Maternal Health Complications:
A Five-Year Study in the Texas Panhandle

VIBRANT moms

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Executive Summary

In Texas, severe maternal morbidity and mortality rates continue to climb despite efforts to improve outcomes across the state. Maternal health outcomes can be directly related to the availability and quality of care provided in the prenatal and postpartum periods. However, maternal health deserts are prevalent in the Texas Panhandle, including in the counties that include and surround the city of Amarillo, Texas.

In order to improve maternal health outcomes among this population, it is important to first identify the most pressing needs. This report describes the prevalence of the top five adverse health conditions experienced in the Texas Panhandle: preeclampsia, diabetes, mental health disorders, obesity, and excessive weight gain during pregnancy.

Among 17,708 deliveries included in our sample from 2018-2022, we found that mental health disorders were the most prevalent adverse condition complicating pregnancy, childbirth, and the puerperium with prevalence as high as 23.5% in 2023. Preeclampsia (6.5%), diabetes (8.1%), obesity (14.5%), and excessive weight gain (9.5%) were also higher than desired with several disparities noted across race categories and ethnicity. Lastly, several outcomes were associated with these conditions including cesarean delivery and postpartum hemorrhage.

This report provides insight into the unique concerns of six Texas Panhandle counties: Deaf Smith, Gray, Parmer, Potter, Randall, and Swisher.

I. Background

The United States is facing a maternal health crisis that is disproportionately affecting Black and Native American women, as well as women in rural areas, with Texas grappling with its own share of the crisis.[1,2] As reported in the Texas Maternal and Morbidity Review Committee and Department of State Health Services Joint Biennial Report in 2024, the Texas maternal mortality ratio for 2020 and 2021 was 24.2 and 23.0 per 100,000 live births, respectively.[3] This excludes mortality related to Covid-19.

In addition to mortality, severe maternal morbidity rates for in-hospital deliveries increased from 72.7 per 10,000 deliveries in 2020 to 85.5 per 10,000 as of 2021.[3,4] The highest rates of severe maternal morbidity were among Black, non-Hispanic women, women without private insurance coverage for delivery, women of maternal age greater than 35, and those with less than a high school education.[5]

Rates for severe maternal morbidity vary in the Texas Panhandle with dramatically higher rates in our rural counties.[6] Per the Severe Maternal Morbidity Dashboard, the severe maternal morbidity rate for our public health region (Region 1) was 62.9 per 10,000 deliveries. This rate is higher than all but 2 other public health regions in the state.[7]

Factors contributing to maternal morbidity and mortality occur at every level of the socioecological model: the individual/family level (e.g., chronic disease, lack of access to care or limited financial resources, delay or failure in seeking care), the provider level (e.g., quality of care, failure to screen or adequately assess risk, discrimination), the facility level (e.g., lack of standardized procedures), and the system level (e.g., lack of continuity of care, lack of resources, discrimination).[5] The rural counties of the Texas Panhandle are home to many families with low income and limited access to healthcare placing them at heightened risk of severe maternal morbidity and mortality.[8] As such, efforts to reduce maternal morbidity and mortality must be innovative and collaborative to address the complex interplay between factors within our communities.

The VIBRANT MOMS Coalition was created to address this maternal health crisis in the Texas Panhandle. In order to be most effective and address the most pressing needs, we sought to identify the adverse maternal health conditions most prevalent in our community. Doing so ensures we are addressing the critical needs of the community, and allows us to evaluate the impact of future interventions.

We identified baseline rates of preeclampsia, as well as eclampsia, hypertension, diabetes, obesity, substance use, mental health conditions, and other systemic conditions complicating pregnancy.

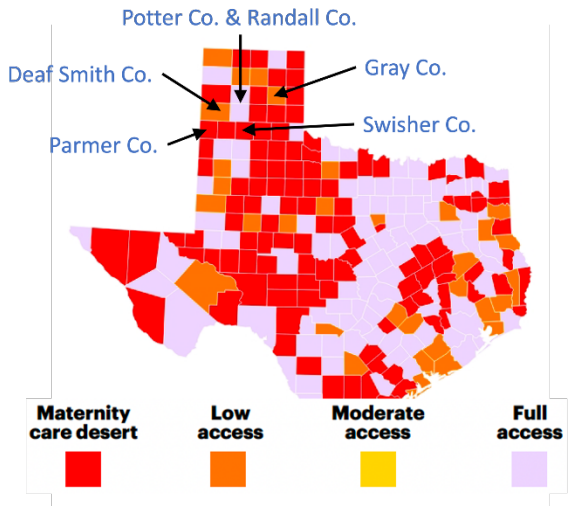
This report details the results of our study of individuals living in Deaf Smith, Gray, Parmer, Potter, Randall, Potter, and Swisher counties.

II. Approach

We used the Texas Hospital Inpatient Discharge Public Use Data File (referred to as Texas PUDF) to meet our objectives. The dataset is available through the Texas Health Care Information Council (THCIC) and collects data for discharges from all state licensed hospitals except those that meet exemption criteria.[9] The data in the Texas PUDF is available from 1999-2022, and we used data from 2018-2022.

We sampled based on the Centers for Medicare and Medicaid Services Diagnosis Related Group (DRG) codes for either Cesarean or vaginal delivery (**Table 1**). Of note, some individuals may have delivered a child or children on more than one occasion during the study time frame. We used "delivery with unique delivery date" as the sampling unit rather than the person.

Our sample included females of child-bearing age (10-59) with a home address in one of our 6 priority counties: Deaf Smith, Gray, Parmer, Potter, Randall, and Swisher.



We included individuals with missing data for county using a zip code zoned to one of the priority counties. Additionally, we included deliveries that occurred at hospitals outside of the Texas Panhandle since we included any female with a home address in our priority counties rather than only those that delivered in one of the hospitals in our region. This is reflected in the results.

Importantly, we defined child-bearing age as 14-59. However, the Texas PUDF includes 14-year-olds in the "10-14" category. Thus, the full age range included individuals younger than initially defined.

We calculated the frequency of each adverse health condition using appropriate ICD-10 codes (Appendix A) identified via an online codebook published by the AAPC (formerly known as the American Academy of Professional Coders).[10] Additionally, we summarized demographic information attributed to each patient that delivered a child during the time frame including race, ethnicity, age at time of delivery, and the primary and secondary sources of payment.

We stratified adverse health conditions by race and ethnicity categories to permit a more granular assessment of maternal health in our community and performed statistical analysis (e.g., Chi-square) to formally test for group differences with a p-value < 0.05 indicating statistically significant differences. All analyses were conducted in Stata/MP version 18.0 (StataCorps, LLC, College Station, Texas). Lastly, we stratified adverse health conditions by outcomes including delivery type (Cesarean vs. vaginal), premature rupture of membranes, postpartum hemorrhage, and preterm labor.

Table 1. Diagnosis Related Group (DRG) codes for identifying individuals in our priority counties that delivered a child or children between 2018 and 2022.

