Research Square

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Associations of Socioeconomic Status with Maternal Mental Health: Insight from NIH All of Us Research Program

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Abstract

Background

Maternal mental health conditions during pregnancy and the postpartum period are a major public health concern, affecting the health of both mothers and their children. However, the combined impact of multiple socioeconomic factors on perinatal depression and anxiety remains poorly understood. This study examined the association between socioeconomic status and maternal mental health among pregnant women in the NIH All of Us Research Program.

Methods

We conducted a retrospective cohort study of individuals aged 18–55 years with at least one documented pregnancy in the All of Us research program between January 1, 2018, and December 31, 2023. Multidimensional socioeconomic factors, including education level, marital status, health insurance, employment status, and income, were studied. The primary outcomes were depression and anxiety during the perinatal period. Associations were assessed using generalized linear models, and adjusted odds ratios with 95% confidence intervals were reported.

Results

The study identified 8,062 individuals, with a median age of 30.2 years (SD = 6.2). Most participants identified as White (47.9%), Hispanic or Latino (31.8%), or Black (15.4%). Overall, 9.5% of the participants had depression, and 10.7% had anxiety during the perinatal period. Participants who had attended some college (OR: 1.48, 95% CI: 1.06–1.77), who were separated (OR: 1.71, 95% CI: 1.13–2.58), and who were unemployed (OR: 1.29, 95% CI: 1.10–1.52) had significantly higher odds of both depression and anxiety. Women with an annual household income greater than 150k had significantly lower odds (OR: 0.63, 95% CI: 0.47–0.84) of perinatal depression and anxiety.

Conclusion

Education, employment, marital status, and income were strongly associated with perinatal depression and anxiety. These findings suggest multidimensional socioeconomic screenings should be integrated into prenatal and postpartum care to identify women at risk before psychiatric symptoms develop, which may improve the health outcomes of both mothers and their children.

BACKGROUND

Maternal Mental health conditions during pregnancy and postpartum are increasingly recognized as a significant public health challenge in the United States. It impacts the health of both mother and child.

Historically, maternal mental health has been primarily addressed post-childbirth, with an emphasis on postpartum depression (PPD).[1] However, growing evidence highlights the importance of monitoring mental health throughout pregnancy, from conception to the postpartum period.[1–3] In the U.S., one in five women experiences a mental health condition during and/or pregnancy annually.[4] Among affected women, less than 15% of received treatment, and up to 75% of maternal mental health conditions were left undiagnosed and untreated.[5] An untreated diagnosis of mental health during pregnancy and the postpartum also increases the risk of adverse social, cognitive, and emotional developmental outcomes in offspring.[6] Studies have shown that maternal mental health is associated with maternal mortality, preterm birth (births before 37 weeks), low birthweight (< 2,500 g), and fetal growth restriction.[7–9] Globally, approximately 10% of pregnant women and 13% of postpartum women experienced at least one mental health disorder, primarily depression and anxiety.[10] Recent epidemiological data suggest that approximately one in seven women in the U.S. experience perinatal depression, while anxiety affects upwards of 20% of the perinatal population.[11] Despite the high prevalence, the burden of these mental health conditions is not distributed equally across the U.S.

A significant determinant of this inequity is socioeconomic status (SES) across the population. SES is a multifaceted construct often measured through a combination of education, income, and occupation, and can be measured at both the individual and community levels.[12–15] In the context of the U.S. healthcare system, which is characterized by high costs, fragmented insurance coverage, and significant barriers to specialty care access, SES plays a critical determinant shaping mental health outcomes during pregnancy. Current literature has established a robust and complex relation between low SES and poor maternal mental health outcomes.[16–19] Low SES, including low education and lack of income, increases perinatal psychological distress and the risk of psychiatric disorders.[20] Previous studies have also shown that women with low educational attainment and limited financial resources are up to eleven times more likely to develop significant depressive symptoms than those with higher SES.[16] Low SES populations are also more likely to experience barriers to healthcare access, further compounding the burden of untreated perinatal mental health disorders.[21]

