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Trends in the Incidence of Gestational Diabetes Mellitus Among the Medicaid Population Before and During the COVID-19 Pandemic

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Abstract

Importance: Although there are many regional and national studies on the trends in the incidence of gestational diabetes mellitus (GDM), the trends in the incidence of GDM among the Medicaid population are lacking, especially before and during coronavirus disease of 2019 (COVID-19).
Objective: To investigate the trends in the incidence of GDM before and during COVID-19 pandemic (2016–2021) among the Louisiana Medicaid population.
Design, Setting, and Participants: This study included 111,936, Louisiana Medicaid pregnant women of age 18–50 between January 1, 2016, to December 31, 2021.
Main Outcomes and Measures: Pregnancies, GDM, and pre-pregnancy diabetes cases were identified by using the Tenth Revisions of the International Classification of Disease code. The annual incidence of GDM and annual prevalence of pre-pregnancy diabetes were calculated for each age and race subgroup.
Results: The age-standardized incidence of GDM increased from 10.2% in 2016 to 14.8 in 2020 and decreased to 14.0% in 2021. The age-standardized prevalence of pre-pregnancy diabetes increased from 2.8% in 2016 to 3.4% in 2018 and decreased to 2.3% in 2021. The age-standardized rate of GDM was the highest among Asian women (23.0%), then White women (15.5%), and African American women (13.9%) (p for difference <0.001). The COVID-19 pandemic saw an increase in the incidence of GDM, with a rise in prominent GDM risk factors, such as obesity and sedentary behaviors, suggesting an association.
Conclusion and Relevance: The incidence of GDM significantly increased during the COVID-19 pandemic. Potential reasons might include increased sedentary behavior and increased prevalence of obesity. GDM is a major public health issue, and the prevention of GDM is particularly essential for the Louisiana Medicaid population owing to the high prevalence of GDM-related risk factors in this population.

Keywords: prevalence, incidence, GDM, diabetes, health disparities, COVID-19

Introduction

Gestational diabetes mellitus (GDM) is any degree of glucose intolerance with onset or first recognition during pregnancy.[1] It is a major public health problem affecting about 8% of pregnancies in the United States.[1] GDM is a growing concern owing to adverse health outcomes for both mothers and children.[1–3] Worse pregnancy outcomes for the mothers include primary cesarean delivery, macrosomia, preterm birth, and preeclampsia.[2,4,5] The mothers also have an increased long-term risk of developing diabetes, hypertension, metabolic syndrome, and cardiovascular disease (CVD).[6–9] Up to 70% of women with a history of GDM will develop type 2 diabetes after 10 years postpartum.[10]

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Offspring born to women with GDM have an increased risk for obesity and cardiometabolic disorders later in life, including diabetes, hypertension, and hyperlipidemia.[11–14]

Previous studies have shown an increase in the incidence of GDM in the United States over the past 30 years.[15–19] Several,[18,20,21] but not all studies,[22] show that the prevalence of GDM is significantly higher among minority groups (Asians, Hispanics, African Americans) compared with non-Hispanic White women. Major risk factors of GDM are more prevalent in minority groups,[12,15] such as obesity and overweightness,[23,24] physical inactivity,[25] and lower socioeconomic status (SES) based on a poverty–income ratio, which may lead to poorer health.[26]

Another factor that might be correlated with an increase in the prevalence of GDM is the result of the COVID-19 pandemic, which has been associated with an increase in prominent GDM risk factors. The COVID-19 pandemic resulted in an increase in obesity, physical inactivity, and sedentary lifestyle.[27] Among adults, the pandemic led to a higher average body mass index (BMI) and significantly higher rates of obesity (+0.6% and +3%, respectively).[28]

Louisiana is a state that leads in the prevalence of diabetes, obesity, CVD, physical inactivity, and tobacco use.[29] Therefore, Louisiana's population encounters many public health concerns, and it ranks second to last in the overall health status in all states.[29] At the end of 2021, Louisiana had over 1.9 million residents (about 42% of Louisiana's population) receive health care coverage through Medicaid, most of whom are children under the age of 19.[30] Medicaid provides medical benefits to low-income and SES individuals and families, and the Medicaid population generally faces more disparities in health and health care. Since the Louisiana Medicaid population has a higher prevalence of diabetes, obesity, and physical inactivity (risk factors for GDM), this population might have a high incidence of GDM.[30]

While several studies have assessed the trends in the incidence of GDM, few studies have assessed the trends in the incidence of GDM among the Medicaid population. This present study will assess the trends in the annual incidence of GDM among Louisiana Medicaid pregnant women from 2016 to 2021.