DRG	Description
765	Cesarean section with CC/MCC
766	Cesarean section without CC/MCC
767	Vaginal delivery with sterilization and/or D&C
768	Vaginal delivery with O.R. procedure except sterilization and/or D&C
774	Vaginal delivery with complicating diagnoses
775	Vaginal delivery without complicating diagnoses
783	Cesarean section with sterilization with MCC
784	Cesarean section with sterilization with CC
785	Cesarean section with sterilization without CC/MCC
786	Cesarean section without sterilization with MCC
787	Cesarean section without sterilization with CC
788	Cesarean section without sterilization without CC/MCC
796	Vaginal delivery with sterilization/D&C with MCC
797	Vaginal delivery with sterilization/D&C with CC
798	Vaginal delivery with sterilization/D&C without CC/MCC
805	Vaginal delivery without sterilization/D&C with MCC
806	Vaginal delivery without sterilization/D&C with CC
807	Vaginal delivery without sterilization/D&C without CC/MCC

Note: CC = complication or comorbidity; MCC = major complication or comorbidity; D&C = dilation and curettage; O.R. = operating room

III. Results

Demographics

We identified 17,708 deliveries among women with a home address located within our priority counties between January 2018 and December 2022. The majority of deliveries were among women from Potter and Randall counties (**Figure 1**). This distribution mirrors that of population estimates for 2023 by the Texas Demographic Center (Appendix B).[11]

More than 80% of deliveries were among women ages 20-34, and most of the women in the sample were white and Non-Hispanic (**Figure 2a-c**). However, a large proportion (31%) of women were identified as "Other" for race. This may reflect some of the 25% of individuals who identified as Hispanic. Only 6% of deliveries in our sample were among Black women. This distribution is similar to estimates from the Texas Demographic Center for 2022 (Appendix B).

Figure 1. Sample distribution across counties

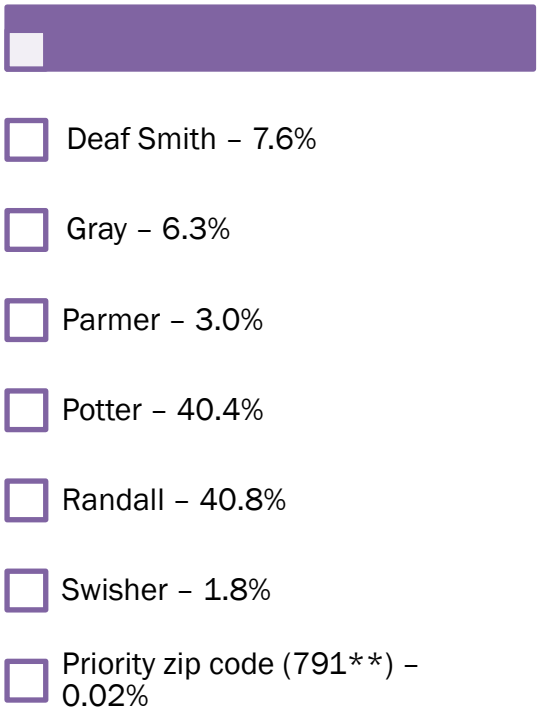


Figure 2a

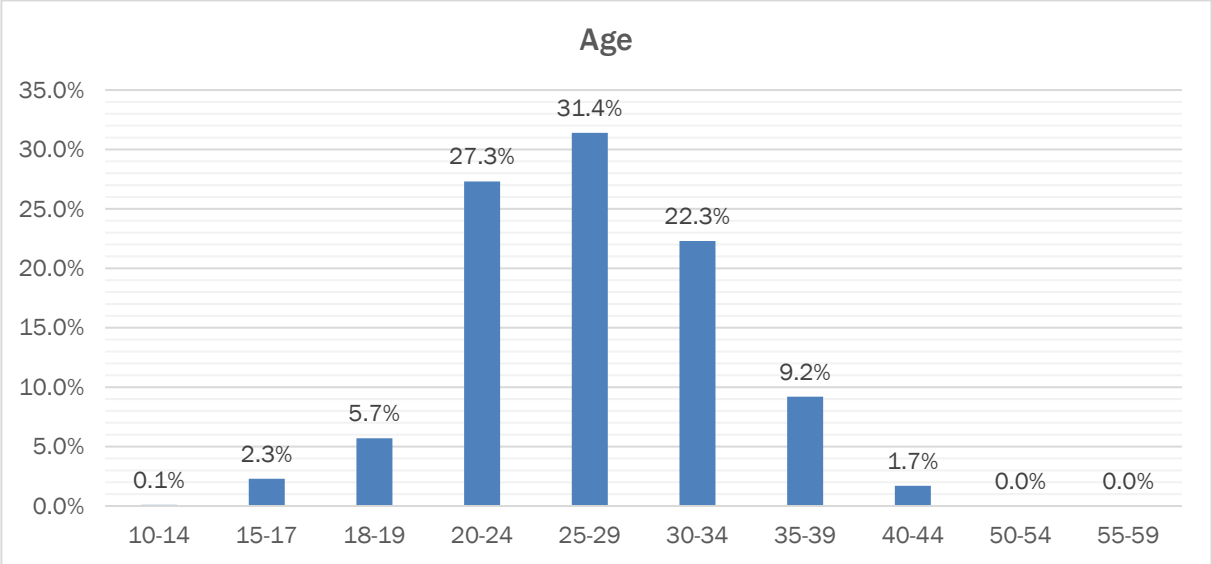


Figure 2b

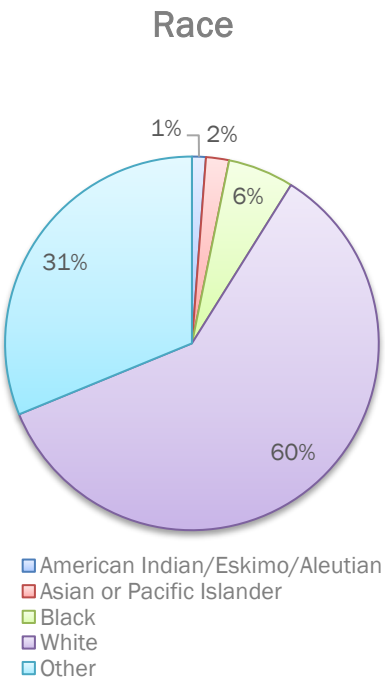
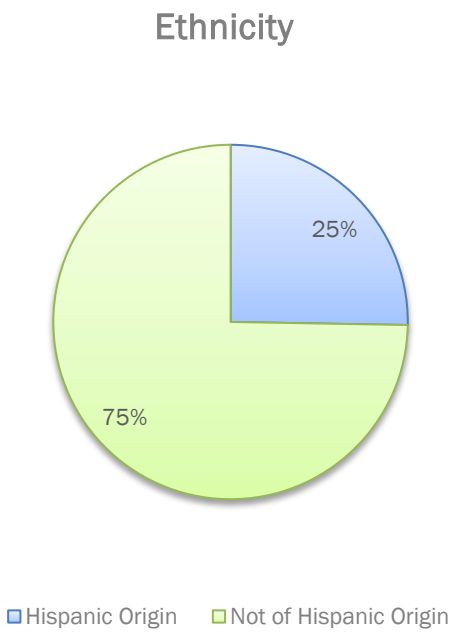
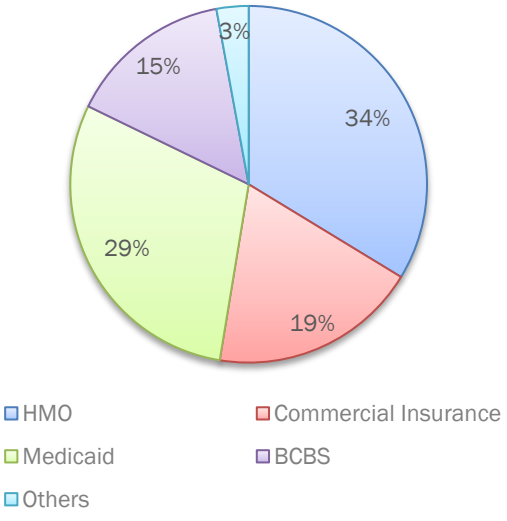


Figure 2c



The majority of deliveries took place at Northwest Texas Healthcare System (51.4%) and Baptist St. Anthony's Hospital (37.4%) in Amarillo, Texas, followed by Hereford Regional Medical Center (4.7%) in Hereford, Texas. The remaining deliveries took place in 57 other hospitals across the state of Texas, as we included the deliveries of any pregnant person with a home address in one of the priority counties and did not require that they deliver at a hospital in the Texas Panhandle.