Despite increasing awareness regarding maternal mental health, substantial gaps remain in understanding how multiple dimensions of socioeconomic status collectively influence both perinatal depression and anxiety among pregnant women. There is a notable lack of longitudinal research that tracks the co-occurrence of depression and anxiety across the entire perinatal period from conception to postpartum.[22,23] While some studies have started to work on the perinatal period, they often lack consistency in identifying how symptom patterns evolve from pregnancy through postpartum.[22] Most studies are cross-sectional and focused primarily on the postpartum period rather than mental health conditions occurring during pregnancy.[16,24] Findings regarding the relationship between socioeconomic status and maternal mental health varied across studies. Previous studies observed no association between poor income and low education with depressive symptoms during pregnancy.[25] Other studies, on the contrary, reported greater evidence supporting the association of low SES and maternal mental

health.[26] Additionally, few studies considered the mental health symptoms during the perinatal period and examined the risk among samples of racially diverse women.[27,28] Within these previous studies on maternal mental health, there remains a need to examine the prevalence of depression and anxiety using multifaceted socioeconomic status on the perinatal population in the U.S.

To accommodate the abovementioned research needs, we have conducted an integrative analytic approach that simultaneously considers the multidimensional socioeconomic status of depression and anxiety within large, diverse populations across the nation in the NIH All of Us Research Program.[29] We used a generalized linear model to identify and interpret risk factors of both depression and anxiety during the perinatal period.

METHODS

Study Population

Individuals with at least an electronic health record of pregnancy between January 1, 2018, and December 31, 2023, in the National Institutes of Health (NIH) All of Us (AoU) research program were included. The pregnancy events include normal pregnancy as well as pregnancies with clinical conditions, including high-risk pregnancy, fetal abnormalities, normal delivery, incidental pregnancy, gestational hypertension, abortion, and gestational diabetes. These conditions were identified using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes defined in the 2023 official guideline from the Centers for Medicare and Medicaid Services (CMS).[30] A single pregnancy era encompasses multiple pregnancy-related encounters, including prenatal visits, labor and delivery records, follow-up consultations, and other medical interactions documented throughout the pregnancy journey. As AoU initiated participant enrollment in 2018,[29] Participants with pregnancies before January 2018 were excluded. We considered the analysis of pregnancies occurring among individuals aged 18–55 years to ensure ethical consistency and inclusion of clinically plausible pregnancies at advanced maternal ages.[31] In the case of multiple pregnancies, only the first recorded pregnancy for each individual was included in the analysis. A detailed inclusion and exclusion flow diagram is presented in Fig. 1.

Data Collection

The NIH All of Us Research Program was launched in 2018 and is a collaborative initiative involving over 400 academic institutions. Its goal is to enroll at least one million participants across the United States to build one of the most diverse health databases in history. The program collects comprehensive data, including electronic health records (EHR), surveys, physical measurements, biospecimens, and wearable device information, to better understand how genetic, environmental, and lifestyle factors influence health and disease. The participants are from a diverse cohort of adults (18+) across the United States, with nearly half representing groups traditionally underrepresented in research, including racial and

ethnic minorities, people from varied socioeconomic backgrounds, and individuals with disabilities.[29,32] The dataset is stored in a secure cloud-based researcher workbench platform. An institutional data use agreement (DUA) is required. As an authorized user under the DUA between Meharry Medical College and NIH All of Us Research Program, we can access diverse data that enable us to investigate a broad spectrum of factors influencing health and disease.[33] This study utilized available deidentified data from Controlled Tier - Version 7.

Index Pregnancy

The index pregnancy was defined as the first recorded pregnancy episode for everyone. We first identified the initial hospital visit related to pregnancy using pregnancy-specific ICD-10 diagnosis codes recorded in the EHR. For each participant, the earliest pregnancy-related encounter was used to calculate the pregnancy start date, and all subsequent encounters occurring within a 10-month window were grouped into a single pregnancy episode. The 10-month interval was chosen to reflect the expected gestational period while accommodating heterogeneity in EHR documentation, including delayed prenatal care and post-delivery follow-up. To distinguish multiple pregnancy episodes for the same participant during the study period (2018–2023), we calculated the interval between the start date of one pregnancy and the next recorded pregnant visit. If this visiting interval exceeded 10 months, it was considered the start of a new pregnancy episode. This approach minimized misclassification due to overlapping or closely spaced pregnancies. The most frequently observed ICD-10 codes for pregnancy identification are normal pregnancy (Z34) and high-risk pregnancies (O09). Other pregnancy conditions are incidental pregnancy state (Z33.1), fetal abnormalities (O35, O36), normal delivery (O80), abortion-related diagnoses (Z33.2, O04, O07, O08), gestational diabetes (O24), and gestational hypertension (O13, O16). Less common conditions included viral diseases (O98, primarily HIV), abnormal glucose levels (O99.81), cardiomyopathy (O90.3), abuse and maltreatment in pregnancy (O9A.3, O9A.4, O9A.5). The complete list of pregnancy-related ICD-10 codes and their corresponding frequencies across the cohort are presented in Supplementary Table 1.

