Factors impacting gestational diabetes mellitus health disparities in the Midwestern U.S.

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Introduction:

- GDM is a common diagnosis during pregnancy is affecting up to 10% of pregnancy in the United States. (Gregory & Ely, 2022)
- The presence of GDM can lead to negative health outcomes for mother increasing the risk of adverse pregnancy, as such preeclampsia, hypertension, and preterm labor, while macrosomia, dysmaturation, birth injury, and respiratory distress in the infant. (Delanerolle, et al, 2021)
- Racial disparities during pregnancy increase risks for historically devalued racial and ethnic groups:
  - Women of devalued racial/ethnic minority groups including Asian Americans, have consistently been found to have an increased risk of GDM. (Hedderson, Darbinian & Ferrara, 2010)
  - Black women with GDM are more likely to experience preterm delivery, while Asian women were more likely to have large for gestational age infants (Nguyen, et al., 2012)
  - Black women are more likely to give birth to low birthweight infants. (Vilda, et al., 2019)
  - From 2014-2020, among women with GDM in the US, Black and Asian/Pacific Islander individuals continued to have increased risk for small for gestational age neonates compared to White individuals, while American Indian individuals did not (Venkatesh et al., 2022).
- Interactions between race, meternal age, and BMI have been reported to increase the risk of GDM (Makgoba, et al., 2012a), and birthweight (Makgoba, et al., 2012b) for some communities. However these have not been fully explored.

Objective:
- To examine the influence of race, maternal age, and BMI on rates of GDM diagnosis, as well as fetal growth.

Hypotheses:
- Racial disparities in rates of GDM will not be fully accounted for by the influence of BMI and maternal age.
- Racial disparities in fetal growth (birthweight and gestational length) will not be fully accounted for by the influence of BMI and maternal age.

Methodology:

- We examined 11,311 medical records between 2011-2021, from a large Midwestern healthcare system servicing South Dakota, North Dakota, Minnesota and Iowa.

- Inclusion criteria:
  - Maternal age between 18-45
  - First recorded pregnancy
  - Gestational length <43 weeks
  - Recorded pregnancy BMI or Height & Weight to calculate BMI
  - Race was indicated by maternal medical record as follows:
    - American Indian/Alaskan Native referred to here as Indigenous Americans (IA; N=407)
    - Asian (N=194)
    - African American/Black referred to here as Black (N=334)
    - Native Hawaiian/Pacific Islanders (NH/PI; N=23)
    - Caucasian/White referred to here as White (N=10166).

After meeting inclusion criteria, 9,720 records were retained for analysis.
- Gestational Diabetes Mellitus (GDM) was identified using ICD-10 code 024.axx.

Statistical Analysis:
We first analyzed the data descriptively, summarizing continuous variables with mean and standard deviation and categorical variables using frequencies and percentages.

Odds ratio and 95% confidence intervals (CI) were obtained for each race group using logistic regression.
- Maternal Age, Female Child, BMI
- Race

Multiple linear regression was used in the birth weight models.
- Maternal Age, Female Child, BMI, Gestational Length, GDM Diagnosis
- Race

Results

Demographics and study variables are outlined in Table 1, and prevalence of GDM in Table 2.
Study variable correlation coefficients in Figure 1.

Table 1: Demographics

	IA (N=294)	Asian (N=162)	Black (N=262)	NH/PI (N=17)	White (N=8985)	Total (N=9720)
Mean (SD)						
Maternal Age	23.6 (5.2)	28.2 (5.3)	26.6 (5.3)	25.6 (4.3)	27.3 (4.5)	27.2 (4.6)
BMI (Kg/M^2)	30.9 (6.5)	25.8 (5.3)	29.4 (7.5)	26.6 (5.0)	28.2 (606)	28.3 (6.7)
Gestational Length (weeks)	38.5 (3.3)	38.6 (3.2)	38.4 (4.1)	38.0 (2.4)	38.9 (2.6)	38.8 (2.6)
Birthweight (Grams)	3349.0 (585.1)	3153.2 (503.1)	3187.5 (536.8)	2962.9 (433.0)	3309.7 (553.3)	3304.6 (553.7)
Frequency (%)						
Female Child	146 (49.8%)	74 (45.7%)	114 (43.7%)	11 (64.7%)	4378 (48.8%)	4723 (48.7%)

	IA	Asian	Black	NH/PI	White	Total
	12 (4.1%)	24 (14.8%)	18 (6.9%)	2 (11.8%)	464 (5.2%)	520 (5.3%)

Regression analysis:
After entering covariates of maternal age, BMI, and fetal sex, Black women were less likely, while Asian and NH women were more likely to be diagnosed with GDM than White women. Furthermore, after entering covariates for maternal age, BMI, fetal sex, GDM diagnosis, and gestational length neonates of IA women were heavier, while Black women had babies that weighed less than White women.