Methods

Data source

The present study used the most updated data from the Louisiana Medicaid dataset. The Louisiana Medicaid dataset is available in electronic form. Medicaid administrative data are collected by the Centers for Medicaid Services (CMS) and derived from reimbursement information or the payment of services. Claims data are clinically valid and include various key attributes related to care such as admission and discharge dates, diagnoses and procedure codes, source of care, and demographic data (*e.g.,* birth date, age, race and ethnicity, sex, place of residence, *etc.*). Cohorts of pregnancies between January 1, 2016, and December 31, 2021, were identified from the database. The study was approved by both Pennington Biomedical Research Center Institutional Review Boards.

We examined GDM incidence in pregnant women with Medicaid from Louisiana. A total of 111,936 women, ages 18–50 during their first pregnancy, were included in the present study. Pregnancies were identified using the Tenth Revisions of the International Classification of Disease (ICD) code. GDM cases were identified by using the ICD-10 code O24.4, which represents "gestational diabetes mellitus." Identification of diabetes that was present before pregnancy was done by using the ICD-10 codes O24.0 and O24.1, which refer to preexisting diabetes mellitus occurring in pregnancy for types 1 and 2, respectively. Women with pre-pregnancy diabetes were included in the analysis as a distinct group.

In this dataset, our classification of race/ethnicity included African American, White, Asian, Native American, and Hawaiian or Pacific Islander. The race/ethnicity-specific analyses were narrowed down to the following three largest racial/ethnic groups: African American, White, and Asian. The other races were excluded from the race/ethnicity-specific analyses due to the small sample size (*e.g.,* $n = 951$ for Native American women over the study period).

Statistical analysis

The number of first-time pregnancies, GDM cases, and pre-pregnancy diabetes cases of study participants for each age group in each study year was reported. The data were examined as 1-year groups from 2016 to 2021. The annual age-specific incidence of GDM and race/ethnicity-specific incidence of GDM, as well as age-specific prevalence of pre-pregnancy diabetes and race/ethnicity-specific prevalence of pre-pregnancy diabetes, were calculated by using the general linear model. The linear trend in incidence/prevalence across time was tested using incidence of GDM/prevalence of pre-pregnancy diabetes as the outcome variable and year as a continuous variable by using the logistic regression. The age-standardized incidence or prevalence was calculated by the direct method from the 2010 Census population with 5- to 10-year age groups (15–19, 20–24, 25–29, 30–34, 35–39, and 40–50) for each year and race subgroup. The results were statistically significant when $p < 0.05$. All statistical analyses were performed with SAS Software Version 9.4 (SAS Institute Inc).

Results

Table 1 shows the numbers of first-time pregnancies (for each study year), incidence of GDM, and diabetes before pregnancy by age and study year in the Louisiana Medicaid population. A total of 111,936 first-time pregnant women were identified in our dataset from 2016 to 2021. Among those individuals, 7,633 women had a GDM-complicated pregnancy and 1,691 women had diabetes before their pregnancy. The mean maternal age during pregnancy was 26.1 ± 5.0 years, and it did not change significantly over the study period. The mean maternal age between women pregnant before and during the COVID-19 pandemic was insignificant.

Table 2 shows the annual incidence of GDM for each age group in the Louisiana Medicaid population. The crude incidence of GDM increased from 5.7% in 2016 to 8.3% in 2020, with a slight decrease to 7.6% in 2021. The age-standardized incidence of GDM increased from 10.2% in 2016 to 14.8% in 2020 and decreased to 14.0% in 2021 (p for trend <0.001).

The annual prevalence of diabetes before pregnancy for each age group is presented in Table 3. The crude prevalence

Table 1. Numbers of First Pregnancy, Incidence of Gestational Diabetes Mellitus, and Diabetes Before Pregnancy by Age and Year in Louisiana Medicaid Population, from 2016 to 2021