Predictors

Multiple predictors were included in this analysis, including race, ethnicity, age, and multi-dimensional socioeconomic status factors. Race and ethnicity were obtained from self-reported electronic health record data and analyzed using a composite variable. Individuals identifying as Hispanic or Latino were classified as Hispanic regardless of race, while Non-Hispanic individuals were categorized as non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, or non-Hispanic Other.[34] Socioeconomic status variables, including education level, marital status, employment status, household income, and insurance coverage, were derived from participant-reported basic survey questionnaire (details in the supplementary materials). The selection of these covariates was based on prior evidence identifying established correlates of maternal mental health.[3,35–39]

After integrating predictors, we observed substantial unresponsive or skipped results in socioeconomic variables, with more than 31% of participants not reporting or skipping income-related survey questions, followed by 1.4% for education and 2.2% for health insurance. As socioeconomic questions were self-reported, it is often considered missing not at random (MNAR).[40] Therefore, all descriptive and inferential statistical analyses were restricted to individual participants with complete data.

Outcome Variables

Outcome Variables
The primary outcome was maternal mental health, specifically depression (F20.4, F31.3-F31.5, F32.x, F33.x, F34.1, F41.2, F43.2, F53.0, Z13.31, Z13.32) and anxiety (F43.22, F43.23, F06.4, F40, F41) occurring from pregnancy to postpartum period (together referred to as the perinatal period). Specifically, the depression and anxiety outcomes during perinatal were identified if recorded between the pregnancy start date and extending through the first year after childbirth.[41]

Statistical Analyses

We conducted a multivariate regression analysis using a Generalized Linear Model (GLM) with a binomial family and a logit link function for the binary outcome of depression and anxiety. The model included main effects for all 26 covariates, including race/ethnicity, age, and multiple socioeconomic factors, to estimate adjusted associations with the risk of depression and anxiety during the perinatal period. The descriptive statistics report each continuous variable with median and interquartile range (IQR), and categorical variables were presented as frequencies with percentages. Multiple categorical variables were encoded by using one-hot encoding during the analyses. The GLM model results are presented as odds ratios (ORs) with corresponding 95% confidence intervals (CIs), and $p < 0.05$ was considered statistically significant. All statistical data analyses were performed using Jupyter Notebook on the NIH All of Us researcher workbench.

RESULTS

Study population

A total of 8,062 pregnant women were identified after applying the inclusion and exclusion criteria (Fig. 1). The majority of participants were non-Hispanic White (47.9%), Hispanic (31.8%), and non-Hispanic Black (15.4%), with a mean maternal age of 30.2 years (SD = 6.2). Overall, 7.3% of the participants received education below eleventh grade, 33.2% were unemployed, 53.1% participants had an annual household income below 50k, 52.98% were married, and 4.4% participants had no health insurance coverage (Table 1). A total of 9.5% participants experienced depression, and 10.7% experienced anxiety during the perinatal period in the study. A detailed description of the study population is summarized in Table 1.

Table 1
Demographic and Socioeconomic status characteristics of the study population

Variables	**Pregnant individual (N = 8,062)**
Age (years), mean (SD)	30.2 (6.2)
Race/Ethnicity, n (%)	
Hispanic	2560 (31.75)
NH Black	1241 (15.39)
NH White	3861 (47.89)
NH Asian	331 (4.11)
Other	69 (0.86)
Socioeconomic Status Factors, n (%)	
Education Level	
Advanced Degree	1750 (21.71)
Below Eleven Grade	587 (7.28)
College Graduate	1897 (23.53)
High School Graduate	1668 (20.69)
Some college, 1–3 years	2160 (26.79)
Employment Status	
Employed	5383 (66.77)
Income Level	
Greater than 150k	1133 (14.05)
Less than 10k	1394 (17.29)
10k to less than 50k	2888 (35.82)
50k to less than 100k	1709 (21.19)
100k to less than 150k	938 (11.63)
Marital Status	
Divorced or Widow	336 (4.17)
Married	4271 (52.98)
Never Married	1895 (23.51)
NH: Non-Hispanic; Other: Middle Eastern or North African, Native Hawaiian or Other Pacific Islander	