Figure 3. First Payment Source



Health maintenance organizations (HMO) were the first payment source for approximately one-third of deliveries and represented the largest proportion of deliveries, followed by Medicaid and commercial insurance (**Figure 3**). Blue Cross/Blue Shield was coded in the dataset independent of other commercial insurance and covered approximately one-sixth of deliveries. Only one percent of deliveries were coded as charity, indigent, or unknown first payment source.

Adverse Health Conditions

Table 2 provides an overview of the frequency of adverse health conditions among deliveries from 2018-2022. We included high-level categories and subgroups for adverse conditions of interest that could be further stratified. For example, diabetes mellitus is a high-level ICD-10 code that could be further specified as Type I, Type II, and gestational diabetes. We did not fully stratify all adverse health conditions as some of the subcodes were non-specific. Therefore, the frequencies listed for subgroups in the table will not sum to the total in the high-level category.

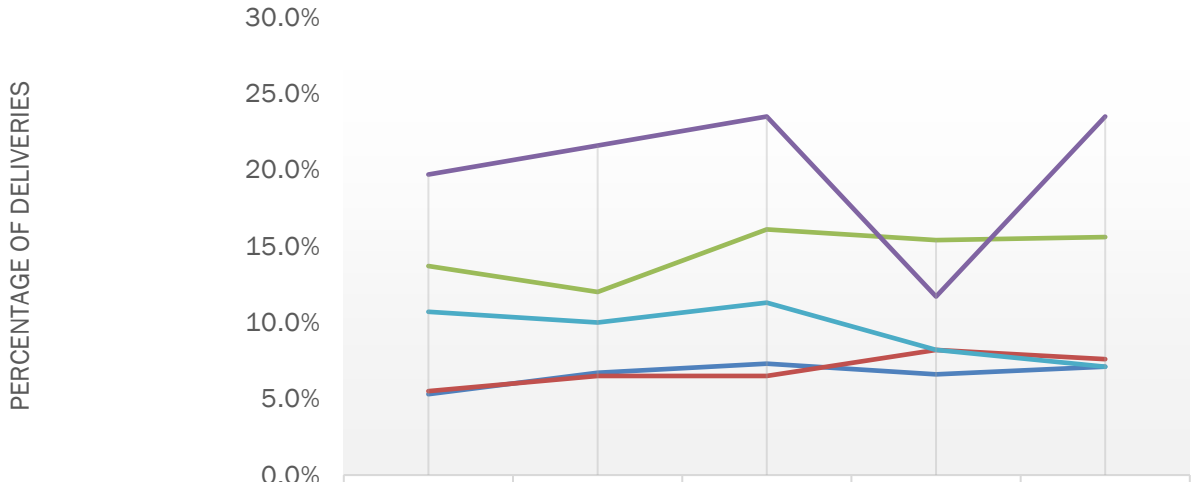
Preeclampsia, diabetes mellitus (specifically gestational diabetes), obesity, mental health disorders, and excessive weight gain during pregnancy were the most frequent adverse health conditions identified in our priority population with all but excessive weight gain increasing over the last 5 years (**Figure 4**).

Table 2. The frequency of maternal health conditions coded at time of delivery among residents of 6 counties in the Texas Panhandle between 2018-2022

Adverse health condition	# Deliveries (%)
Any preeclampsia[a]	1,162 (6.6)
Diabetes mellitus[b]	1,435 (8.1)
Type I	50 (0.3)
Type II	141 (0.8)
Gestational	1,206 (6.8)
Obesity	2,565 (14.5)
Mental health disorders[b]	2,015 (11.4)
Depression	737 (4.2)
Anxiety	546 (3.1)
Bipolar disorder	125 (0.7%)
Iron deficiency anemia	436 (2.5)
Excess weight gain	1,683 (9.5)
Low weight gain	338 (1.9)
Diseases of the[c] …	
…Nervous system	312 (1.8)
…Circulator system	136 (0.8)
…Respiratory system	1,156 (6.5)
…Digestive system	546 (3.1)
…Skin/subcutaneous system	100 (0.6)

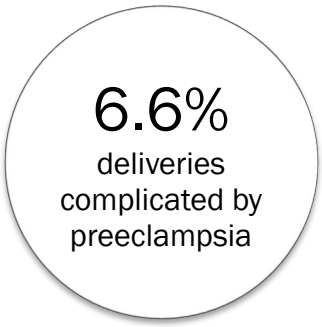
[a]Includes nascent pre-eclampsia and pre-existing hypertension with pre-eclampsia
[b]We do not include all possible subgroups so numbers in subgroups will not sum to the total.
[c]These diseases are coded as “complicating pregnancy, childbirth, or the puerperium.”

Figure 4. Top 5 adverse health conditions impacting pregnant people in the Texas Panhandle between 2018-2022



	2018	2019	2020	2021	2022
Preeclampsia	5.3%	6.7%	7.3%	6.6%	7.1%
Gestational diabetes	5.5%	6.5%	6.5%	8.2%	7.6%
Obesity	13.7%	12.0%	16.1%	15.4%	15.6%
Mental health disorder	19.7%	21.6%	23.5%	11.7%	23.5%
Excessive weight gain	10.7%	10.0%	11.3%	8.2%	7.1%

Approximately 6.6% of deliveries were complicated by preeclampsia but only 17 (0.1%) resulted in eclampsia. This is similar to estimates of preeclampsia in the United States (5-7%).[12]



The percentage of gestational diabetes was also similar to national statistics (8.1% in 2021) with the increase observed between 2018 and 2022 in our population similar to that observed at the national level (6.0% in 2016 to 8.3% in 2021).[13] Maternal obesity was a common health condition in our population with 16.1% of deliveries indicating obesity as complicating pregnancy, childbirth, and the puerperium. Global estimates are similar (16.3% from 2010-2019) with North America sitting slightly higher than our priority population at 18.7%.[14]

Excessive maternal weight gain reported as affecting the perinatal period decreased over the last 3 years in our priority population, though 7.1% is still concerning. It should be noted, however, that the prevalence of maternal obesity and excessive maternal weight gain is likely under-reported. The billing code for obesity and excessive maternal weight gain require that there be indication of these two conditions *complicating pregnancy, childbirth, or the puerperium*. It is possible women in the dataset were obese or had excessive weight gain but the conditions were not indicated in the medical record as complicating this period of their lives. Conversely, the largest increase was seen in the proportion of

deliveries following pregnancy that were complicated by mental health disorders with an unusual dip in 2021. This is likely an underestimate as healthcare providers must document a mental health disorder as complicating pregnancy, childbirth, or the puerperium in the medical record at time of delivery. Indeed, national estimates suggest that as many as 20% of women experience an anxiety disorder or depression during pregnancy.[15,16] Our data are consistent with this estimate with the exception of 2021.

