Biostats 536 Project
Group 07

Dear Collaborator,

This document contains the analysis results of your data on pregnant women from South Africa. Some of the sections, like the background and the data description are your area of expertise, but I would like for you to pay attention to these sections as well because they reflect my understanding of the subject and the research question. The statistical analysis I have chosen was dictated to a certain degree by my understanding of the problem and the data, so please correct me if there are errors so we can determine if they would have an impact on the results. Please call me after reviewing this report to discuss sections that are not clear in either end.

Summary

A cohort of 755 pregnant women with singleton pregnancies who could not afford private healthcare were followed in a peri-urban setting in Western Cape, South Africa to determine if difference in weight profiles and/or symphysis fundal height (SFH) profiles were different between women who do and do not deliver preterm, low birth weight (LBW) and small for gestational age (SGA) babies. Logistic regression models with robust standard errors were built with three predictors of interest: average change in maternal weight per week, minimum SFH by estimated gestational age and average SFH change per week. A total of nine regression models were used, one for each combination of outcome of interest and predictor of interest. After adjusting for maternal baseline characteristics, specifically maternal height and smoking status, the odds ratio of LBW in women with one centimeter weekly change in SFH was 0.47 (p-value=0.007) and the odds ratio of SGA was 0.48 (p-value=0.004). There was no significant association between SFH change and preterm delivery. The odds ratio of preterm delivery with a one centimeter change in minimum SFH per gestational age was 0.0008 (p-value=0.001), and the odds ratio of LBW was 0.004 (p-value=0.013). Although the odds ratio of minimum SFH and SGA was 0.02, this association was not significant (p-value=0.49) when adjusting for maternal characteristics. The odds ratios didn't change markedly in the unadjusted analysis, except for minimum SFH per gestational age and SGA, where the odds was significant at 0.001 (p-value=0.023 vs. 0.49 in the adjusted analysis). There was no significant association between weight change per week and any of the outcomes. When using R-squared values as a prediction measure, none of the variables were particularly good in predicting LBW, preterm delivery or SGA, although minimum SFH per gestational age had the highest R-squared value for preterm delivery (0.031) and LBW (0.071). Minimum SFH per estimated gestational age had the highest area under the curve in ROC curves to predict LBW (0.71), preterm delivery (0.66) and SGA (0.69). Although not without limitations, minimum SFH per gestational age seems to be the most useful measure to predict poor perinatal outcomes, and certainly the most practical at evaluating women that come for a single prenatal visit.

Comment [A1]: Lead off with our overall goal.

Comment [A2]: We had to restrict our data further. Also tell us how many subjects had visits between 20-30 weeks EGA, because they are all we could use in our analysis

Comment [A3]: why not parity?

Comment [A4]: Calling it "change" first conjures up a difference within a woman over time, while you are instead comparing women who differed by 1.0 cm/week in their rate of increase in SFH—a difference that is not really that biological over the entire 20-30 week period of interest (even though we might have such estimates based on very sparse measurements for some women).

You should choose a smaller reference comparison.

Comment [A5]: Beause you chose a difference that is too extreme, we estimate an OR that is pretty amazing, if true. (Of course, this borders on choosing to measure a person's height in miles.)

Comment [A6]: Why would these be relevant. (I can actually tell you that in this case they might be a little relevant, but if you are going to invoke them, you better understand their limitations.)

Comment [A7]: Similarly, what does AUC tell us, or, for that matter, an ROC curve.

Background

Within this cohort, three measures of poor birth outcomes were collected. Low birth weight (LBW) defined as <2500 grams can be the result of preterm delivery (PTD), defined as <38 weeks gestation, or small for gestational age (SGA) pregnancies, and it results in significant morbidity and mortality during the perinatal period. Despite the advances in prenatal care and a decreasing incidence in perinatal mortality over the past two centuries, these outcomes remain a major public health problem, especially in the developing world where prenatal care is not always available. Ultrasound can help determine the fetal size for gestational age and prevent pregnancy complications by referring these women to higher level of care, but financial constraints in developing countries make necessary the development of cheaper alternatives to predict complicated deliveries.

Comment [A8]: You need to first give background on your understanding of the problem. In this problem in particular, a technical statistical analysis that does not constantly revisit the goal is likely to go wrong. So re-order your sentences.

Some of the prenatal care measures to detect complications during pregnancy include checking maternal blood pressure to detect cases of pre-eclampsia (related to intra-uterine growth retardation), weighing the mother to make sure the fetus is growing and the mother is not retaining too much fluid (which happens in pre-eclampsia), and obtaining the symphysis fundal height (SFH), an indirect measure of fetal size that is more useful after 20 weeks of gestation and can be adjusted by gestational age.