Variables	Pregnant individual (N = 8,062)
Living with Partner	1395 17.30)
Separated	165 (2.05)
Health Insurance Coverage	
Yes	7774 (96.43)
Outcome, n (%)	
Depression	765 (9.49)
Anxiety	863 (10.71)
NH: Non-Hispanic; Other: Middle Eastern or North African, Native Hawaiian or Other Pacific Islander	

Association between Socioeconomic Status and Perinatal Depression

Table 2 summarizes the statistical significance using the odds ratio (OR) for variables associated with perinatal depression. After adjusting for covariates, individuals who attended some colleges (OR: 1.48, 95% CI: 1.06–1.77) had higher odds of depression than advanced degree of participants with advanced degrees. Unemployed individuals (OR: 1.29, 95% CI: 1.10–1.52) were associated with higher odds of depression than their counterparts.

Table 2
Odds ratio (OR) of perinatal Depression by Sociodemographic characteristics

Variables	OR (95% CI)	P value
Age (reference: 25–35 years)		
18–25 years	0.90 (0.74 to 1.11)	0.33
36–55 years	1.03 (0.86 to 1.23)	0.73
Socioeconomic status (SES)		
Education Status (reference: Advanced Degree)		
Below Eleven Grade	1.06 (0.73 to 1.53)	0.77
College Graduate	1.06 (0.84 to 1.34)	0.61
High School Graduate	1.29 (0.97 to 1.73)	0.08
Some college, 1–3 years	1.48 (1.06 to 1.77)	< 0.001
Employment Status (reference: Employed)		
Unemployed	1.29 (1.10 to 1.52)	< 0.001
Marital Status (reference: Married)		
Divorced or Widowed	1.29 (0.92 to 1.82)	0.14
Living with Partner	0.97 (0.78 to 1.21)	0.82
Never Married	1.09 (0.89 to 1.33)	0.43
Separated	1.40 (0.89 to 2.21)	0.15
Income Level (reference: 100k to less than 150k)		
Greater than 150k	0.83 (0.62 to 1.11)	0.21
Less than 10k	0.86 (0.62 to 1.21)	0.39
10k to less than 50k	0.78 (0.59 to 1.04)	0.09
50k to less than 100k	0.86 (0.66 to 1.13)	0.28
Health Insurance Coverage (reference: Yes)		
No	1.04 (0.72 to 1.51)	0.83

Association between Socioeconomic Status and Perinatal Anxiety

Table 3 summarizes the statistical significance using the OR for variables associated with perinatal anxiety. After adjusting for covariates, participants who attended some colleges (OR: 1.30, 95% CI: 1.02–1.66) had higher odds of anxiety than advanced degree of participants. Unemployed individuals (OR: 1.41, 95% CI: 1.21–1.64), and separated (OR: 1.71, 95% CI: 1.13–2.58) were associated with higher anxiety than their counterparts. However, income higher than 150k (OR: 0.63, 95% CI: 0.47–0.84) was less likely to have perinatal anxiety compared with income between 100k and 150k individuals.

