Impact of Timing of Labor Duration: A Retrospective Study

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Introduction

- Circadian physiology suggests that uterine responsiveness to oxytocin increases at night due to melatonin and oxytocin receptor sensitivity Uterine responsiveness to oxytocin increases at night due to melatonin and oxytocin receptor sensitivity [2,3].
- We hypothesized that nighttime (0–8 hrs) inductions would shorten labor duration.
- Secondary objectives: evaluate effects of maternal BMI and GDM on labor duration and interactions with induction timing.
- Optimizing induction timing may improve satisfaction and reduce fatigue, cesarean risk, and resource burden.

Methods

- Design: A retrospective cohort study was conducted using data from McLaren Greater Lansing collected through the Obstetrics Initiative of Michigan (OBI).
- The sample included 521 primiparous patients admitted for labor induction between December 2019 and December 2023. Patients were excluded if under 18 years, with multiple gestations, spontaneous labor, or non-Pitocin induction.
- Measurements of Major Variables: Gestational Diabetes Mellitus (GDM): Defined by the presence of comorbidity codes “diabetes” or “gestational diabetes.”
- Labor Duration: Calculated by subtracting the time of induction initiation (based on first oxytocin dose) from time of delivery.
- Time of Induction: Grouped into 6 intervals: 0–4, 4–8, 8–12, 12–16, 16–20, and 20–24 hours.
- BMI Categories: Normal (18.5–25), Overweight (25–30), Obese (≥30). No underweight subjects were present. Maternal Age: Categorized as <30 or ≥30 years. Race: Classified as “White,” “Black,” or “Other” due to limited subgroup sizes.

Statistical Analysis

- Descriptive statistics: counts/percentages for categorical variables, mean ± SD for labor duration.
- Bivariate analysis: t-tests and one-way ANOVA used to compare labor duration across groups.
- Multivariate linear regression evaluated associations with induction time, BMI, GDM, and interaction terms ($p < 0.05$).
- Estimated marginal means calculated using the emmeans R package [4], with Benjamini-Hochberg adjusted p-values.
- All analyses conducted in R v4.4.1 [5].

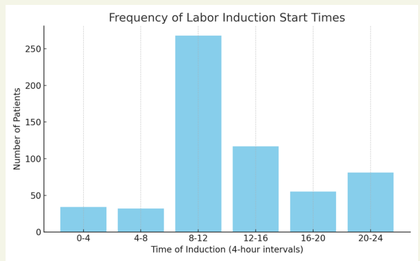
Results

- Mean Labor Duration: 12.8 ± 6.2 hours
- Primary Outcome: No significant association between induction time and labor duration ($p > 0.05$)
- Overweight and obese patients had significantly longer labor compared to those with normal BMI (+1.55 hours, $p = 0.0347$).
- Obesity independently associated with prolonged labor (+2.65 hours; $p = 0.0016$). Overweight status also increased duration (+1.95 hours; $p = 0.0341$).
- GDM: No significant association with labor duration ($p = 0.9682$)
- Induction Timing Trends: Although not statistically significant, labor duration appeared longest for inductions initiated between 20–24 hours (18.4 ± 8.9 hrs) and shortest for 4–8 hours (13.4 ± 5.2 hrs).
- Age and Race: Neither maternal age category nor race showed statistically significant associations with labor duration

Figures

Figure 1

- Frequency distribution of induction start times. Most inductions occurred between 8:00–16:00.



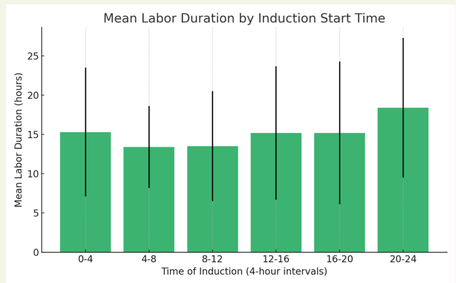
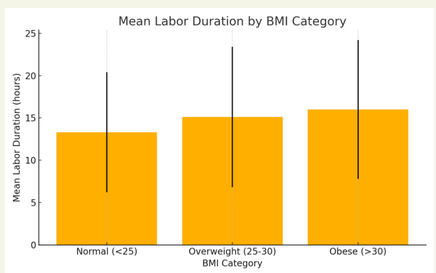


Figure 2

- Mean labor duration by time of induction. No significant difference was found across time intervals.

Figure 3

- Mean labor duration by BMI category. Patients with obesity had the longest average labor duration.



Discussion

- While our hypothesis was not supported, several important findings emerged.
- Circadian uterine sensitivity may be diminished by clinical factors such as bright artificial lighting and continuous stimuli, which suppress melatonin and reduce oxytocin responsiveness [2,3,6].
- Melatonin is critical to circadian signaling and may regulate uterine contractility and oxytocin receptor expression [7].
- BMI was the most significant predictor of prolonged labor; obesity may reduce myometrial contractility and delay cervical ripening [1].
- These findings align with prior evidence linking obesity to dystocia and higher cesarean rates.
- Power limitations may have prevented detection of subtle differences. Larger, prospective studies are needed.
- Future studies should incorporate environmental factors like ambient light, noise, and maternal sleep patterns to further assess circadian effects on labor [8].

Conclusion

- Our findings indicate that the timing of labor induction does not significantly influence labor duration in primiparous patients.
- While physiologic theories suggest circadian modulation of uterine responsiveness, clinical outcomes in this cohort did not reflect these differences.
- Instead, maternal BMI emerged as the most meaningful predictor of prolonged labor.
- These results underscore the importance of maternal health optimization over scheduling strategies when aiming to improve labor efficiency and outcomes.

References and Acknowledgements

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