This study was designed to determine if weight profiles and/or SFH profiles differ between women who do and do not deliver LBW, preterm or SGA babies. Answering this question will tell future researchers if weight profiles and SFH are viable/reliable methods to isolate high-risk pregnancies in developing countries for early referral and prevent perinatal morbidity/mortality.

Scientific Questions of Interest

1. Is there an association between maternal weight profile or SFH profile between 20 and 30 weeks gestation and either PTD, LBW, or SGA?
2. Do any associations from the above models persist when accounting for maternal baseline characteristics?
3. Could the above models be useful in predicting which mothers will deliver a PTD, LBW, or SGA infant?

Source of the data

You have data on 755 patients from a cohort study in a peri-urban setting in Western Cape, South Africa. These are women with singleton pregnancies that could not afford healthcare and were followed from enrollment with maternal weight and SFH at each visit. Mother’s height in centimeters, parity (number of prior deliveries) and smoking status were also recorded at some point, and at the time of delivery, the sex of the baby, the baby’s birth weight in grams and gestational age in weeks were recorded. We limited our analysis to visits within 20 to 30 weeks of gestational age.

There were some unavailable data for the analysis:

1. Missing data: estimated gestational age was absent in 2 visits, maternal weight was absent in 9 visits and SFH measures were absent in 13 visits, before restricting the data to between 20 and 30 weeks. Smoking status and sex of the baby both had 4 out of 755 patients with missing values. Height of the mother was not available in 6 patients. Change in weight per week between 20 and 30 weeks was available in 658 out of 755 patients. Change in SFH per week between 20 and 30 weeks was available in 658 patients as well. Minimum SFH per gestational age between 20 and 30 weeks was available in 708 out of 755 patients. The higher availability of minimum SFH per gestational age is due to the fact that it can be measured in one visit instead of requiring at least two visits.

2. Other relevant variables not present in the data: maternal weight at start of pregnancy was not available. Also, there were no records on maternal blood pressure, history of maternal infections, diabetes mellitus, glucoses or urinary infections in the data. These are all relevant variables associated with perinatal morbidity and fetal size. Confounding adjustment for these variables was therefore not possible in our analysis.

Comment [A9]: Good description

Comment [A10]: and likely easily available in a resource-poor environment

Comment [A11]: Confounding is less of an issue, instead the question is whether we could improve our predictive model if we had all of them.

Statistical Methods

To address the primary question, we constructed logistic regression models with robust standard error estimates. Logistic regression was chosen since it is commonly used to model binary outcomes, likely making your results most comparable to existing literature on this topic. The use of robust standard error estimates relaxed the assumption that the variance of the data is equal to that predicted by the binomial mean-variance relationship. We assumed that the observations in this cohort were independent. If this population of women was in the United States, these three birth outcomes would be considered rare enough that the odds ratio (OR) generated from our logistic regression analysis could reasonably approximate the relative risk (RR). However, if it is known that any of these outcomes affect well over 10% of births in Cape Town, South Africa, you may want to be cautious in interpreting the generated ORs as RRs. Regarding missing data, a missing at random model was assumed, and any individual that was missing data on any variable used in a specific analysis was excluded in that analysis. We characterized patterns of missing data and discussed potential implications in our discussion. A 0.05 level of significance was used for all hypothesis testing. All analysis was performed using Stata 12.0 (Stata Corp, College Station, TX).

To align with the goal of exploring variables to use for prediction, for all predictors of interest, we only considered visits between 20 and 30 weeks estimated gestational age (EGA). For both weight profile and SFH, we set out to consider both one single measure and one measure that took into account multiple visits, in order to explore the utility of each approach. The single measure allows us to consider women who only visited once between weeks 20 and 30, and may be of better practical use in a clinic setting. Conversely, utilizing multiple visits for each woman may provide us with more accurate and stable information. Ultimately, due to the variability of maternal baseline weight, which was not available for our use, we felt that a single measurement of weight would not be appropriate, and only change in weight was considered. Our final predictors of interest were as follows: the average change in weight per week, defined

Comment [A12]: very nice

as the difference between the weight at the last visit and weight at first visit divided by the number of weeks between those visits; minimum SFH divided by EGA; and average change in SFH per week, defined as the difference between the SFH at the last visit and SFH at the first visit divided by the number of weeks between those visits. This resulted in nine logistic regression models with robust standard error estimates: one for each combination of the outcomes of interest (PTD, LBW, and SGA) and the predictors of interest.