Table 3
Odds ratio (OR) of perinatal Anxiety by Sociodemographic characteristics

Variables	OR (95% CI)	P value
Age (reference: 25–35 years)		
18–25 years	0.87 (0.72 to 1.05)	0.15
36–55 years	1.0 (0.85 to 1.19)	0.98
Socioeconomic status (SES)		
Education Status (reference: Advanced Degree)		
Below Eleven Grade	0.93 (0.65 to 1.34)	0.71
College Graduate	1.13 (0.91 to 1.41)	0.27
High School Graduate	1.22 (0.93 to 1.61)	0.15
Some college, 1–3 years	1.30 (1.02 to 1.66)	< 0.001
Employment Status (reference: Employed)		
Unemployed	1.41 (1.21 to 1.64)	< 0.001
Marital Status (reference: Married)		
Divorced or Widow	1.14 (0.82 to 1.59)	0.44
Living with Partner	1.02 (0.83 to 1.24)	0.88
Never Married	0.93 (0.77 to 1.14)	0.95
Separated	1.71 (1.13 to 2.58)	< 0.001
Income Level (reference: 100k to less than 150k)		
Greater than 150k	0.63 (0.47 to 0.84)	< 0.001
Less than 10k	0.84 (0.61 to 1.15)	0.27
10k to less than 50k	0.79 (0.61 to 1.03)	0.08
50k to less than 100k	0.91 (0.71 to 1.16)	0.46
Health Insurance Coverage (reference: Yes)		
No	0.98 (0.68 to 1.41)	0.92

DISCUSSION

This study of 8,062 pregnant women in the NIH All of Us Research Program demonstrates that socioeconomic status is strongly associated with perinatal depression and anxiety. Our primary

outcomes reveal that maternal mental health burdens are substantial, with 9.5% of participants experiencing depression and 10.7% experiencing anxiety within the perinatal window. Our findings showed that lower educational attainment, unemployment, and marital separation were associated with an increased risk of maternal psychological distress during the perinatal period.

Lower educational attainment was significantly associated with higher odds of perinatal depression and anxiety. Compared with women holding an advanced degree, those with some college education had 1.5-fold higher odds of depression and 1.3-fold higher odds of anxiety. These findings are consistent with prior studies suggesting that higher educational attainment protects against adverse maternal mental health outcomes.[42,43] Employment status was a strong predictor of perinatal mental health. Unemployed women had significantly higher odds of both depression and anxiety after adjustment for potential confounders. This finding is consistent with previous studies showing that unemployment and financial instability contribute to psychological distress during the perinatal period.[16,44] The financial burden of pregnancy and childcare, combined with unstable employment, may increase the risk of perinatal depression and anxiety. Our findings also underscore the importance of social support during the perinatal period. Women who were separated had higher odds of perinatal anxiety than those who were married, suggesting that stable partner and family support may protect maternal mental health.

Household income showed a differential association with perinatal depression and anxiety. Although income was not significantly associated with perinatal depression, participants with an annual household income greater than $150,000 had significantly lower anxiety than those with annual household incomes between $100,000 and $150,000. The lack of an association with depression suggests that other factors, such as educational attainment and employment status, may mediate their relationship with socioeconomic status.

Our findings suggest that routine prenatal and postpartum care should incorporate socioeconomic screening in addition to mental health assessments to identify women at increased risk before symptoms develop. Early identification and intervention are essential for improving maternal and child health outcomes. Policies and interventions that promote educational attainment, employment stability, and social support may help reduce the burden of perinatal mental health conditions, particularly among women who are unemployed, separated, or have lower educational attainment.

Despite its strengths, this study has several limitations. First, all socioeconomic measures in the NIH All of Us Research Program were collected at a single time point for each participant. Because survey completion could have occurred either before or after pregnancy, these measures may not accurately reflect changes in socioeconomic status throughout the perinatal period. Second, to preserve data integrity, we used a complete case analysis, i.e., our analysis was limited to participants with complete data, as income information may not be missing at random. Future studies should consider advanced imputation methods to address missing socioeconomic data. Third, because participants in the NIH All of Us Research Program are volunteers, they may differ from the general pregnant population in socioeconomic characteristics and health behaviors. Therefore, we should be cautious when

generalizing these findings to all pregnant populations. Finally, our analysis was limited to a few pregnancy-related conditions defined by CMS ICD-10 guidelines, whereas a wider range of pregnancy conditions will be examined in future work.

CONCLUSION

In summary, this investigation demonstrates that socioeconomic status impacts women's perinatal mental experiences. Education, employment, marital status, and income were strongly associated with perinatal depression and anxiety. These findings suggest multidimensional socioeconomic screenings should be integrated into prenatal and postpartum care to identify women at risk before psychiatric symptoms develop, which may improve the health outcomes of both mothers and their children.