Differences by race and ethnicity

Preeclampsia. The frequency of preeclampsia disproportionately impacted black women in our priority population. As demonstrated in **Table 3**, the proportion of deliveries without preeclampsia among women that identified as black was 5.4%, whereas the proportion *with* preeclampsia was 9.2%. These group differences were statistically significant on Chi-square analysis (p = 0.000). There was not a significant difference in the proportion of deliveries with preeclampsia across ethnicity (p = 0.112).

Table 3. The frequency of *preeclampsia* complicating pregnancy, childbirth, or the puerperium stratified by race and ethnicity

Race and ethnicity	# Deliveries without preeclampsia (%)	# Deliveries with preeclampsia (%)
American Indian/Eskimo/Aleutian	188 (1.1)	24 (2.1)
Asian or Pacific Islander	333 (2.0)	29 (2.5)
Black	894 (5.4)	107 (9.2)
White	9,983 (60.3)	632 (54.4)
Other	5,148 (31.1)	370 (31.8)
		p = 0.000
Not of Hispanic origin	12,306 (74.6)	889 (76.7)
Hispanic origin	4,189 (25.4)	270 (23.3)
		p = 0.112

Gestational diabetes. A similar trend was found for gestational diabetes. The proportion of deliveries without gestational diabetes among women that identified as “other” was 30.7%, whereas the proportion of deliveries with gestational diabetes among women that identified as “other” was 36.9% (p = 0.000).

This difference mirrors the results found in analyses comparing Hispanic to non-Hispanic women. The proportion of deliveries not complicated by gestational diabetes among women that identified as of Hispanic origin was higher (28.9%) than the proportion of deliveries that were not complicated with gestational diabetes (25.0%) (p = 0.003) (**Table 4**).

Table 4. The frequency of *gestational diabetes* complicating pregnancy, childbirth, or the puerperium stratified by race and ethnicity.

Race and ethnicity	# Deliveries without gestational diabetes (%)	# Deliveries with gestational diabetes (%)
American Indian/Eskimo/Aleutian	184 (1.1)	28 (2.3)
Asian or Pacific Islander	314 (1.9)	48 (4.0)
Black	951 (5.7)	50 (4.2)
White	9,980 (60.5)	635 (52.7)
Other	5,073 (30.7)	445 (36.9)
		p = 0.000
Not of Hispanic origin	12,341 (75.0)	854 (71.1)
Hispanic origin	4,112 (25.0)	347 (28.9)
		p = 0.003

Obesity. The proportion of deliveries with obesity complicating pregnancy, childbirth, and the puerperium was significantly different across race categories compared to the proportion of deliveries without obesity (**Table 5)**.

The primary driver of this difference was among women that identified as White. Only 49.0% of deliveries with obesity were among White women, whereas 61.8% of deliveries without obesity were among white women. Deliveries among women that identified as Black, American Indian/Alaska Native/Aleutian, and “other” made up the difference (p = 0.000). There were no significant differences in the proportion of deliveries with obesity when stratified by ethnicity (p = 0.434).

Table 5. The frequency of *obesity* complicating pregnancy, childbirth, or the puerperium stratified by race and ethnicity.

Race and ethnicity	# Deliveries without obesity (%)	# Deliveries with obesity (%)
American Indian/Eskimo/Aleutian	155 (1.0)	57 (2.2)
Asian or Pacific Islander	329 (2.2)	33 (1.3)
Black	784 (5.2)	217 (8.5)
White	9,359 (61.8)	1,256 (48.9)
Other	4,516 (29.8)	1,002 (39.1)
		p = 0.000
Not of Hispanic origin	11,296 (74.9)	1,899 (74.1)
Hispanic origin	3,796 (25.1)	663 (25.9)
		P = 0.434

Mental Health Disorders. As noted with the other adverse health conditions, there was a statistically significant difference in the distribution of race categories among deliveries following pregnancy complicated by mental health disorders and those not complicated by mental health disorders (p = 0.000). There was also a statistically significant difference in the proportion of deliveries following pregnancy complicated by mental health disorders across ethnicity (p = 0.000).

The largest difference was noted among deliveries with women that identified as white and "other." While 59.1% of deliveries following pregnancy *not* complicated by mental health disorders were among women that identified as White, 71.2% of deliveries *with* mental health disorders were among women that identified as White. The "other" category had a lower proportion of deliveries following pregnancy with mental health disorders than did those without (**Table 6**).

Table 6. The frequency of *mental health conditions* complicating pregnancy, childbirth, or the puerperium stratified by race and ethnicity.

Race and ethnicity	# Deliveries without mental health conditions (%)	# Deliveries with mental health conditions (%)
American Indian/Eskimo/Aleutian	197 (1.2)	15 (1.2)
Asian or Pacific Islander	348 (2.1)	14 (1.1)
Black	943 (5.7)	58 (4.6)
White	9,721 (59.1)	894 (71.3)
Other	5,244 (31.9)	274 (21.8)
		p = 0.000
Not of Hispanic origin	12,133 (74.0)	1,062 (84.8)
Hispanic origin	4,269 (26.0)	190 (15.2)
		p = 0.000

Excessive weight gain. There was a statistically significant difference in the distribution of deliveries following pregnancy complicated by excessive weight gain across race categories (p = 0.000). The most notable differences were in deliveries in which women identified as Black or "other." As demonstrated in **Table 7**, the proportion of deliveries following pregnancy without excessive weight gain among women that identified as Black was 5.3%, whereas the proportion of deliveries with excessive weight gain was 8.9%.

This trend is similar in deliveries following pregnancy with women who identified as "other." Only 30% of deliveries following pregnancy without excessive weight gain were among women that identified as "other," whereas 42.3% with excessive weight gain were among women that identified as "other." A much lower proportion of deliveries following pregnancy with excessive weight gain were among women that identified as white (43.8%) compared those without excessive weight gain (61.6%). Lastly, there was a significant difference in the proportion of deliveries complicated by excessive weight gain among women that identified as Hispanic compared to non-Hispanic (p = 0.000).

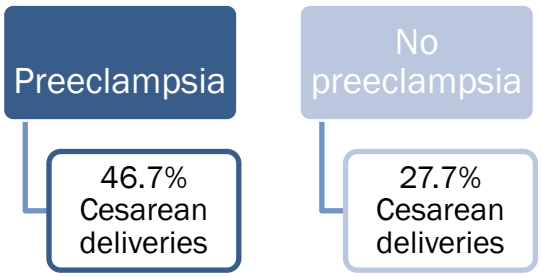
Table 7. The frequency of *excessive weight gain* complicating pregnancy, childbirth, or the puerperium stratified by race and ethnicity.

Race and ethnicity	# Deliveries without excessive weight gain (%)	# Deliveries with excessive weight gain (%)
American Indian/Eskimo/Aleutian	174 (1.1)	38 (2.3)
Asian or Pacific Islander	316 (2.0)	46 (2.7)
Black	851 (5.3)	150 (8.9)
White	9,878 (61.6)	737 (43.8)
Other	4,806 (30.0)	712 (42.3)
		p = 0.000
Not of Hispanic origin	11,858 (74.2)	1,337 (79.5)
Hispanic origin	4,114 (25.8)	345 (20.5)
		p = 0.000

Outcomes

Cesarean section

A total of 5,118 pregnancies (28.9%) culminated with cesarean delivery. On simple analysis, there were no significant differences across races (p = 0.253). However, a significantly higher proportion of Hispanic patients delivered via cesarean compared to non-Hispanic (30.1% vs. 28.5%, p = 0.038).