Logistic regression models the log odds of the outcome occurring as a linear function of the predictors. For interpretability, the log odds were exponentiated to yield ORs. The parameters in the models can be interpreted as the average proportionate change in odds of experiencing one of the outcomes of interest for each one unit increase of the predictor variable. We assessed associations between our predictors of interest and outcomes using these ORs, 95% confidence intervals, and hypothesis testing with two sided p-values. The null hypothesis is that there is no change, which corresponds to an OR of 1.00. The p-value tells us the probability of observing the obtained estimate if there is truly no association. The 95% confidence intervals represent the range of realistic values for the true odds ratio. Due to the fact that we are using multiple measures for each predictor of interest in this analysis, we have to be cognizant of the issue of "multiple comparisons". Essentially, this means that we are giving ourselves multiple chances to have a significant outcome, and that should be taken into account when interpreting our p-values and confidence intervals. We should be cautious in interpreting significance in these results, and this issue should be addressed in any future manuscripts.

Results of our regression are presented in unadjusted form, with only the predictors of interest in the model, as well as after adjustment for the maternal baseline covariates. Adjusting for the maternal baseline covariates changes the interpretation of the parameters to be the proportionate change in odds of the outcome occurring within groups of women with the same baseline characteristics. We adjust for these covariates so that we can observe any association between our predictors and the outcome beyond any relationship that exists between the baseline characteristics and the outcomes. Covariates in our model were chosen using *a priori* knowledge about the relationship between the covariates, the outcomes, and the predictors of interest, and include maternal height (in cm), maternal smoking (yes/no), maternal parity (continuous), and maternal age (continuous).

To address our secondary question regarding the usefulness of our models for prediction of mothers who will deliver a PTD, LBW or SGA infants, we assessed model fit by considering the R-squared statistic as well as plotting receiver operating characteristic (ROC) curves to characterize the accuracy of our models. The R-squared statistic tells us about the proportion of variability in the data that is attributable to the linear combination of predictors in our model. The ROC curve will attempt to illustrate the discriminating performance of our model. ROC curves would ideally be created using a different set of data than the one used to build the model, but we can still learn something about the predictive value of these models using this data, which is why we are showing them to you here.

Comment [A13]: And this is relevant because we have sampled (nearly) the population we care about.

Comment [A14]: Using the words "True Positive Rate" versus "False Positive Rate" will often be understood.

And it is that that we want to think about. If we are to identify, say, 50% or the high risk pregnancies, what proportion of the low risk pregnancies will also be identified (it is around 25%)

To recapitulate, the specific questions answered in the analyses presented below are:

1. Are maternal weight profiles, in the form of changes in weight per week during weeks 20 to 30 of gestation, associated with PTD, LBW or SGA babies?
2. Are SFH profiles, in the form of changes in SFH per week during weeks 20 to 30 of gestation, associated with PTD, LBW or SGA babies?
3. Are SFH profiles, in the form of minimum SFH by estimated gestational age, associated with PTD, LBW or SGA babies?
4. Do any of the above models have useful predictive potential?

Results

In this study, there were 755 women with singleton pregnancies available for analysis. Population descriptives for this study population are shown in Table 1a. Briefly, the mean age of women was 24.8 and infants born were 51% male. The three outcomes assessed in this study were preterm birth (PTD), low birth weight (LBW) and small for gestational age (SGA). Population descriptives by these outcomes are presented in Table 1b. In our population, 24 births were PTD, and the proportion of infant sex differed by PTD with 41.7% of PTDs being male and 51.4% of non-preterm births were male. For LBW, 75 births fell under the definition for LBW. Of the infants with LBW, the proportion of women who were smokers differed by LBW with 44% of those with LBW were smokers and 29.3% of those were not LBW were smokers. The distribution of infant sex also differed among those who were LBW or not, with 41.3% of those were LBW being male, and 52.1% of those were not LBW being male. There were 105 infants who were SGA. Of those who were SGA compared to those who were not, the proportion of smokers, and infant sex differed. 43.3% of those who were SGA were smokers compared to 28.8% of those who were not SGA. 42.3% of those who were SGA were male compared to 52.4% of those who were not SGA.

Comment [A15]: Notably, all patients who were LBW were also called SGA. This is not how it should be in general, so I worry about their definitions.

In our study population, the mean number of visits by women was 7.7 and the mean gestational age at enrollment was 22.4 weeks (Table 2a). Subject visit characterization is presented in Table 2b. For PTDs, the average number of visits for those who were PTD was higher (7.8) than those who were not preterm (5.3). For LBW and SGA, the visit characteristics for women were fairly similar between groups.

