**Should All Women be Given Labour Induction at Term?**

Giving birth to a child can dramatically affect a woman’s body and health. Although the labour process often is expectative, it can be dangerous for the woman and her child under some circumstances. Based on the mother’s past pregnancies, healthcare accessibility, and health conditions, her antenatal risk score can be assessed, which will then be used to predict the chances of labour complication and other deadly clinical problems. The measuring scale for antenatal risk score was first introduced by Goodwin et al. in 1969 and was recently validated by Burstyn (2010) and Al-Hindi et al. (2020). Using this risk score, maternal healthcare professionals can plan ahead to prepare for a safe delivery, for example, by monitoring and managing the mother’s health as well as other external factors and having all necessary interventions ready by the hospital admission. According to Alberta Health Service, one of the most common, preventive interventions is labour induction – a synthetic stimulation that induces uterine contraction, which is given to an expectant mother in the end of her pregnancy (not earlier than 39 weeks) but before the labour process begins, to facilitate a safe vaginal birth (AHS, 2021). This method often helps to reduce the risk of labour complication in pregnant women with health issues (e.g., diabetes, hypertension, serious infections, or lung diseases) that may threaten the mother and child’s life if the pregnancy continues. Sometimes, a doctor may prescribe inducing labour for non-medical reasons such as the pregnant woman living too far from healthcare facilities, having pregnancy gone one to two weeks past the estimated due date, or simply choosing to have an elective induction (AHS, 2021).

Having several life-saving benefits, especially in cases with severe chronic diseases, labour induction can be overused. More women are receiving the stimulation even when their conditions are suitable for natural labour (Seijmonsbergen-Schermers, Scherjon, & De Jonge, 2019). Indeed, healthy women undergone unnecessary labour induction may face unwanted side effects of the inducing medicines such as post-delivery bleeding or low heart rate, post-procedure infections, and serious consequences of failed induction such as uterine rupture (Mayo Clinic, 2021). In addition to that, unnecessary labour induction can place more burden on maternal healthcare resources, as induced women have to be in hospital beds for days to be medically assessed, monitored and/or in waiting for the procedure (Seijmonsbergen-Schermers et al., 2019). Therefore, it is essential to study and evaluate labour induction’s effectiveness in preventing birth complication and other causes of mother and child’s mortality as well as potential harms on both pregnant women with high antenatal risk scores and those who are at low or minimal risk.

**Research Question**

The objectives of this project are (1) to validate the relationship between Albertan pregnant women’s antenatal risk scores and their obstetrical outcomes as well as (2) to assess the effect modification of labour induction on that relationship. Particularly, my first hypothesis is that women who had higher risk scores were more likely to have adverse outcomes (e.g., death, birth complication, or other conditions that resulted in longer stay in bed). Secondly, high risk women who had received induction prior to admission are expected to show less severe outcomes than those who had not been labour induced. Thirdly, for women who were at minimal or no antennal risk, it is hypothesized that inducing labour would not change the likelihood of unwanted outcomes.

**Methods**

A (retrospective) case control study will be conducted to test the proposed hypotheses on AHS’s sample set of inpatient hospitalization data for three fiscal years from 2007/08 to 2009/10 (i.e., from March 2007 to March 2010). This discharge abstract data contains records of 28862 Albertan pregnant women (from 13 to 60 years old, *mean* 29 years, *sd* 6 years) who had their antenatal risk scores documented. These scores are integers ranging from 0 to 99, with higher scores indicate higher risk of birth complication as well as maternal and neonatal mortality. According to the AHS measuring scale for antenatal risk score, a score of 0-2 means low risk, 3-6 means moderate, and 7 or above means high risk (Burstyn, 2010). In this study, risk scores are classified into “low” and “moderate to high” groups.

The severity of maternal outcome will be evaluated based on the patient’s total length of stay in the hospital and the patient’s discharge status and place (e.g., death, transferring to acute care unit or discharging to home). The longer a patient had to stay in bed, the more likely that she had a serious condition that required further care and monitoring. Discharge places are converted to outcome scores (1-7) with higher score indicate more severe outcomes (7 – “died”, 6 – “to acute care”, 5 – “to continuing care”, 4 – “to other”, 3 – “left against medical advice”, 2 – “home with support”, 1 – “to home without support”). A preliminary data cleaning and exploration was performed in Python, followed by a t-test analysis in R to compare the maternal outcomes of women who had antenatal low risk scores to those with moderate/high risk scores.

**Results**

The average risk score recorded in this sample data set was 2.75 with a standard deviation of 7.69, and 64.60% of the total of 28862 pregnant women were at minimal risk of clinical complications and mortality (i.e., less than 3). Most women (99.28%) who were discharged to their residences required no additional medical support (i.e., outcome score = 1). On average, hospitalized women stayed for a total of two days (*sd* 2 days), and 75% of them stayed for three consecutive days at most. The shortest stay was one day whilst the longest took 86 days. In total, 1694 expectant mothers (5.87%) had received labour induction prior to admission, while 27168 others had not.