Though in-depth examination of the determinants of cesarean delivery was not pursued in this study, we noted several important differences when stratified by the presence or absence of adverse health conditions. Substantially more pregnancies complicated by preeclampsia required cesarean delivery compared to vaginal delivery (46.7% vs. 27.7%, respectively, p = 0.000).

Similarly, substantially more pregnancies complicated by gestational diabetes resulted in cesarean delivery (39.8% vs. 28.1%, p = 0.000). Another notable difference was observed among pregnancies complicated by obesity. Forty percent of pregnancies complicated by obesity required cesarean delivery compared to 27.0% not complicated by obesity (p = 0.000).

Lastly, we observed a small increase in cesarean delivery among pregnancies complicated by mental health disorders (32.3% with disorders vs. 28.4% without, p = 0.000) and excessive weight gain (30.8% with excessive weight gain vs. 28.7% without, p = 0.074).

Premature rupture of membranes

Approximately 8 .8% of deliveries in the sample experienced premature rupture of membranes. Interestingly, only 4.3% of deliveries complicated by preeclampsia experienced premature rupture of membranes compared to 9.1% of those not complicated by preeclampsia (p = 0.000). This may be due to early induction of labor or cesarean section in individuals with preeclampsia.

Additionally, there was no difference in the proportion of deliveries complicated by gestational diabetes that experienced premature rupture of membranes (8.8% with gestational diabetes vs. 8.6% without, p = 0.808). This is inconsistent with prior literature demonstrating increased odds of premature rupture of membranes among women with preeclampsia and gestational diabetes.[17] This may be the result of early intervention among women with known gestational hypertension or diabetes.

Slightly more deliveries following pregnancy complicated by mental health disorders experienced premature rupture of membranes (9.3% with mental health disorder vs. 8.8% without, p = 0.434), and there was little to no difference in the proportion of deliveries with premature rupture of membranes given obesity (p = 0.173). However, a statistically significantly smaller proportion of deliveries complicated by excessive weight gain experienced premature rupture of membranes (7.4%) when compared to individuals without excessive weight gain (9.0%, p = 0.028).

Post-partum hemorrhage

In our sample, 679 (3.8%) deliveries experienced post-partum hemorrhage with a substantially higher proportion among deliveries with preeclampsia (7.6%) compared to those without (3.6%, p = 0.000).

We identified a similar difference among deliveries complicated by excessive weight gain – 6.7% of deliveries with excessive weight gain experienced post-partum hemorrhage compared to 3.5% without excessive weight gain (p = 0.000). There was a similar but slightly smaller difference in post-partum hemorrhage given obesity (5.1% with obesity vs. 3.6% without, p = 0.000).

Lastly, there were little to no differences in the proportion of deliveries that experienced post-partum hemorrhage given gestational diabetes and mental health disorders (p = 0.261 and p = 0.559, respectively).

Pre-term labor

Seven hundred and eighty-seven deliveries (4.4%) were complicated by preterm labor. There were few to no differences in the proportion of deliveries that experienced preterm labor given preeclampsia (4.8% with vs. 4.4% without; p = 0.521). The same was true for gestational diabetes (4.7% with vs. 4.4% without; p = 0.622).

The most notable differences were among deliveries following pregnancy complicated by mental health disorders. Approximately 6% of deliveries following pregnancy complicated by mental health disorders experienced pre-term labor compared to 4.2% without mental health disorders (p = 0.000).

There were no differences in the proportion of deliveries that experienced pre-term labor given obesity (p = 0.918). However, there was a statistically significant difference in the proportion of deliveries that experienced pre-term labor given excessive weight gain (p = 0.037).

Limitations

This study is the first of its kind to provide a granular snapshot into the adverse health conditions impacting pregnant women in our region. Advocates for greater maternal care and improved outcomes can use this information to identify the conditions and groups most in need. However, there are some important limitations to consider.

The analyses were based on ICD-10 codes reflecting conditions complicating pregnancy, childbirth, and the puerperium. As such, it is critical that physicians chose to document these conditions in the medical record at time of delivery. We have likely provided an underestimate of mental health disorders and other adverse health conditions, especially if they were experienced and treated prior to delivery.

Additionally, the coding of obesity and excess gestational weight gain are substantially lower than expected based on our knowledge of the community and statistics within our state. Texas Public Health Region 1, which includes the Texas Panhandle, has the highest adult obesity rate in the state of 44.9%.[18] Excess gestational weight gain is also likely to be underreported through ICD10 codes, as nationally 48% of pregnant women gain above recommendations, and that proportion is higher among those with obesity.[13]

We presented only a fraction of the adverse conditions explored in our study. We did not report adverse conditions if 1) the prevalence was less than 1% or 2) the data was unreliable. For example, our team attempted to identify abuse and injury as an adverse health outcome of pregnancy. However, the code for “maternal malignant neoplasms, traumatic injuries and abuse classifiable elsewhere but complicating pregnancy, childbirth and the puerperium (O9A)” was not sensitive to capture this condition. We found only one case of physical abuse. The absence of cases in this dataset does not suggest there were no cases of abuse during pregnancy but is likely a limitation of the data set and research strategy.

Lastly, the data set is not longitudinal and does not capture events that occurred prior to delivery. In order for us to capture abuse or other adverse conditions that may have complicated pregnancy, childbirth, or the puerperium, the healthcare provider needed to specifically document it in the medical record at time of delivery. Additional research with a longitudinal dataset is warranted to capture this information.

IV. Implications

Maternal health conditions, including preeclampsia, gestational diabetes, and mental health disorders, are significant concerns in Texas Panhandle counties, as they can lead to adverse outcomes for both mothers and infants. Our findings indicate that individuals with these conditions experience higher cesarean delivery rates compared to those without. While this result was expected, the increased cesarean rates have substantial implications for both short- and long-term infant health and contribute to rising healthcare costs.

Preeclampsia rates are on the rise, disproportionately affecting historically marginalized women and leading to severe health consequences. Many women who develop gestational hypertension may have had undiagnosed chronic hypertension before pregnancy, reinforcing the need for proactive management of chronic disease both prior to and during pregnancy.

When examining preterm labor and premature rupture of membranes, we found little to no difference between those with and without maternal health conditions. This outcome was anticipated, particularly for patients with preeclampsia, as they are often delivered before labor begins to prevent the severe complications associated with the condition.

Obesity and excessive gestational weight gain, though known to be prevalent in these communities, were not well-documented in the dataset. This limitation stems from the requirement that these conditions be explicitly coded as affecting pregnancy in inpatient records. Improving reporting and coding practices is essential to accurately capturing the impact of these factors.

As outlined in the report, preeclampsia is one of the top five adverse maternal health conditions in the region. Evidence-based interventions, such as the use of low-dose aspirin (LDA), can help reduce its occurrence. Ultimately, our findings highlight the critical role of comprehensive prenatal care and access to mental health services in identifying pregnancy complications, monitoring weight gain, and preventing pregnancy-related mortality.