Descriptives for the three predictors of interest examined in this study (change in weight per week, minimum SFH and change in SFH) by outcome group are presented in Table 3. There are no large differences in the predictors by outcome groups.

Results of the logistic regression evaluating change in weight per week are presented in Table 4. The odds ratio of preterm delivery with a one ounce increase in weight per week is 0.63 (95% CI = 0.12 – 3.31). This result is not statistically significant with a p-value of 0.609. Among those with the same maternal baseline characteristics (maternal height, maternal smoking, maternal parity, maternal age), this odds ratio is 0.64 and is also not statistically significant. The odds ratio of LBW with a one ounce increase in weight per week is 0.74 (95% CI = 0.37 – 1.46) and this result is not statistically significant (p-value = 0.609). Among women who have the same maternal baseline characteristics, this odds ratio remains the same and is also not statistically significant. The odds ratio of SGA with a one ounce increase in weight per week is

Comment [A16]: Did you really convert to ounces? If so, that is good.

0.75 (95% CI = 0.42 – 1.33) and is not statistically significant (p-value = 0.323). This odds ratio is 0.74 for women who have the same maternal baseline characteristics, and is also not statistically significant.

Results of the logistic regression evaluating change in SFH per week are shown in Table 5. The odds ratio of preterm delivery with a one centimeter change in SFH per week is 0.63 (95% CI = 0.24 – 1.66) and is not statistically significant (p-value = 0.345). Among women who have the same maternal baseline characteristics, this odds ratio is 0.65 (95% CI = 0.24 – 1.74) and is also not statistically significant. The odds ratio of LBW with a one centimeter change in SFH per week is 0.47 (95% CI = 0.28 – 0.81), and is statistically significant (p-value=0.007). Among women who have the same maternal baseline characteristics, this odds ratio remains the same and is also statistically significant. The odds ratio of SGA with a one centimeter change in SFH per week is 0.48 (95% CI = 0.29 – 0.79) and is statistically significant (p-value = 0.004). This odds ratio is 0.49 (p-value = 0.008) among women who have the same maternal baseline characteristics.

Results of the logistic regression evaluating minimum SFH are presented in Table 6. The odds ratio of preterm delivery with a one centimeter change in minimum SFH per gestational age is 0.0009 (95% CI = 0.00 – 0.07) and is statistically significant (p-value=0.002). This odds ratio is 0.0008 (p-value=0.001) among women who have the same maternal baseline characteristics. The odds ratio of LBW with a one centimeter change in minimum SFH per gestational age is 0.006 (95% CI = 0.00 – 0.31) and is statistically significant (p-value = 0.023). Among women who have the same maternal baseline characteristics, the odds ratio is 0.004 (p-value=0.013). The odds ratio of SGA with a one centimeter change in minimum SFH per gestational age is 0.01 and is statistically significant (p-value=0.023). Among women with the same maternal baseline characteristics, this odds ratio is 0.02 (p-value=0.49).

Logistic regression results for the odds ratio of PTD, LBW, and SGA based on weight change, SFH change and minimum SFH are summarized in Figure 1a-c.

Overall model fits for the adjusted analyses are presented as R-squared values. For PTD and weight change, SFH change, and minimum SFH per gestational age, the R-squared values are 0.16, 0.017, and 0.031, respectively. For LBW and weight change, SFH change, and minimum SFH per gestational age, the R-squared values are 0.057, 0.070, 0.071, respectively. For SGA and weight change, SFH change, and minimum SFH per gestational age, the R-squared values are 0.051, 0.062, and 0.056, respectively.

ROC curves for the three poor birth outcomes assessed based on the predictors of interest assessed are presented in Figure 2a-c. Minimum SFH has the highest area under the curve (AUC) for LBW (0.71), PTD (0.66), and SGA (0.69).

Discussion

Of the predictors evaluated, use of SFH seems to provide the most clinically useful measure of estimating the outcomes presented. Using change in weight per week indicated a decreased odds of the three outcomes with an increase in weight per week, however none of these results were statistically significant, even when accounting for maternal baseline characteristics. In evaluating the change in SFH per week and the minimum SFH by EGA the odds were decreased and significant for almost all of the outcomes, even when accounting for maternal baseline characteristics.

Comment [A17]: We can actually use the R squared to tell us in an absolute sense that the predictive models are not very good.

From your ROC curves you can see that 50% sensitivity only has 75% specificity. This means that the PPV of a rule that provides 50% sensitivity is only about 25%. This will not work, because too many women will be being seen in the high risk clinic.