Abbreviations

AoU - All of Us

NIH - National Institutes of Health

CMS - Centers for Medicare and Medicaid Services

ICD-10 - International Classification of Diseases, Tenth Revision

EHR – Electronic Health Record

SES – Socioeconomic Status

GLM– Generalized Linear Model

MNAR – Missing Not at Random

IQ - Interquartile Range

OR - Odds Ratio

CI - Confidence Interval

SD – Standard Deviation

HRSA - Health Resources and Services Administration

HHS - Health and Human Services

Declarations

Human Ethics and Consent to Participate. This study used de-identified data from the National Institutes of Health All of Us Research Program (Controlled Tier – version 7). Access was granted through Meharry's Data Use and Registration Agreement with All of Us, and analyses were conducted by authorized users in the All of Us Researcher Workbench. All of Us participants provided informed consent at enrollment.

Consent for Publication. Not applicable. The approval for dissemination of this work was obtained through the All of Us Research Program's publication review process.

Availability of Data and Materials. This research was conducted using data from the National Institutes of Health All of Us Research Program. Access to the data is available upon application and approval of an institutional data use agreement with the NIH All of Us Research Program.

Authors' contributions. All authors contributed to this study. AC supervised all stages of the work and provided critical scientific and methodological guidance, as well as manuscript reviews. US conducted the data analysis and manuscript drafting under the supervision of AC. TG, BA, JJ provided critical review and revisions to improve the intellectual content of the manuscript. All authors read and approved the final manuscript.

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Figures

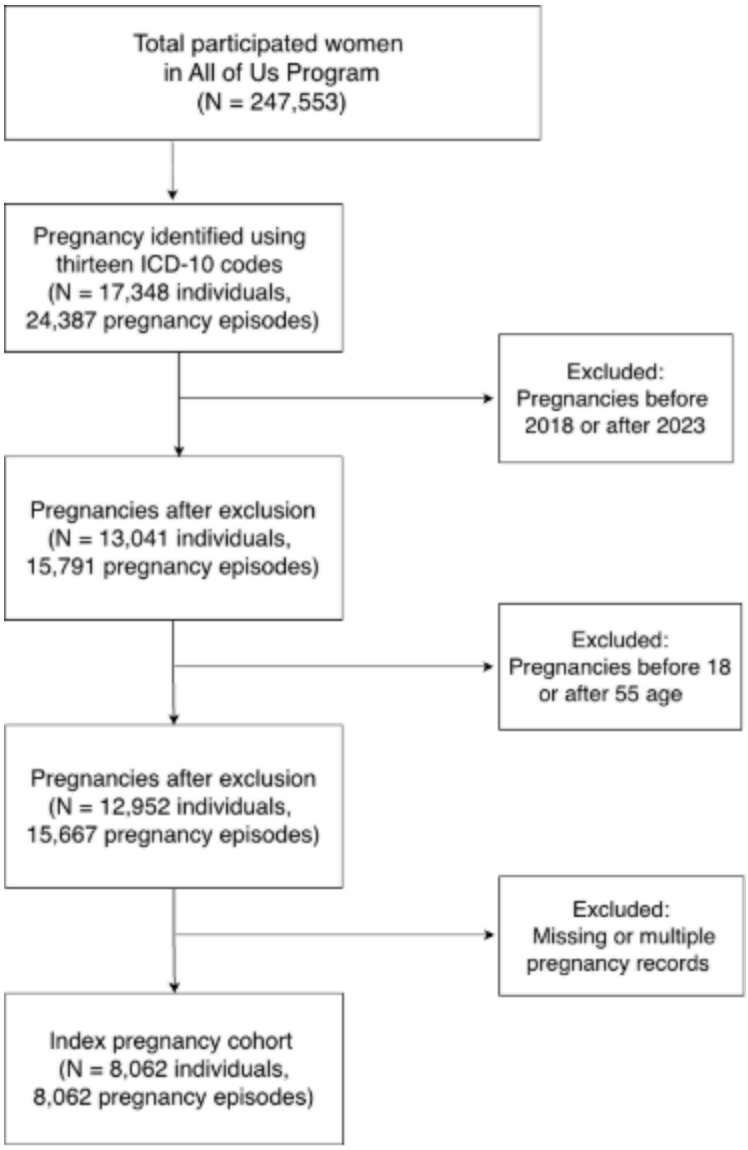


Figure 1

Flowchart of pregnant individual identification based on inclusion and exclusion criteria

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