V. Appendices

Appendix A

Condition	ICD-10 code
Pre-eclampsia	O14
Mild to moderate pre-eclampsia	O14.0
Mild to moderate pre-eclampsia, unspecified trimester	O14.00
Mild to moderate pre-eclampsia, second trimester	O14.02
Mild to moderate pre-eclampsia, third trimester	O14.03
Mild to moderate pre-eclampsia, complicating childbirth	O14.04
Mild to moderate pre-eclampsia, complicating the puerperium	O14.05
Severe pre-eclampsia	O14.1
Severe pre-eclampsia, unspecified trimester	O14.10
Severe pre-eclampsia, second trimester	O14.12
Severe pre-eclampsia, third trimester	O14.13
Severe pre-eclampsia, complicating childbirth	O14.14
Severe pre-eclampsia, complicating the puerperium	O14.15
HELLP syndrome	O14.2
HELLP syndrome (HELLP), unspecified trimester	O14.20
HELLP syndrome (HELLP), second trimester	O14.22
HELLP syndrome (HELLP), third trimester	O14.23
HELLP syndrome (HELLP), complicating childbirth	O14.24
HELLP syndrome (HELLP), complicating the puerperium	O14.25
Unspecified pre-eclampsia	O14.9
Unspecified pre-eclampsia, unspecified trimester	O14.90
Unspecified pre-eclampsia, second trimester	O14.92
Unspecified pre-eclampsia, third trimester	O14.93
Unspecified pre-eclampsia, complicating childbirth	O14.94
Unspecified pre-eclampsia, complicating childbirth	O14.95
Pre-existing hypertension with pre-eclampsia	O11
Pre-existing hypertension with pre-eclampsia, first trimester	O11.1
Pre-existing hypertension with pre-eclampsia, second trimester	O11.2
Pre-existing hypertension with pre-eclampsia, third trimester	O11.3

Pre-existing hypertension with pre-eclampsia, complicating childbirth	O11.4
Pre-existing hypertension with pre-eclampsia, complicating the puerperium	O11.5
Pre-existing hypertension with pre-eclampsia, unspecified trimester	O11.9
Eclampsia	O15
Eclampsia complicating pregnancy	O15.0
Eclampsia complicating pregnancy, unspecified trimester	O15.00
Eclampsia complicating pregnancy, second trimester	O15.02
Eclampsia complicating pregnancy, third trimester	O15.03
Eclampsia complicating labor	O15.1
Eclampsia complicating the puerperium	O15.2
Eclampsia, unspecified as to time period	O15.9
Pre-existing hypertension complicating pregnancy, childbirth and the puerperium	O10
Pre-existing essential hypertension complicating pregnancy, childbirth and the puerperium	O10.0
Pre-existing essential hypertension complicating pregnancy	O10.01
Pre-existing essential hypertension complicating childbirth	O10.02
Pre-existing essential hypertension complicating the puerperium	O10.03
Pre-existing hypertensive heart disease complicating pregnancy, childbirth and the puerperium	O10.1
Pre-existing hypertensive heart disease complicating pregnancy	O10.11
Pre-existing hypertensive heart disease complicating childbirth	O10.12
Pre-existing hypertensive heart disease complicating the puerperium	O10.13
Pre-existing hypertensive chronic kidney disease complicating pregnancy, childbirth and the puerperium	O10.2
Pre-existing hypertensive chronic kidney disease complicating pregnancy	O10.21
Pre-existing hypertensive chronic kidney disease complicating childbirth	O10.22
Pre-existing hypertensive chronic kidney disease complicating the puerperium	O10.23
Pre-existing hypertensive heart and chronic kidney disease complicating pregnancy, childbirth and the puerperium	O10.3
Pre-existing hypertensive heart and chronic kidney disease complicating pregnancy	O10.31
Pre-existing hypertensive heart and chronic kidney disease complicating childbirth	O10.32

Pre-existing hypertensive heart and chronic kidney disease complicating the puerperium	O10.33
Pre-existing secondary hypertension complicating pregnancy, childbirth and the puerperium	O10.4
Pre-existing secondary hypertension complicating pregnancy	O10.41
Pre-existing secondary hypertension complicating childbirth	O10.42
Pre-existing secondary hypertension complicating the puerperium	O10.43
Unspecified pre-existing hypertension complicating pregnancy, childbirth and the puerperium	O10.9
Unspecified pre-existing hypertension complicating pregnancy	O10.91
Unspecified pre-existing hypertension complicating childbirth	O10.92
Unspecified pre-existing hypertension complicating the puerperium	O10.93
Gestational pregnancy-induced hypertension without significant proteinuria	O13
Gestational pregnancy-induced hypertension without significant proteinuria, first trimester	O13.1
Gestational pregnancy-induced hypertension without significant proteinuria, second trimester	O13.2
Gestational pregnancy-induced hypertension without significant proteinuria, third trimester	O13.3
Gestational pregnancy-induced hypertension without significant proteinuria, complicating childbirth	O13.4
Gestational pregnancy-induced hypertension without significant proteinuria, complicating the puerperium	O13.5
Gestational pregnancy-induced hypertension without significant proteinuria, unspecified trimester	O13.9
Unspecified maternal hypertension	O16
Unspecified maternal hypertension, first trimester	O16.1
Unspecified maternal hypertension, second trimester	O16.2
Unspecified maternal hypertension, third trimester	O16.3
Unspecified maternal hypertension, complicating childbirth	O16.4
Unspecified maternal hypertension, complicating the puerperium	O16.5
Unspecified maternal hypertension, unspecified trimester	O16.9
Diabetes mellitus in pregnancy, childbirth, and the puerperium	O24
Pre-existing type 1 diabetes mellitus, in pregnancy, childbirth and the puerperium	O24.0
Pre-existing type 1 diabetes mellitus, in pregnancy, first trimester	O24.011

Pre-existing type 1 diabetes mellitus, in pregnancy, second trimester	O24.012
Pre-existing type 1 diabetes mellitus, in pregnancy, third trimester	O24.013
Pre-existing type 1 diabetes mellitus, in pregnancy, unspecified trimester	O24.019
Pre-existing type 1 diabetes mellitus, in childbirth	O24.02
Pre-existing type 1 diabetes mellitus, in the puerperium	O24.03
Pre-existing type 2 diabetes mellitus, in pregnancy, childbirth and the puerperium	O24.1
Pre-existing type 2 diabetes mellitus, in pregnancy, first trimester	O24.111
Pre-existing type 2 diabetes mellitus, in pregnancy, second trimester	O24.112
Pre-existing type 2 diabetes mellitus, in pregnancy, third trimester	O24.113
Pre-existing type 2 diabetes mellitus, in pregnancy, unspecified trimester	O24.119
Pre-existing type 2 diabetes mellitus, in childbirth	O24.12
Pre-existing type 2 diabetes mellitus, in the puerperium	O24.13
Unspecified pre-existing diabetes mellitus in pregnancy, childbirth and the puerperium	O24.3
Unspecified pre-existing diabetes mellitus in pregnancy	O24.31
Unspecified pre-existing diabetes mellitus in childbirth	O24.32
Unspecified pre-existing diabetes mellitus in the puerperium	O24.33
Gestational diabetes mellitus	O24.4
Gestational diabetes mellitus in pregnancy, diet controlled	O24.410
Gestational diabetes mellitus in pregnancy, insulin controlled	O24.414
Gestational diabetes mellitus in pregnancy, controlled by oral hypoglycemic drugs	O24.415
Gestational diabetes mellitus in pregnancy, unspecified control	O24.419
Gestational diabetes mellitus in childbirth, diet controlled	O24.420
Gestational diabetes mellitus in childbirth, insulin controlled	O24.424
Gestational diabetes mellitus in childbirth, controlled by oral hypoglycemic drugs	O24.425
Gestational diabetes mellitus in childbirth, unspecified control	O24.429
Gestational diabetes mellitus in the puerperium, diet controlled	O24.430
Gestational diabetes mellitus in the puerperium, insulin controlled	O24.434
Gestational diabetes mellitus in puerperium, controlled by oral hypoglycemic drugs	O24.435
Gestational diabetes mellitus in the puerperium, unspecified control	O24.439