*Hypothesis 1: Women who had higher risk scores were more likely to have (a) higher outcome scores and (b) longer stay in the hospital*

For the proposed hypotheses, t-test analysis was used to compare maternal outcome score and total length of stay between two groups: low-risk versus high-risk (hypothesis 1) and induced versus non-induced (hypothesis 2 and 3) as well as to calculate the 95% confidence interval. Since the data were not normally distributed, Wilcoxon rank sum tests with continuity correction were performed and will also be reported. A result of t = -3.7441, df = 16853, p-value = 0.00009081 and W = 94705238, p-value = 0.00000005622 supports part (a) of Hypothesis 1. On average, at 95% confidence level, women of the low-risk group (age 13-47, *mean* 30 years, *sd* 6 years) tended to have lower outcome score by 0.008 to 0.026, compared to the high-risk women (age 13-60, *mean* 28 years, *sd* 5 years). The mean outcome score of the low-risk group was 1.02, and the mean outcome score of the high-risk group was 1.04.

Similarly, a significant result (t = -27.227, p-value < 10-15 and W = 65424976, p-value < 10-15) was found for total length of stay, supporting Hypothesis 1b. Averagely, women who were at minimal risk stayed for almost 2 days, while those with moderate to high risk stayed for almost 3 days in the hospital. The mean difference in length of stay between the two groups was 1 day at the 95% level of confidence.

*Hypothesis 2: High-risk women who had received induction prior to admission (a) experienced less severe outcomes and (b) stayed for less days than those who had not been labour induced.*

Hypothesis 2 was partially supported since receiving labour induction was not shown to affect the difference in outcome scores of women with moderate to high antenatal risk scores. The total days in hospital, on the other hand, were slightly different: on average, labour induced women could leave the hospital a little sooner (0.02 to 0.27 day, at 95% confidence interval) than those who had not received the intervention. Detailed statistical report can be found in Table 1.

*Hypothesis 3: Labour induction would not change the (a) likelihood of unwanted maternal outcomes and (b) length of stay in low-risk women.*

Hypothesis 3 was also partially supported. The outcome scores of women with minimal risk did not changed between induced and not-induced groups. However, labour induced women stayed a bit longer (0.26 to 0.41 day, at 95% confidence level) in the hospital than those who had not been labour induced. This pattern was also observed when comparing induced to non-induced group without controlling for antenatal risk score.

*Table 1 - Detailed statistical results of Hypothesis 2 and 3 (H2 & H3)*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | H2 – High-risk group | | H3 – Low-risk group | | All Data | |
| Outcome score | Length of stay | Outcome score | Length of stay | Outcome score | Length of stay |
| µ Not Induced | 1.04 | 2.82 | 1.02 | 1.86 | 1.03 | 2.20 |
| µ Induced | 1.02 | 2.67 | 1.03 | 2.19 | 1.03 | 2.38 |
| µNot Induced - µInduced  (95% CI) | -0.01 to 0.04 | 0.02 to 0.27 | -0.03 to 0.01 | -0.41 to -0.26 | -0.02 to 0.02 | -0.25 to -0.12 |
| t | 1.1703 | 2.2827 | -0.85894 | -9.0857 | -0.15255 | -5.5197 |
| p-value | 0.2422 | 0.02261\* | 0.3906 | < 10-15 \* | 0.8788 | < 10-7\* |
| W | 3232030 | 3014764 | 8965063 | 7256040 | 23014214 | 19526166 |
| p-value | 0.3691 | 0.004072\* | 0.4452 | < 10-15\* | 0.9523 | < 10-15 \* |

**Interpretation**

In consistence with Goodwin et al.’s (1969), Burstyn’s (2010) and Al-Hindi et al.’s (2020) findings, women with lower antenatal risk scores were more likely to have less severe maternal outcomes than those of higher risk. Although the mean outcome scores of both low-and high-risk groups were close to the minimum value of 1, suggesting that the majority of both groups were discharged to home without additional medical support, the outcome scores of the low-risk group were slightly better than those of the high-risk group. Additionally, on average the low-risk group were discharged one day sooner than their counterpart.

In general, the maternal outcomes of women who had received labour induction prior to admission did not differ from those of women who had not been labour induced. Most of women from either group were discharged to their homes without support. The total length of stay of the labour induced women, however, were slightly longer than that of women who had not received the intervention. The similar pattern of results was also found in women of the low-risk score group. These small differences (less than 0.25 day) in the length of stay between labour induced and non-induced groups might be due to the extra administrative and health monitoring process associated with the induction procedure. Women in the high-risk group, on the other hand, seemed to stay slightly longer in the hospital when they had not received the labour induction intervention than if they had. These are also consistent with previous literature where Seijmonsbergen-Schermers et al. (2019) have found that unnecessary induced labour can increase cost in time, but if the intervention was performed for expectant mothers who are at high risk of health problems and mortality it can help to alleviate the severity of clinical complications, which could be reflected by a decrease of total days in bed in this project.

**Limitations**

Using patient’s length of stay in hospital and discharge place/status can be convenient to provide some insights into how labour induction can alter the relationship between antenatal risk and birth complication/mortality. However, these variables may not sufficiently measure maternal and neonatal outcomes. Potential confounding factors such as hospital wait-time, procedure time, and even birth delivery time can also contribute to the change in the total length of stay. Therefore, other variables such as a expectant mother’s detailed diagnosis, health record, and number of professional caregivers who were responsible for her health should be analyzed to better assess her postpartum outcome.

Another limitation comes from the analysis method of this project. Due to the scope and time constraint of the assignment, only descriptive statistics and simple t-tests/Wilcoxon rank sum tests were used to examine the data. This might reduce the ability to optimally tackle and deprive information from this multidimensional data set, as t-test or Wilcoxon rank sum test only allows a simple comparison of two group means at a time. Hence, future analysis built upon this project should employ more advanced analysis techniques to better address the proposal research questions.

**Reference**

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