Intersectional Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA) for Social Determinants of Health and Pregnancy Outcomes

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PurpleLab® HEALTHCARE ANALYTICS

RWD141

Background

- Disparities persist across pregnancy outcomes, yet most studies rely on additive models or limited interaction terms that fail to capture the complexity of overlapping social determinants of health (SDOH).
- This study applies MAIHDA, a rigorous intersectional approach, to better understand how social positions jointly shape pregnancy outcomes.

Objectives

Investigate how intersecting SDOH, combinations of multiple social identities and positions, are associated with **miscarriage** and **termination** pregnancy outcomes using a large U.S. claims dataset.

Methods

Data Source:

- We used **PurpleLab's healthcare claims repository** of medical and pharmacy claims (Jan 1, 2014 to June 30, 2024), to identify pregnancy-related events for women aged 18 to 49.
- Pregnancy outcome events were classified as: (1) **Full-Term Delivery**; (2) **Miscarriage**; or (3) **Termination** using curated lists of ICD-10-CM, ICD-10-PCS, CPT-4, and HCPCS.
- We defined our intersectional strata using six SDOH measures:

- **Age Group** — 18–24, 25–29, 30–34, 35–39, 40–49
- **Race and Ethnicity** — NH White, NH Black, Hispanic, NH Other
- **Education Attainment Levels** — HS or less, College or more
- **Marital Status** — Married, Single
- **Medicaid Enrollment** — Yes, No
- **US Geographical Region** — Northeast, Midwest, South, West

Statistical Analysis:

- **Multilevel Analysis of Individual Heterogeneity and Discriminatory Accuracy (MAIHDA)** was used to quantify how intersecting SDOH influences the likelihood of miscarriage and termination compared to delivery.
- Each model includes a **random intercept** per intersectional stratum plus **additive fixed effects** of the six SDOH factors while excluding strata with <10 events to ensure model stability.
- Identified the **top 5 intersectional groups** with the highest predicted probability of experiencing miscarriage or termination, based on their combined social characteristics.

Conclusion

- **Intersectionality matters:** The full model, which accounted for multiple social factors and their combined influence, added meaningful information. This approach revealed that certain combinations of social positions were associated with higher predicted likelihoods than would be expected from looking at individual factors alone.
- **MAIHDA captures compounded inequities:** This approach identifies disparities that are missed by standard single-variable models, highlighting how overlapping disadvantages shape outcomes in complex ways.
- **Isolated traits are not outcome determinants:** Health outcomes are shaped by the intersections of social identities—not by isolated traits. Interventions must address structural determinants that disproportionately affect groups exposed to multiple axes of social vulnerability.

Results

Miscarriage vs. Delivery Model

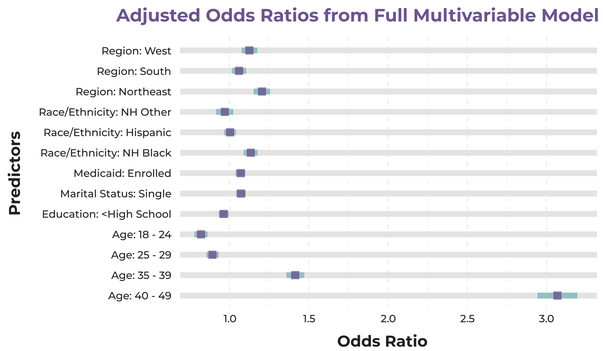
Number of Patients: **398,163**

Number of Stratum: **565**

Before adjusting for the six individual SDOH factors, **3.9%** of the variation in miscarriage outcomes was due to differences across intersectional social groups defined by those factors.

Adding the six SDOH factors explained **94.6%** of the between-group variance

	Random Intercept Only Model	Full Model
AIC:	536323.8	535117.7
BIC:	536345.6	535281.1



Notes: Reference categories: Region = Midwest; Race/Ethnicity = NH White; Medicaid = Not enrolled; Marital Status = Married; Education = College or more; Age = 30-34.

Termination vs. Delivery Model

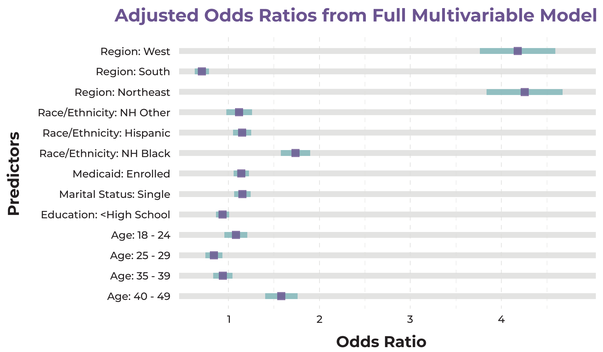
Number of Patients: **228,546**

Number of Stratum: **531**

Before adjusting for the six individual SDOH factors, **4.0%** of the variation in miscarriage outcomes was due to differences across intersectional social groups defined by those factors.

Adding the six SDOH factors explained **85.2%** of the between-group variance

	Random Intercept Only Model	Full Model
AIC:	276773.8	275877.8
BIC:	276794.5	276032.8



Notes: Reference categories: Region = Midwest; Race/Ethnicity = NH White; Medicaid = Not enrolled; Marital Status = Married; Education = College or more; Age = 30-34.

Top 5 Intersectional Strata with the Highest Overall Predicted Probability of Miscarriage

Full Model

Rank	Propensity	Age Group	Race/Ethnicity	Region	Education	Medicaid	Marital Status
1	77.11	40-49	NH Black	Northeast	High School or Less	Medicaid Enrollment	Single
2	76.40	40-49	Hispanic	West	Some College or More	Medicaid Enrollment	Single
3	76.20	40-49	White	Northeast	Some College or More	Medicaid Enrollment	Single
4	76.09	40-49	White	West	Some College or More	Medicaid Enrollment	Single
5	75.94	40-49	NH Black	Northeast	High School or Less	No Medicaid Enrollment	Single

Top 5 Intersectional Strata with the Highest Overall Predicted Probability of Termination

Full Model

Rank	Propensity	Age Group	Race/Ethnicity	Region	Education	Medicaid	Marital Status
1	86.53	18-24	NH Black	Northeast	Some College or More	No Medicaid Enrollment	Single
2	86.15	40-49	NH Black	Northeast	High School or Less	No Medicaid Enrollment	Single
3	85.92	40-49	NH Black	West	High School or Less	Medicaid Enrollment	Single
4	85.54	25-29	NH Black	West	Some College or More	Medicaid Enrollment	Single
5	85.21	40-49	NH Black	Northeast	High School or Less	Medicaid Enrollment	Single

ISPOR 2025 | May 13-16 | Montreal, QC, Canada