3.00	1.00	5.00	5.00
1.00	4.00	4.00	4.00	6.00	3.00	3.00	2.00	2.00	3.00	2.00	2.00	1.00	4.00	5.00
1.00	3.00	4.00	3.00	5.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	3.00	5.00	2.00
1.00	2.00	1.00	2.00	4.00	2.00	3.00	2.00	1.00	3.00	1.00	1.00	3.00	2.00	5.00

Induction of Labour	Maternal age	Gestational age	Fetal Zone Length mm	Total Adrenal Length mm	Fetal Zone Width mm	Total Adrenal Width mm	Fetal Zone Ratio	Cervical Length cm	Bishop Score	Induction to Active Labour hrs	Induction to Delivery hrs	Mode of Delivery	Sensitivity	Specificity
1.00	3.00	5.00	5.00	4.00	2.00	3.00	2.00	2.00	3.00	4.00	1.00	3.00	2.00	1.00
1.00	2.00	3.00	4.00	4.00	2.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	5.00	4.00
1.00	5.00	4.00	4.00	5.00	4.00	2.00	2.00	1.00	2.00	1.00	1.00	3.00	1.00	5.00
1.00	2.00	4.00	2.00	3.00	2.00	1.00	3.00	2.00	3.00	2.00	1.00	3.00	5.00	4.00
1.00	3.00	1.00	2.00	2.00	2.00	3.00	2.00	1.00	3.00	4.00	2.00	3.00	4.00	4.00
1.00	2.00	1.00	3.00	3.00	3.00	2.00	1.00	2.00	3.00	2.00	3.00	3.00	1.00	5.00
1.00	5.00	2.00	2.00	4.00	2.00	4.00	2.00	2.00	3.00	4.00	1.00	3.00	1.00	5.00
1.00	1.00	2.00	4.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	1.00	1.00
1.00	2.00	3.00	4.00	4.00	3.00	4.00	2.00	2.00	2.00	4.00	4.00	1.00	2.00	3.00
1.00	3.00	2.00	2.00	6.00	3.00	3.00	2.00	2.00	3.00	1.00	2.00	1.00	3.00	4.00
1.00	4.00	1.00	4.00	5.00	2.00	3.00	1.00	2.00	2.00	1.00	3.00	1.00	1.00	4.00
1.00	4.00	4.00	3.00	1.00	4.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	2.00	3.00
1.00	3.00	5.00	3.00	5.00	4.00	3.00	2.00	2.00	3.00	4.00	4.00	1.00	4.00	4.00
1.00	5.00	4.00	2.00	1.00	2.00	2.00	1.00	2.00	3.00	2.00	4.00	3.00	4.00	2.00
1.00	3.00	2.00	2.00	5.00	3.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	5.00	5.00
1.00	6.00	2.00	4.00	4.00	1.00	2.00	2.00	2.00	3.00	2.00	1.00	3.00	5.00	2.00
1.00	1.00	4.00	5.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	2.00
1.00	4.00	4.00	2.00	2.00	2.00	3.00	2.00	1.00	2.00	1.00	2.00	1.00	4.00	1.00
1.00	2.00	4.00	5.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	1.00	1.00	5.00	2.00
1.00	2.00	2.00	4.00	4.00	2.00	2.00	3.00	1.00	2.00	2.00	2.00	3.00	2.00	5.00
1.00	5.00	1.00	2.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	1.00	3.00	3.00	4.00
1.00	5.00	2.00	4.00	5.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	4.00	5.00
1.00	1.00	4.00	5.00	3.00	2.00	3.00	2.00	2.00	2.00	1.00	4.00	3.00	2.00	1.00
1.00	3.00	4.00	4.00	3.00	2.00	3.00	2.00	2.00	3.00	3.00	2.00	3.00	2.00	4.00
1.00	3.00	6.00	5.00	5.00	3.00	4.00	3.00	1.00	3.00	3.00	4.00	1.00	4.00	3.00
1.00	1.00	3.00	4.00	4.00	2.00	3.00	2.00	2.00	2.00	4.00	1.00	3.00	2.00	5.00
1.00	3.00	3.00	5.00	4.00	3.00	3.00	1.00	2.00	2.00	1.00	2.00	3.00	3.00	3.00
1.00	4.00	3.00	3.00	4.00	2.00	2.00	2.00	1.00	3.00	3.00	2.00	3.00	3.00	3.00
1.00	3.00	2.00	5.00	4.00	4.00	4.00	2.00	2.00	2.00	3.00	3.00	1.00	2.00	5.00
1.00	1.00	4.00	1.00	4.00	2.00	3.00	2.00	2.00	3.00	3.00	3.00	3.00	5.00	2.00