Age group (years)	*Years of first pregnancy*					
	2016	*2017*	*2018*	*2019*[a]	*2020*[a]	*2021*
No. of first-time pregnancies						
15–19	2277	2298	2461	3135	2312	2641
20–24	6484	5806	5748	7036	5730	7142
25–29	6324	5325	4626	4757	3426	3621
30–34	3948	3598	3215	3489	2373	2653
35–39	1644	1613	1656	1768	1329	1435
40–50	340	345	353	362	314	351
Total	21,018	18,985	18,059	20,547	15,484	17,843
No. of incident gestational diabetes mellitus cases						
15–19	44	33	40	63	59	61
20–24	185	190	241	249	256	304
25–29	337	295	284	358	347	313
30–34	335	337	354	399	312	348
35–39	236	216	256	261	230	245
40–50	61	64	82	68	83	87
Total	1198	1135	1257	1398	1287	1358
No. of diabetes before pregnancy						
15–19	15	8	13	16	10	10
20–24	58	49	48	58	63	62
25–29	64	57	64	69	42	66
30–34	78	73	90	100	53	77
35–39	66	58	50	72	48	47
40–50	17	19	25	17	18	11
Total	298	264	290	332	234	273

[a]The 2019 dataset consisted of dates from 2019 until the COVID-19 pandemic in February 2020. The 2020 dataset consisted of dates from March 2020 until December 2020.

continued to increase from 1.4% in 2016 to 1.6% in 2019, with a slight decreased to 1.5% in 2020 and 2021. The age-standardized prevalence of diabetes before pregnancy increased from 2.8% in 2016 to 3.4% in 2018 and decreased to 2.3% in 2021 (p for trend < 0.001).

The annual race/ethnicity-specific incidence of GDM for each age group in the Louisiana Medicaid population is presented in Table 4. The incidence of GDM increased in all racial/ethnicity groups between 2016 and 2021, with the largest increase seen in Asian women (12.5% in 2016 to 24.3% in 2021, then White women (5.9% in 2016 to 8.6% in 2021), and African American women (4.6% in 2016 to 6.0% in 2021). The age-standardized rate of GDM was the highest among Asian women (23.0%), then White women (15.5%), and African American women (13.9%) (p for difference <0.001). The mean maternal age varied from 25.9 years in African American women, 26.2 years in White women, to 30.3 years in Asian women ($p < 0.001$).

Discussion

The present study found that the incidence of GDM among women in the Louisiana Medicaid population increased from 10.2% in 2016 to 14.8% in 2020 and decreased to 14.0% in 2021. The prevalence of pre-pregnancy diabetes increased from 2.8% in 2016 to 3.4% in 2018 and decreased to 2.3% in 2021. The incidence of GDM increased in all racial/ethnic groups from 2016 to 2021, with the largest increase and highest incidence seen in Asian women.

The prevalence of GDM is due to multiple risk factors, such as a lower SES, physical inactivity, obesity, family history of diabetes, advanced maternal age, and the growth of minority populations with a higher risk of GDM.[15,31] Studies have shown that a lower SES increases the risk of GDM due to more limited access to health care[32] and an increased rate of obesity and sedentary behavior.[33–36] Therefore, the Medicaid population typically has more risk factors for GDM. A higher prevalence of diabetes is also seen in Medicaid-insured individuals with obesity than in privately insured individuals with obesity (10.6% and 10.4% vs. 4.45%).[37]

All these risk factors are directly or indirectly linked to insulin sensitivity or resistance and an impaired function of β-cells to secrete insulin, further increasing the risk of diabetes.[31,32] Type 2 diabetes is more prominent in lower SES individuals as they have more limited autonomy and face more health disparities.[32] These restrictions may induce additional stress and trigger the release of stress hormones, such as cortisol, growth hormone, and glucagon, altering fat deposition and ultimately leading to a higher risk of type 2 diabetes.[32] Lower SES individuals have a greater intake of foods rich in saturated fats and carbohydrates because of affordability.[32]

Table 2. Incidence (%) of Gestational Diabetes Mellitus by Age and Year in Louisiana Medicaid Population, from 2016 to 2021

Age group (years)	*Years of first pregnancy*						p-*values*
	2016	*2017*	*2018*	*2019*[a]	*2020*[a]	*2021*	
15–19	1.9	1.4	1.6	2.9	2.6	2.3	0.062
20–24	2.9	3.3	4.2	3.5	4.5	4.3	<0.001
25–29	5.3	5.5	6.1	7.5	10.1	8.6	<0.001
30–34	8.5	9.4	11.0	11.4	13.2	13.1	<0.001
35–39	14.4	13.4	15.5	14.8	17.3	17.1	0.018
40–50	17.9	18.6	23.2	18.8	26.4	24.8	0.021
Total	5.7	6.0	7.0	6.8	8.3	7.6	<0.001
Age-standardized[b]	10.2	10.4	12.6	11.5	14.8	14.0	<0.001

[a]The 2019 dataset consisted of dates from 2019 until the COVID-19 pandemic in February 2020. The 2020 dataset consisted of dates from March 2020 until December 2020.