Other pre-existing diabetes mellitus in pregnancy, childbirth, and the puerperium	O24.8
Other pre-existing diabetes mellitus in pregnancy, first trimester	O24.811
Other pre-existing diabetes mellitus in pregnancy, second trimester	O24.812
Other pre-existing diabetes mellitus in pregnancy, third trimester	O24.813
Other pre-existing diabetes mellitus in pregnancy, unspecified trimester	O24.819
Other pre-existing diabetes mellitus in childbirth	O24.82
Other pre-existing diabetes mellitus in the puerperium	O24.83
Unspecified diabetes mellitus in pregnancy, childbirth and the puerperium	O24.9
Unspecified diabetes mellitus in pregnancy, first trimester	O24.911
Unspecified diabetes mellitus in pregnancy, second trimester	O24.912
Unspecified diabetes mellitus in pregnancy, third trimester	O24.913
Unspecified diabetes mellitus in pregnancy, unspecified trimester	O24.919
Unspecified diabetes mellitus in childbirth	O24.92
Unspecified diabetes mellitus in the puerperium	O24.93
Other endocrine, nutritional, and metabolic diseases complicating pregnancy, childbirth and the puerperium	O99.28
Endocrine, nutritional and metabolic diseases complicating pregnancy, unspecified trimester	O99.280
Endocrine, nutritional and metabolic diseases complicating pregnancy, first trimester	O99.281
Endocrine, nutritional and metabolic diseases complicating pregnancy, second trimester	O99.282
Endocrine, nutritional and metabolic diseases complicating pregnancy, third trimester	O99.283
Endocrine, nutritional and metabolic diseases complicating childbirth	O99.284
Endocrine, nutritional and metabolic diseases complicating the puerperium	O99.285
Obesity complicating pregnancy, childbirth, or the puerperium	O99.21
Obesity complicating pregnancy, unspecified trimester	O99.210
Obesity complicating pregnancy, first trimester	O99.211
Obesity complicating pregnancy, second trimester	O99.212
Obesity complicating pregnancy, third trimester	O99.213
Obesity complicating childbirth	O99.214
Obesity complicating the puerperium	O99.215

Mental disorders and diseases of the nervous system complicating pregnancy, childbirth and the puerperium	O99.3
Alcohol use complicating pregnancy, childbirth, and the puerperium	O99.31
Alcohol use complicating pregnancy, unspecified trimester	O99.310
Alcohol use complicating pregnancy, first trimester	O99.311
Alcohol use complicating pregnancy, second trimester	O99.312
Alcohol use complicating pregnancy, third trimester	O99.313
Alcohol use complicating childbirth	O99.314
Alcohol use complicating the puerperium	O99.315
Drug use complicating pregnancy, childbirth, and the puerperium	O99.32
Drug use complicating pregnancy, unspecified trimester	O99.320
Drug use complicating pregnancy, first trimester	O99.321
Drug use complicating pregnancy, second trimester	O99.322
Drug use complicating pregnancy, third trimester	O99.323
Drug use complicating childbirth	O99.324
Drug use complicating the puerperium	O99.325
Tobacco use disorder complicating pregnancy, childbirth, and the puerperium	O99.33
Smoking (tobacco) complicating pregnancy, unspecified trimester	O99.330
Smoking (tobacco) complicating pregnancy, first trimester	O99.331
Smoking (tobacco) complicating pregnancy, second trimester	O99.332
Smoking (tobacco) complicating pregnancy, third trimester	O99.333
Smoking (tobacco) complicating childbirth	O99.334
Smoking (tobacco) complicating the puerperium	O99.335
Other mental disorders complicating pregnancy, childbirth, and the puerperium	O99.34
Other mental disorders complicating pregnancy, unspecified trimester	O99.340
Other mental disorders complicating pregnancy, first trimester	O99.341
Other mental disorders complicating pregnancy, second trimester	O99.342
Other mental disorders complicating pregnancy, third trimester	O99.343
Other mental disorders complicating childbirth	O99.344
Other mental disorders complicating the puerperium	O99.345
Diseases of the nervous system complicating pregnancy, childbirth, and the puerperium	O99.35

Diseases of the nervous system complicating pregnancy, unspecified trimester	O99.350
Diseases of the nervous system complicating pregnancy, first trimester	O99.351
Diseases of the nervous system complicating pregnancy, second trimester	O99.352
Diseases of the nervous system complicating pregnancy, third trimester	O99.353
Diseases of the nervous system complicating childbirth	O99.354
Diseases of the nervous system complicating the puerperium	O99.355
Diseases of the circulatory system complicating pregnancy, childbirth and the puerperium	O99.4
Diseases of the circulatory system complicating pregnancy	O99.41
Diseases of the circulatory system complicating pregnancy, first trimester	O99.411
Diseases of the circulatory system complicating pregnancy, second trimester	O99.412
Diseases of the circulatory system complicating pregnancy, third trimester	O99.413
Diseases of the circulatory system complicating pregnancy, unspecified trimester	O99.414
Diseases of the circulatory system complicating childbirth	O99.42
Diseases of the circulatory system complicating the puerperium	O99.43
Diseases of the respiratory system complicating pregnancy, childbirth and the puerperium	O99.5
Diseases of the respiratory system complicating pregnancy	O99.51
Diseases of the respiratory system complicating pregnancy, first trimester	O99.511
Diseases of the respiratory system complicating pregnancy, second trimester	O99.512
Diseases of the respiratory system complicating pregnancy, third trimester	O99.513
Diseases of the respiratory system complicating pregnancy, unspecified trimester	O99.519
Diseases of the respiratory system complicating childbirth	O99.52
Diseases of the respiratory system complicating the puerperium	O99.53
Diseases of the digestive system complicating pregnancy, childbirth and the puerperium	O99.6
Diseases of the digestive system complicating pregnancy	O99.61
Diseases of the digestive system complicating pregnancy, first trimester	O99.611
Diseases of the digestive system complicating pregnancy, second trimester	O99.612
Diseases of the digestive system complicating pregnancy, third trimester	O99.613
Diseases of the digestive system complicating pregnancy, unspecified trimester	O99.619