In regards to the scientific question of interest regarding evaluating the usefulness of these analyses in predicting whether a mother will deliver an infant with one of the three poor outcomes evaluated, the R-squared values can be used as a gauge of how well the predictors and maternal baseline characteristics explain the variability in the outcome. In comparing the R-squared values from the associations analyzed, the use of weight change performs the best in explaining the variability in PTD. All models including predictors and maternal baseline characteristics perform poorly in explaining the variability in the outcomes. The ROC curves can also be used to evaluate the usefulness of these models to predict poor birth outcomes. Based on the ROC curves, LBW and SGA are better predicted than PTD. Of all of the predictors of interest, minimum SFH seems to do the best at predicting outcomes, however weight change and change in SFH do not perform markedly worse. When using this model on independent data in the future, however, we expect the predictive ability of the model to attenuate towards the null. Thus, validation on an independent dataset should be performed before using this in the field.

In a low resource setting where continuity of care can be an issue, the reality of what information is available from expectant mothers should be considered when determining what predictors should be used to determine poor birth outcomes. Since minimum SFH per gestational age is only dependent on one visit, and not contingent on women returning to the clinic, its utility within this setting in determining poor birth outcomes may be the most useful as compared to weight change or change in SFH. Using minimum SFH per gestational age will allow evaluation of all women who attend the clinic for prenatal care, not only those who come for multiple visits. However, for women who do return to clinic for repeated prenatal visits, the use weight change and SFH change measures may also provide additional information adding to the accuracy of trying to assess the risk for poor birth outcomes.

Limitations of the analysis we performed include the lack of information on known risk factors and missing information from certain women and visits. The bulk of the missing data arises from women who did not visit the clinic between 20 and 30 weeks EGA, or when using a measure that requires two visits, did not visit the clinic multiple times within that window. It is likely that there is an association between infrequent prenatal care visits and poor birth outcomes. This association may have biased our results, and in the future, more sophisticated missing data techniques may be employed to combat this bias if the goal is to robustly assess the association between these predictors of interest and adverse birth outcomes. However, since the ultimate goal is to use this information for prediction, and in reality women who do not come for prenatal care cannot be accounted for, the approach taken in this analysis may best align with future practical use. Lastly, the data we do have may contain inaccuracies and inconsistencies in the measures from clinic visits depending on the use of different measurement instruments in the clinic, and different staff members taking measurements.

This analysis was exploratory in nature, so results should be taken with caution as nine different relationships were evaluated, all both adjusted and unadjusted for maternal baseline characteristics. These results though, do provide support for further exploration of the use of SFH in determining poor birth outcomes.

For future study, it would be useful to further evaluate measures of SFH that would be clinically useful in predicting poor birth outcomes. The use of SFH in addition to other risk factors that can be practically collected during clinic visits may be used to develop a model used for prediction in the clinic setting.

Tables and Figures

Figure 1a-c. Odds ratios for Low Birth Weight, Preterm Birth, and Small for Gestational Age with Poor Birth Outcomes, adjusting for maternal baseline characteristics.

