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## Introduction

There are few times in life when nutritional intake matters as much as during the course of pregnancy. Modern science has demonstrated that pregnancy is a critical period of vulnerability that can impact trajectory toward health or disease, in both the birthing parent and the child. As such, much attention has been paid in scientific discourse on identifying modifiable behaviors that can improve the likelihood that results in a healthy pregnancy. The majority of the research in nutrition on this topic are focused on dietary quality, and nutrient adequacy. It is unsurprising that . However, recent evidence has pointed toward a previously under-considered modifiable component of the diet, the timing and duration of eating.

Initial evidence about the impact of the timing of eating on human health came from the field of sleep research. Routinely, researchers found that workers whose shifts are in opposition to the normal circadian rhythm have greater risks of ill health, including EXAMPLE, EXAMPLE, EXAMPLE.

New attention has been called to all health behaviors that impact or are impacted by one’s circadian rhythm. As such, modifying or compressing the timing of ones eating schedule is gaining popularity as a way to modulate health. One such modality is time-restricted eating. Evidence from human studies finds that condensing the eating window is effective for weight loss (Gabel et al., 2018; Hutchison et al., 2019; Lowe et al., 2020). There have also been studies that find that metabolic health markers, such as blood pressure and cholesterol can be improved from TRE without the reduction in body weight (Sutton et al., 2018). However, data from human pregnant populations remains scarce.

Timing data

Ramadan

Loy/Flanagan

Other groups have begun to disentangle the relationship between circadian eating and parental health during pregnancy. One such study found that the timing of meals was associated with maternal glycemia (directionality). Others have found that there is interest or openness to this behavior.   
  
Because pregnancy is a critical period of development with opportunity to impact health of the pregnant person and their child and because evidence surrounding the timing of eating in these populations is minimal, we sought to examine the association between the timing of eating and duration of fasting and mid-gestation glycemia and birth weight in a pregnancy cohort. We hypothesized that those who have earlier meal timing and longer duration of overnight fasts would have more favorable mid-gestation glucose tolerance test results without reductions in their infant’s birth weights.

## Methods

### Study design

The Pregnancy Related Eating Sleeping, and Stress (PRESS) cohort was developed as a longitudinal, survey-based, clinical research study. This study was designed to understand nutritional and behavioral contributors to perinatal health. Participants were recruited into PRESS either by self-selection on the University of Michigan Health Research page or were invited to enroll based on their current OB status at Michigan Medicine reflecting pregnancy. Survey information for this analysis includes those captured at 20-24 weeks gestation (trimester 2), and 30-34 weeks gestation (trimester 3).

### Study population

Individuals who were interested in the study were directed toward a public REDCap link that results in a screening questionnaire. Those who were 18 years old, currently pregnant, in weeks 1-30 of pregnancy, and were currently receiving care and planning to deliver at Michigan Medicine we deemed as eligible. Those who were invited to join the study. We gained informed consent to use survey responses in a research capacity as well as to have read-only access to medical records for the current pregnancy for themselves and for their resulting children. Those who were consented into the study were then directed toward our survey instruments. For data analysis, we excluded individuals with missing timing data, non-plausible timing data, those who were expecting multiples, had pre-existing diabetes before pregnancy, were lost to follow up, or had not had medical chart information abstracted at the time of the analysis.

### Exposure measurement

Our primary exposure was the timing of eating during pregnancy. This was assessed during each trimester using a questionnaire that asked participants “**On a typical day during this trimester, when was the first time in the day you had something to eat? (This includes beverages that have calories; like coffee or tea with cream or sugar)**” to indicate the beginning of an eating window, and “**On a typical day during this trimester, when was the last you had something to eat before going to bed? (This includes beverages that have calories; like coffee with cream or sugar)**” to indicate the end of the eating window. We collected this information for both workdays and weekend days. We then calculated eating duration as the difference between the last eating occasion and first eating occasion and expressed this as hours. To determine fasting duration, we subtracted eating duration from 24 hours. We also evaluated the first and last eating time as an independent exposure, which was expressed in military time. Midpoint of overnight fast was calculated as 1/2 the duration of fasting added to the timing of the last meal of the day. Data were cleaned by inspecting first and last eating and start/stop sleeping to be non-overlapping. Values that did not report timing data in military time were manually assessed and converted to 24-hour format when necessary

### Outcome measurement

The main outcomes of interest were objective values that were abstracted from the medical chart of participants. Trained research staff who had been given view-only access to OB records accessed the participant’s medical charts after their expected due dates and viewed the delivery note. From the medical records of enrolled patients, we collected mid-gestation oral glucose tolerance test results in mg/dL and infant birth weight in grams. We also collected other critical covariate information such as history of diabetes (type 1, type 2, and gestational), current diagnosis of gestational diabetes, history of or current pre-eclampsia, pre-gestational or gestational hypertension, parental body weight before delivery, sex of the infant, gestational age of infant at birth, and delivery method.

#### Oral Glucose Tolerance Test values

The primary outcome for parental health was the results of oral glucose tolerance test that is administered during mid-gestation to all pregnant parents who do not currently have diabetes. These oral glucose tolerance test values were collected from the medical record and were completed during mid gestation (24-28 weeks’ gestation) according to Michigan Medicine guidelines. Expectant parents were instructed to consume a 50-gram liquid glucose drink in under 5 minutes. One hour later, blood was collected via venipuncture and glucose was determined by Michigan Medicine laboratory personnel.

#### Child Birth Weight values

Infant birth weight values in grams were abstracted directly from the pediatric note following delivery of the child. Infant birth weight is recorded as grams.

#### Other Covariates

The data comprised in the PRESS study included validated instruments for repeated measures for dietary quality (DSQ paper here), perceived stress (PSS-4 paper here), nausea and vomiting of pregnancy (PUQ-24 Paper HERE), and disordered eating behavior (EDEQ-s paper here). Sociodemographic and baseline behavioral information was collected upon enrolling in the study. This included data about parity, baseline diabetes and hypertension status, self-reported pre-pregnancy BMI, physical activity, relationship status, smoking exposure, sleeping duration, as well as race/ethnicity, income, and parent level of education. Final models were adjusted for XXXX.

### Statistical Analyses

All exposure and outcome values were assessed for normality through histograms and residual plots. Values that were not normally distributed were expressed as median ± inter-quartile range (IQR). Bivariate analysis was completed by comparison of the exposures and outcomes of interest with   
Results:

As stated previously, we excluded individuals with pre-existing diabetes, inaccurate or missing timing data, loss to follow up, those who delivered multiples, and those without outcome data at the time of the analysis. This resulted in 102 individuals with 54 individuals who have repeated data for trimesters 2 and 3 (Figure 1).

As expressed in table 1, PRESS participants tended to be older (age ± ), highly educated (% with higher edu), and have high household incomes.