Diseases of the digestive system complicating childbirth	O99.62
Diseases of the digestive system complicating the puerperium	O99.63
Diseases of the skin and subcutaneous tissue complicating pregnancy, childbirth and the puerperium	O99.7
Diseases of the skin and subcutaneous tissue complicating pregnancy	O99.71
Diseases of the skin and subcutaneous tissue complicating pregnancy, first trimester	O99.711
Diseases of the skin and subcutaneous tissue complicating pregnancy, second trimester	O99.712
Diseases of the skin and subcutaneous tissue complicating pregnancy, third trimester	O99.713
Diseases of the skin and subcutaneous tissue complicating pregnancy, unspecified trimester	O99.719
Diseases of the skin and subcutaneous tissue complicating childbirth	O99.72
Diseases of the skin and subcutaneous tissue complicating the puerperium	O99.73
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium	O99.8
Abnormal glucose complicating pregnancy, childbirth and the puerperium	O99.81
Abnormal glucose complicating pregnancy	O99.810
Abnormal glucose complicating childbirth	O99.814
Abnormal glucose complicating the puerperium	O99.815
Streptococcus B carrier state complicating pregnancy, childbirth and the puerperium	O99.82
Streptococcus B carrier state complicating pregnancy	O99.820
Streptococcus B carrier state complicating childbirth	O99.824
Streptococcus B carrier state complicating the puerperium	O99.825
Other infection carrier state complicating pregnancy, childbirth and the puerperium	O99.83
Other infection carrier state complicating pregnancy	O99.830
Other infection carrier state complicating childbirth	O99.834
Other infection carrier state complicating the puerperium	O99.835
Bariatric surgery status complicating pregnancy, childbirth and the puerperium	O99.84
Bariatric surgery status complicating pregnancy, unspecified trimester	O99.840
Bariatric surgery status complicating pregnancy, first trimester	O99.841
Bariatric surgery status complicating pregnancy, second trimester	O99.842

Bariatric surgery status complicating pregnancy, third trimester	O99.843
Bariatric surgery status complicating childbirth	O99.844
Bariatric surgery status complicating the puerperium	O99.845
Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium	O99.89
Other specified diseases and conditions complicating pregnancy	O99.891
Other specified diseases and conditions complicating childbirth	O99.892
Other specified diseases and conditions complicating puerperium	O99.893
Maternal malignant neoplasms, traumatic injuries and abuse classifiable elsewhere but complicating pregnancy, childbirth and the puerperium	O9A
Injury, poisoning and certain other consequences of external causes complicating pregnancy, childbirth and the puerperium	O9A.2
Injury, poisoning and certain other consequences of external causes complicating pregnancy	O9A.21
Injury, poisoning and certain other consequences of external causes complicating pregnancy, first trimester	O9A.211
Injury, poisoning and certain other consequences of external causes complicating pregnancy, second trimester	O9A.212
Injury, poisoning and certain other consequences of external causes complicating pregnancy, third trimester	O9A.213
Injury, poisoning and certain other consequences of external causes complicating pregnancy, unspecified trimester	O9A.214
Injury, poisoning and certain other consequences of external causes complicating childbirth	O9A.22
Injury, poisoning and certain other consequences of external causes complicating the puerperium	O9A.23
Physical abuse complicating pregnancy, childbirth and the puerperium	O9A.3
Physical abuse complicating pregnancy	O9A.31
Physical abuse complicating pregnancy, first trimester	O9A.311
Physical abuse complicating pregnancy, second trimester	O9A.312
Physical abuse complicating pregnancy, third trimester	O9A.313
Physical abuse complicating pregnancy, unspecified trimester	O9A.319
Physical abuse complicating childbirth	O9A.32
Physical abuse complicating the puerperium	O9A.33
Sexual abuse complicating pregnancy, childbirth and the puerperium	O9A.4
Sexual abuse complicating pregnancy	O9A.41

Sexual abuse complicating pregnancy, first trimester	O9A.411
Sexual abuse complicating pregnancy, second trimester	O9A.412
Sexual abuse complicating pregnancy, third trimester	O9A.413
Sexual abuse complicating pregnancy, unspecified trimester	O9A.419
Sexual abuse complicating childbirth	O9A.42
Sexual abuse complicating the puerperium	O9A.43
Psychological abuse complicating pregnancy, childbirth and the puerperium	O9A.5
Psychological abuse complicating pregnancy	O9A.51
Psychological abuse complicating pregnancy, first trimester	O9A.511
Psychological abuse complicating pregnancy, second trimester	O9A.512
Psychological abuse complicating pregnancy, third trimester	O9A.513
Psychological abuse complicating pregnancy, unspecified trimester	O9A.519
Psychological abuse complicating childbirth	O9A.52
Psychological abuse complicating the puerperium	O9A.53

Appendix B

Population estimates for the VIBRANT MOMS priority counties from the Texas Demographic Center[11]

County	2020 Census Count	Population Estimate	Percentage
		As of 1/1/2023	
Deaf Smith	18,583	18,392	5.77%
Gray	21,227	20,729	6.51%
Parmer	9,869	9,434	2.96%
Potter	118,525	115,903	36.38%
Randall	140,753	147,367	46.25%
Swisher	6,971	6,801	2.13%
	Total	318,626	

**Percentages calculated by report authors*

Population estimates for the VIBRANT MOMS priority counties, stratified by sex, race, and ethnicity from the Texas Demographic Center[19]

	Total	Total Female	Non-Hispanic White Female	Non-Hispanic Black Female	Non-Hispanic Asian Female	Non-Hispanic Female of Other Race	Hispanic Female
	10-59 years	10-59 years	10-59 years	10-59 years	10-59 years	10-59 years	10-59 years
Deaf Smith	11,804	5,816	1,015	58	27	61	4,655
Gray	13,353	5,776	3,392	121	21	132	2,110
Parmer	6,030	2,869	785	31	10	12	2,031
Potter	75,847	35,865	14,312	2,938	2,202	937	15,476
Randall	95,251	47,514	30,956	1,423	833	1,102	13,200
Swisher	4,326	1,863	759	111	0	35	958
Total	206,611	99,703	51,219	4,682	3,093	2,279	38,430
Percentage		**48.3%[a]**	**51.4%[b]**	**4.7%[b]**	**3.1%[b]**	**2.3%[b]**	**38.5%[b]**

[a]In reference to total population, 10-59 years old
[b]In reference to total female population, 10-59 years old

Technical Appendix

Glossary of terms

Eclampsia	Eclampsia is a life-threatening complication of pregnancy in which seizures occur in a pregnant woman who is suffering from high blood pressure (preeclampsia).
Excess gestational weight gain	Weight gain during pregnancy that exceeds the National Academy of Medicine's weight gain recommendations, stratified by weight status. Found at: Institute of Medicine (US) and National Research Council (US) Committee to Reexamine IOM Pregnancy Weight Guidelines; Rasmussen KM, Yaktine AL, editors. Weight Gain During Pregnancy: Reexamining the Guidelines. Washington (DC): National Academies Press (US); 2009. Available from: https://www.ncbi.nlm.nih.gov/books/NBK32813/ doi: 10.17226/12584
Obesity	Body mass index $\geq$ 30kg/m^2
Preeclampsia	Preeclampsia is a serious condition that occurs after 20 weeks of pregnancy or after giving birth that is characterized by high blood pressure (>140 systolic or >90 diastolic) and protein in the urine or another symptom of organ dysfunction.
Severe Maternal Morbidity (SMM)	Per the Centers for Disease Control and Prevention, SMM includes "unexpected outcomes of labor and delivery that can result in significant short- or long-term health consequences."[4] This may include complications such as hemorrhage, preeclampsia, sepsis, and eclampsia and/or HELLP Syndrome. Additional indicators can be found at https://www.cdc.gov/maternal-infant-health/php/severe-maternal-morbidity/icd.html

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