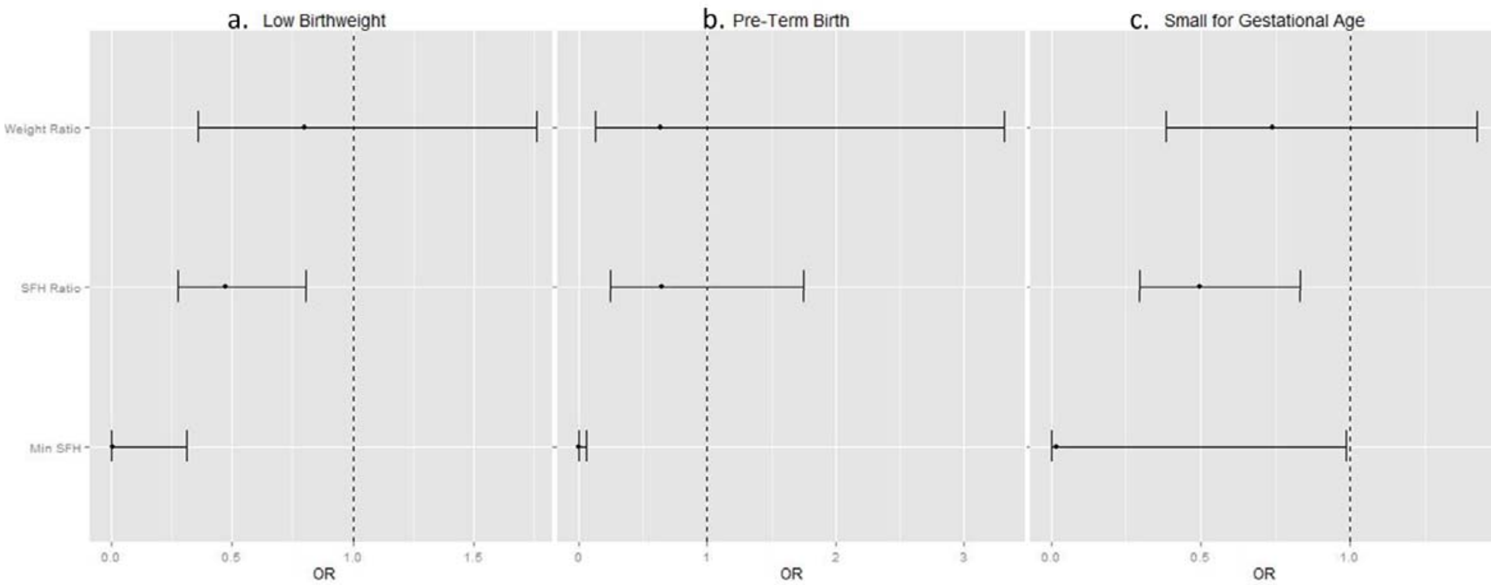
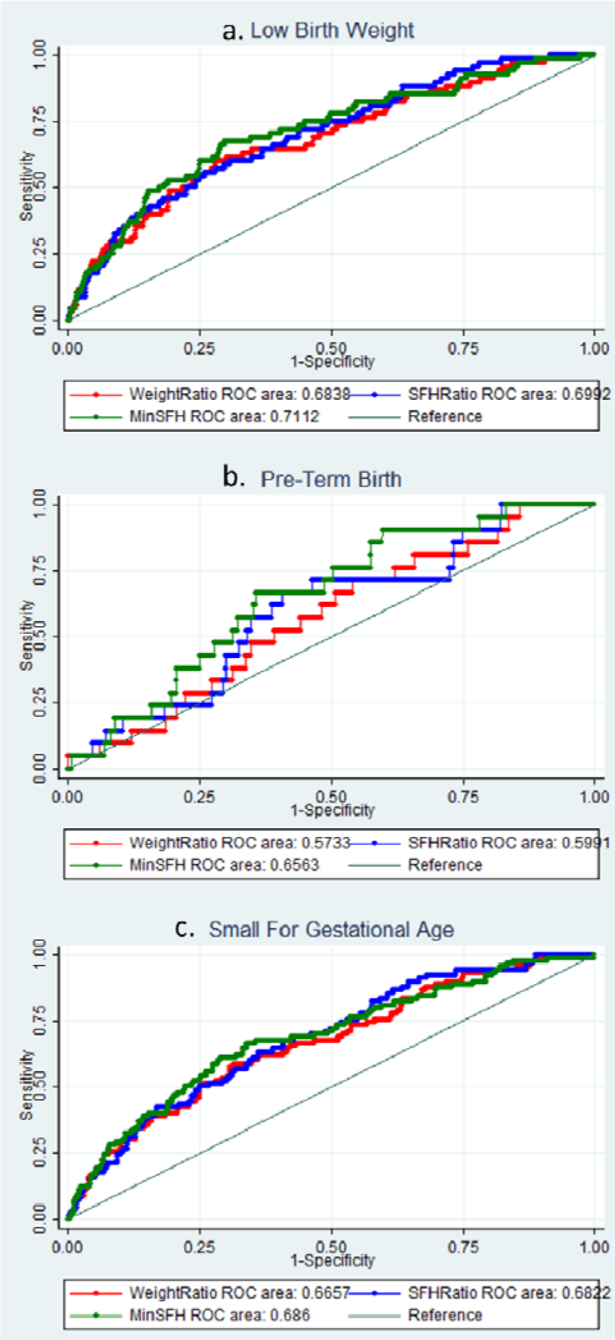


Figure 2a-c. Receiver Operator Curves for Low Birth Weight, Preterm Birth, and Small for Gestational Age with Poor Birth Outcomes.



Comment [A18]: It would also be nice to include the ROC curve for a model that is just baseline variables. I think you will find that the SFH and wt change measures do not add much.

Hence, our predictive model will not differ much from declaring a woman high risk before she gets pregnant.

