Midterm Project (Title TBD)

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The relationship between maternal prenatal smoking and low birth weight (LBW) is a topic that has long been of interest to investigators, due to the association of LBW with poor health outcomes (Blencowe et al., 2019). An infant is considered to be LBW when they are born weighing less than 2500 grams, or less than about 5.5 lbs (WHO, 1993). LBW has been associated with many adverse effects, such as a higher mortality rate (Martin et al., 2013); various psychiatric and neurological problems (Hack et al., 2005); and even poor academic achievement (Hack et al., 2002). LBW has also been implicated as an economic impact, with Kowlessar et al. (2011) reporting an increased cost of hospital stays at $27,200 for LBW infants compared to $3,200 for all newborns. Maternal smoking during pregnancy has been of intense interest for decades because it has been implicated in LBW (Zhand and Yang, 2019; Parascandola, 2014; Yerushalmy, 1971).

However, although the association of maternal smoking with LBW is well-documented and consistent (Ventura et al., 2003), the mechanism by which it contributes to LBW and how this mechanism might be affected by other factors are not well understood. For example, the risk of LBW from prenatal smoking has been demonstrated to be significantly reduced among overweight and obese mothers (La Merrill et al., 2011). But it is unclear how these mechanisms interact with one another, as maternal pre-pregnancy BMI is itself implicated as a predictor for birth-weight (Gul et al., 2020). This relationship is further complicated by the fact that one of the primary outcomes that makes LBW a topic of interest for researchers, perinatal death, is not always associated with LBW in the way that it might seem that it should — it was demonstrated by Yerushalmy (1971) that among LBW infants, maternal smoking was actually associated with a decreased risk of perinatal death. Shah(2014) proposed that these seemingly contradictory findings, often referred to as the "Birthweight Paradox" (VanderWeele, 2014). This would reasonably explain Yerushalmy's finding if the association of this phenotype with maternal smoking were strong enough such that LBW infants with smoking mothers were much more likely to have this phenotype compared to others.

The mechanisms that might contribute to the "other" phenotypes of LBW are not entirely clear, although existing work does point toward some reasonable candidates to start with. Vanderweele (2014) proposes that the increase in mortality for LBW infants with non-smoking mothers compared to smoking mothers may be that there is a much more insidious root cause for LBW in non-smoking mothers, such as malnutrition. There is some support for malnutrition as a potential cause for LBW, as it has been demonstrated there is a higher risk of pregnancies resulting in LBW in situations of inadequate social support, such as in low-income households (Gould, Davey, and Leroy, 1989) and in teenage pregnancies (Fraser et al., 1995). As noted above, low pre-pregnancy BMI has been noted to be associated with LBW (Gul et al., 2020), as well.

This analysis has two primary aims: (1) to evaluate the effects of BMI on the relationship between maternal smoking and birth weight; and (2) to develop a model to predict birthweight based on factors such as smoking status, maternal BMI, and age. A major reason BMI is of interest in this analysis is due to its usefulness as a diagnostic tool for evaluating malnutrition, which can be otherwise difficult to assess (Cederholm et al., 2015). If a high BMI were to significantly mitigate the risk of LBW from maternal smoking compared to low BMI, this may highlight a potential biological mechanism for LBW and infant mortality that could be evaluated in future work. The motivation behind the second aim in this analysis would be to provide validation for existing methods of predicting LBW based on maternal characteristics, such as maternal pre-pregnancy BMI (Gul et al., 2020), maternal height (Inoue et al., 2016), and smoking status (Knopik et al., 2016).