Induction of Labour	Maternal age	Gestational age	Fetal Zone Length mm	Total Adrenal Length mm	Fetal Zone Width mm	Total Adrenal Width mm	Fetal Zone Ratio	Cervical Length cm	Bishop Score	Induction to Active Labour hrs	Induction to Delivery hrs	Mode of Delivery	Sensitivity	Specificity
1.00	5.00	4.00	2.00	4.00	2.00	1.00	2.00	2.00	2.00	3.00	1.00	3.00	2.00	5.00
1.00	3.00	2.00	3.00	4.00	3.00	3.00	2.00	2.00	3.00	4.00	3.00	3.00	4.00	4.00
1.00	3.00	1.00	4.00	4.00	2.00	3.00	2.00	2.00	3.00	1.00	3.00	3.00	1.00	4.00
1.00	2.00	3.00	4.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	3.00	4.00	4.00
1.00	4.00	2.00	5.00	4.00	2.00	3.00	3.00	2.00	3.00	2.00	2.00	3.00	5.00	3.00
1.00	4.00	5.00	4.00	5.00	3.00	4.00	2.00	2.00	2.00	4.00	3.00	1.00	5.00	5.00
1.00	2.00	4.00	4.00	2.00	2.00	2.00	3.00	2.00	3.00	5.00	3.00	3.00	4.00	4.00
1.00	3.00	1.00	3.00	1.00	3.00	3.00	2.00	2.00	3.00	2.00	3.00	3.00	5.00	1.00
1.00	4.00	5.00	4.00	3.00	2.00	2.00	2.00	1.00	3.00	2.00	1.00	3.00	2.00	1.00
1.00	1.00	2.00	5.00	3.00	2.00	4.00	2.00	2.00	3.00	2.00	2.00	3.00	2.00	3.00
2.00	4.00	4.00	2.00	2.00	1.00	3.00	1.00	3.00	1.00	5.00	5.00	1.00	5.00	4.00
2.00	3.00	3.00	1.00	1.00	1.00	2.00	1.00	3.00	1.00	6.00	4.00	1.00	4.00	3.00
2.00	2.00	3.00	2.00	3.00	1.00	2.00	1.00	2.00	2.00	5.00	5.00	1.00	3.00	2.00
2.00	2.00	5.00	3.00	3.00	1.00	1.00	1.00	4.00	1.00	5.00	5.00	1.00	3.00	1.00
2.00	3.00	1.00	2.00	2.00	1.00	2.00	1.00	4.00	1.00	5.00	4.00	1.00	1.00	5.00
2.00	5.00	5.00	1.00	4.00	2.00	1.00	1.00	3.00	1.00	5.00	4.00	1.00	3.00	5.00
2.00	2.00	4.00	2.00	2.00	1.00	2.00	1.00	2.00	1.00	6.00	4.00	1.00	2.00	4.00
2.00	5.00	3.00	1.00	4.00	1.00	1.00	1.00	3.00	1.00	4.00	5.00	1.00	5.00	3.00
2.00	2.00	6.00	2.00	1.00	1.00	1.00	1.00	3.00	1.00	4.00	4.00	1.00	5.00	3.00
2.00	5.00	4.00	2.00	5.00	2.00	1.00	1.00	2.00	1.00	6.00	4.00	1.00	2.00	5.00
2.00	5.00	3.00	1.00	3.00	1.00	1.00	1.00	3.00	1.00	6.00	5.00	1.00	1.00	2.00
2.00	4.00	2.00	2.00	4.00	1.00	3.00	1.00	2.00	1.00	5.00	4.00	1.00	3.00	5.00
2.00	1.00	4.00	2.00	1.00	1.00	2.00	1.00	4.00	1.00	6.00	4.00	1.00	4.00	4.00
2.00	3.00	4.00	1.00	2.00	1.00	1.00	2.00	3.00	1.00	6.00	4.00	1.00	3.00	2.00
2.00	2.00	5.00	2.00	2.00	1.00	1.00	1.00	4.00	1.00	5.00	4.00	1.00	1.00	3.00
2.00	5.00	2.00	1.00	3.00	1.00	1.00	1.00	2.00	1.00	6.00	4.00	1.00	2.00	3.00
2.00	2.00	1.00	2.00	4.00	1.00	3.00	1.00	4.00	2.00	5.00	4.00	1.00	4.00	2.00
2.00	5.00	2.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00	6.00	5.00	1.00	1.00	4.00
2.00	2.00	5.00	1.00	5.00	1.00	1.00	1.00	2.00	2.00	6.00	4.00	1.00	5.00	5.00
2.00	2.00	4.00	1.00	3.00	1.00	2.00	1.00	3.00	1.00	5.00	2.00	1.00	4.00	5.00

Induction of Labour	Maternal age	Gestational age	Fetal Zone Length mm	Total Adrenal Length mm	Fetal Zone Width mm	Total Adrenal Width mm	Fetal Zone Ratio	Cervical Length cm	Bishop Score	Induction to Active Labour hrs	Induction to Delivery hrs	Mode of Delivery	Sensitivity	Specificity
2.00	2.00	2.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	5.00	4.00	1.00	4.00	5.00
2.00	3.00	2.00	1.00	4.00	1.00	1.00	2.00	3.00	1.00	5.00	4.00	1.00	1.00	4.00
2.00	6.00	4.00	2.00	6.00	1.00	1.00	1.00	3.00	1.00	6.00	5.00	1.00	5.00	2.00
2.00	6.00	4.00	1.00	5.00	1.00	2.00	1.00	3.00	2.00	6.00	5.00	1.00	3.00	2.00
2.00	4.00	4.00	1.00	1.00	1.00	2.00	1.00	3.00	1.00	6.00	4.00	1.00	3.00	4.00
2.00	5.00	5.00	1.00	4.00	1.00	2.00	1.00	3.00	1.00	5.00	1.00	1.00	5.00	5.00
2.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	5.00	5.00	1.00	3.00	2.00
2.00	5.00	4.00	1.00	2.00	2.00	2.00	1.00	3.00	1.00	4.00	4.00	1.00	4.00	5.00
2.00	5.00	4.00	1.00	2.00	1.00	1.00	1.00	3.00	2.00	5.00	4.00	1.00	1.00	5.00
2.00	4.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	5.00	5.00	1.00	1.00	3.00