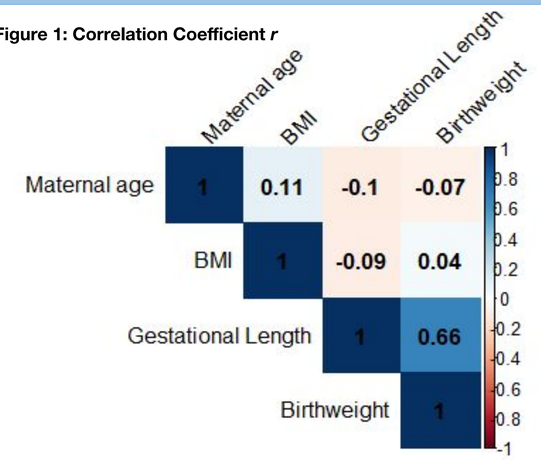
Logistical Regression predicting GDM Diagnosis	β (95% CI)
Maternal Age	0.07*** (0.05, 0.08)
Neonate Female	0.06 (-0.10, 0.22)
Overweight	0.32*** (0.08, 0.55)
BMI Class I	0.60*** (0.36, 0.85)
BMI Class II	0.72*** (0.43, 1.00)
BMI Class III	0.98*** (0.70, 1.25)
Indigenous Americans	0.34 (-0.10, 0.77)
Asian Americans	1.66*** (1.14, 2.18)
Black	0.49** (0.04, 0.94)
NH/PI	1.87* (-0.09, 3.84)
Constant	-3.90*** (-4.38, -3.42)
Observations	4,244
Log Likelihood	-1,872.22
Akaike Inf. Crit.	3,766.43

Note: Reference group for BMI is "Normal" classification. Reference group for Race/Ethnicity is "White." ***p<0.01; **p<0.05; *p<0.1

Regression Model Predicting Birthweight	β (95% CI)
Maternal Age	-3.78*** (-6.45, -1.11)
Neonate Female	-118.41*** (-144.48, -92.35)
Overweight	62.69*** (28.47, 96.91)
BMI Class I	115.77*** (77.35, 154.20)
BMI Class II	78.34*** (31.76, 124.93)
BMI Class III	192.74*** (146.00, 239.48)
GDM+	45.86** (10.76, 80.96)
Indigenous Americans	171.11*** (99.03, 243.18)
Asian Americans	-49.59 (-159.69, 60.52)
Black	-122.60*** (-205.33, -39.87)
NH/PI	-55.73 (-542.21, 430.74)
Gestational length (Days)	186.34*** (179.57, 193.11)
Constant	-3,801.66*** (-4,080.05, -3,523.27)
Observations	4,169
R^2	0.43
Adjusted R^2	0.43
Residual Std. Error	428.81 (df = 4156)
F Statistic	259.07*** (df = 12; 4156)

Note: Reference group for BMI is "Normal" classification. Reference group for Race/Ethnicity is "White." ***: p<0.01; **: p<0.05; *: p<0.1

Figure 1: Correlation Coefficient *r*



Discussion

Despite having access to prenatal care in the same health system, disparities related to GDM and fetal growth were observed. These disparities, which are experienced by historically marginalized pregnant women, exist regardless of maternal age and BMI. When we examined the same data set with only racial category predicting GDM Diagnosis, the model resulted in the same directional pattern for each racial category (IA: β=0.14, Asian: β =1.55***, Black β =0.49**, NH: β =1.61).

Further research is necessary to determine if other factors, not available to us in this dataset including experiences of racism (Hilmert, et al., 2008), may influence pregnancy health increasing the risk of GDM diagnosis and/or reduce fetal growth.

By providing prenatal care that addresses culturally specific risks for groups experiencing health disparities, along with maternal age and BMI, we may be able to improve pregnancy related health outcomes in the future.

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