Table 1a: Selected descriptive Statistics (n=755 women with singleton pregnancies)

Variable	Number Missing	Mean (SD) or n (%)	Min, Max
Age - mean (SD)	0	24.8 (5.4)	14, 43
Parity - mean (SD)	0	1.1 (1.2)	0, 6
Height (cm) - mean (SD)	6	156.7 (6.5)	106, 176
Smoking - n (%)	4		
Yes		231 (30.8)	
No		520 (69.2)	
Sex of infant - n (%)	4		
Male		383 (51.0)	
Female		368 (49.0)	

Table 1b: Selected descriptive statistics, by outcome

	Preterm[a]				Low birth weight[a]				Small for gestational age[a]			
	Yes n=24		No n=726		Yes n=75		No n=676		Yes n=105		No n=650	
Variable	Mean (SD) or n (%)	Min, Max	Mean (SD) or n (%)	Min, Max	Mean (SD) or n (%)	Min, Max	Mean (SD) or n (%)	Min, Max	Mean (SD) or n (%)	Min, Max	Mean (SD) or n (%)	Min, Max
Age - mean (SD)	23.9 (4.8)	18, 33	24.8 (5.4)	14, 43	23.9 (4.8)	16, 34	24.9 (5.4)	14, 43	23.8 (4.9)	16, 35	24.9 (5.4)	14, 43
Parity - mean (SD)	1.1 (1.1)	0, 3	1.1 (1.2)	0, 6	0.9 (1.2)	0, 6	1.1 (1.2)	0, 6	0.9 (1.1)	0, 6	1.1 (1.2)	0, 6
Height (cm) - mean (SD)	156.2 (4.8)	146, 166	156.7 (6.5)	106, 176	153.6 (5.8)	142, 166	157 (6.5)	106, 176	154.6 (5.9)	142, 172	157 (6.5)	106, 176
Smoking - n (%)												
Yes	7 (29.2)		223 (30.7)		33 (44)		198 (29.3)		45 (43.3)		186 (28.8)	
No	17 (70.8)		503 (69.3)		42 (56)		478 (70.7)		59 (69.2)		461 (71.2)	
Infant's Sex - n (%)												
Male	10 (41.7)		373 (51.4)		31 (41.3)		352 (52.1)		44 (42.3)		339 (52.4)	
Female	14 (58.3)		353 (48.6)		44 (58.7)		324 (47.9)		60 (57.7)		308 (47.6)	

[a]Total n=755. Numbers may not add up to total due to missing data

Table 2a: Subject disposition

Variable	Mean (SD)	Min, Max
Number of Visits	7.7 (2.3)	2, 14
Length of Time Observed (wks)	15.6 (4.4)	1, 24
Gestational Age at Enrollment	22.5 (4)	15, 39

Table 2b: Subject disposition, by outcome

	Preterm				Low birth weight				Small for gestational age			
	Yes		No		Yes		No		Yes		No	
Variable	Mean (SD)	Min, Max	Mean (SD)	Min, Max	Mean (SD)	Min, Max	Mean (SD)	Min, Max	Mean (SD)	Min, Max	Mean (SD)	Min, Max
Number of Visits	5.3 (2.4)	2, 10	7.8 (2.2)	2, 14	6.7 (2.7)	2, 12	7.9 (2.2)	2, 14	7.1 (2.7)	2, 13	7.8 (2.2)	2, 14
Length of Time Observed (wks)	12.1 (5)	3, 20	15.7 (4.3)	1, 24	14 (4.8)	3, 22	15.8 (4.3)	1, 24	14.3 (4.7)	3, 23	15.8 (4.3)	1, 24
Gestational Age at Enrollment	21.4 (3.1)	15, 27	22.5 (4.1)	17, 39	21.6 (3.1)	15, 36	22.6 (4.1)	17, 39	21.9 (3.4)	15, 36	22.6 (4.1)	18, 39

Table 3: Descriptive Statistics of Predictors of Interest, Stratified by Outcomes

		Mean	SD	Min	Max
Change in weight per week					
Preterm delivery	Yes	0.36	0.51	-1.50	1.05
	No	0.42	0.35	-1.00	3.00
Low Birth Weight	Yes	0.38	0.35	-1.50	1.05
	No	0.42	0.36	-1.00	3.00
Small for Gestational Age	Yes	0.39	0.33	-1.50	1.43
	No	0.42	0.37	-1.00	3.00
Overall Sample		0.42	0.36	-1.50	3.00
Minimum SFH divided by gestational age					
Preterm delivery	Yes	0.90	0.05	0.79	1.00
	No	0.93	0.06	0.60	1.12
Low Birth Weight	Yes	0.91	0.06	0.79	1.12
	No	0.93	0.06	0.60	1.10
Small for Gestational Age	Yes	0.91	0.07	0.76	1.12
	No	0.93	0.06	0.60	1.10
Overall Sample		0.93	0.06	0.60	1.12
Change in SFH per week					
Preterm delivery	Yes	0.94	0.46	-0.33	2.00
	No	1.02	0.41	-1.50	3.55
Low Birth Weight	Yes	0.90	0.46	-1.50	2.00
	No	1.03	0.40	-1.40	3.55
Small for Gestational Age	Yes	0.91	0.44	-1.50	2.00
	No	1.04	0.40	-1.40	3.55
Overall Sample		1.02	0.41	-1.50	3.55

Comment [A19]: A very useful table would have presented average weight and average SFH by EGA week. You would rapidly see that any difference starts to show up at 27 weeks or so, if then.

Table 4: Logistic Regression results using change in weight per week

Change in weight per week and preterm delivery

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Change in weight per week	653	0.63	0.11, 3.71	0.609	648	0.64	0.12, 3.31	0.594
Smoker					648	0.83	0.31, 2.24	0.717
Mother's height					648	0.98	0.94, 1.03	0.463
Mother's age					648	0.91	0.81, 1.02	0.11
Parity					648	1.35	0.90, 2.01	0.146

Change in weight per week and low birth weight

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Change in weight per week	654	0.74	0.37, 1.46	0.609	649	0.74	0.36, 1.76	0.576
Smoker					649	1.71	1.00, 2.91	0.05
Mother's height					649	0.93	0.88, 0.97	0.001
Mother's age					649	0.96	0.89, 1.03	0.234
Parity					649	0.97	0.67, 1.40	0.87

Change in weight per week and small for gestational age

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Change in weight per week	658	0.75	0.42, 1.33	0.323	649	0.74	0.38, 1.42	0.365
Smoker					649	1.93	1.21, 3.08	0.006
Mother's height					649	0.94	0.91, 0.98	0.003
Mother's age					649	0.95	0.89, 1.01	0.13
Parity					649	0.94	0.68, 1.30	0.684

Table 5: Logistic regression results using change in SFH per week

Change in SFH per week and preterm delivery

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Change in SFH per week	653	0.63	0.24, 1.66	0.345	648	0.65	0.24, 1.74	0.391
Smoker					648	0.84	0.31, 2.24	0.727
Mother's height					648	0.98	0.93, 1.02	0.409
Mother's age					648	0.92	0.82, 1.03	0.127
Parity					648	1.34	0.89, 2.02	0.16

Change in SFH per week and low birth weight

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Change in SFH per week	654	0.47	0.28, 0.81	0.007	649	0.47	0.28, 0.81	0.006
Smoker					649	1.73	1.01, 2.96	0.045
Mother's height					649	0.92	0.88, 0.97	0.001
Mother's age					649	0.96	0.89, 1.04	0.315
Parity					649	0.96	0.66, 1.37	0.804

Change in SFH per week and small for gestational age

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Change in SFH per week	658	0.48	0.29, 0.79	0.004	649	0.49	0.29, 0.83	0.008
Smoker					649	1.96	1.23, 3.14	0.005
Mother's height					649	0.94	0.91, 0.98	0.002
Mother's age					649	0.96	0.90, 1.02	0.196
Parity					649	0.92	0.67, 1.27	0.618

Table 6: Logistic regression results using minimum SFH/EGA

Minimum SFH/estimated gestational age and preterm delivery

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Minimum SFH/EGA	703	0.0009	0.00001, 0.07	0.002	698	0.0008	0.00001, 0.06	0.001
Smoker					698	0.91	0.36, 2.30	0.837
Mother’s height					698	0.98	0.94, 1.02	0.303
Mother’s age					698	0.94	0.86, 1.04	0.259
Parity					698	1.26	0.87, 1.81	0.218

Minimum SFH/estimated gestational age and low birth weight

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Minimum SFH/EGA	704	0.006	0.0001, 0.31	0.013	699	0.004	0.00006, 0.31	0.013
Smoker					699	1.80	1.06, 3.03	0.029
Mother’s height					699	0.93	0.88, 0.97	0.002
Mother’s age					699	0.97	0.90, 1.04	0.366
Parity					699	0.95	0.67, 1.36	0.784

Minimum SFH/estimated gestational age and small for gestational age

	Unadjusted				Adjusted			
	n	Odds Ratio	95% CI	P-Value	n	Odds Ratio	95% CI	P-Value
Minimum SFH/EGA	708	0.01	0.0004, 0.56	0.023	699	0.02	0.0004, 0.99	0.049
Smoker					699	1.99	1.27, 3.14	0.003
Mother’s height					699	0.95	0.91, 0.98	0.004
Mother’s age					699	0.97	0.91, 0.98	0.33
Parity					699	0.89	0.65, 1.21	0.454