[b]Age adjusted for the direct method to the year 2000 Census population using the age groups 15–19, 20-24, 25–29, 30–34, 35–39, and 40–50 years.

Table 3. Prevalence (%) of Diabetes Before Pregnancy by Age and Year in Louisiana Medicaid Population, from 2016 to 2021

	Years of first pregnancy						
Age group (years)	*2016*	*2017*	*2018*	*2019*[a]	*2020*[a]	*2021*	p-*values*
15–19	0.7	0.4	0.5	0.5	0.4	0.4	0.663
20–24	0.9	0.8	0.8	0.8	1.1	0.9	0.613
25–29	1.0	1.1	1.4	1.5	1.2	1.8	0.009
30–34	2.0	2.0	2.8	2.9	2.2	2.9	0.021
35–39	4.0	3.6	3.0	4.1	3.6	3.3	0.552
40–50	5.0	5.5	7.1	4.7	5.7	3.1	0.301
Total	1.4	1.4	1.6	1.6	1.5	1.5	0.331
Age-standardized[b]	2.8	2.8	3.4	2.8	2.9	2.3	<0.001

[a]The 2019 dataset consisted of dates from 2019 until the COVID-19 pandemic in February 2020. The 2020 dataset consisted of dates from March 2020 until December 2020.
[b]Age adjusted for the direct method to the year 2000 Census population using the age groups 15–19, 20-24, 25–29, 30–34, 35–39, and 40–50 years.

Individuals from a lower SES also live in more unsafe environments and have less access to exercise facilities, promoting physical inactivity.[32] A similar lifestyle was seen and exacerbated during the COVID-19 pandemic.[38]

Data demonstrating the trends in the incidence of GDM in the United States before and during the COVID-19 pandemic are lacking. The present study showed that the highest incidence of GDM from 2016 to 2021 was seen during the peak of the COVID-19 pandemic and the following year (2020–2021). This finding agrees with several studies outside of the United States.[39–41] A recent study in Romania found that the prevalence of GDM increased from 5.78% in 2017–2019 to 8.20% in 2019–2020.[40] Another study in Italy indicated that prevalence of GDM increased from 9% in 2019 to 13.5% in 2020.[41] An increase in the incidence of GDM during the COVID-19 pandemic may be attributed to a sedentary lifestyle, with physical activity at a minimum,[42–44] directly resulting in weight gain among adults after the first month of lockdown.[45]

The COVID-19 pandemic resulted in lockdown restrictions, leading to the closure and halt of crucial sources of physical activity, such as gyms and fitness centers. Just one week of confinement due to the COVID-19 pandemic could significantly contribute to the observed decline in physical activity levels among adults.[46] Wilke et al. showed that moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) declined by 41% and 42.2%, respectively, in adults of age 24–54 years during the lockdown.[47] However, in Australia, while fewer children met the MVPA recommendations during the lockdown, more adults met the MVPA recommendations than before the COVID-19 pandemic.[43] Several studies have shown a correlation between maternal obesity and the incidence of GDM.[33–35,40,48,49] The performance of recreational physical activity before and/or during pregnancy decreased the risk of GDM.[50–52]

Previous studies have examined how the incidence of GDM differs in various racial/ethnic groups. In 2017, the International Diabetes Federation declared that the occurrence of GDM ranged from 9% in Africa, 12.6% in North America, to 21% in Asia.[49] Our data agrees that the incidence of GDM was higher among Asian American women, which was supported by some[15,53,54] but not all regional data.[55] The latter study observed that the greatest prevalence of GDM was seen in African American women due to their pre-pregnancy BMI; however, the study concluded that BMI was not an effective GDM screening tool

Table 4. Annual Race/Ethnicity-Specific Incidence (%) of Gestational Diabetes Mellitus by Age and Year in Louisiana Medicaid Population, from 2016 to 2021

	White		*African American*		*Asian*		
Year of pregnancy	*No./No.*	*Incidence*	*No./No.*	*Incidence*	*No./No.*	*Incidence*	p-*values*
2016	570/9731	5.9	376/8100	4.6	47/377	12.5	<0.001
2017	521/8794	5.9	387/7393	5.2	32/305	10.5	<0.001
2018	576/8346	6.9	443/7179	6.2	47/281	16.7	<0.001
2019[a]	636/8506	7.5	446/8488	5.3	59/341	17.3	<0.001
2020	531/6105	8.7	450/6649	6.8	48/187	25.7	<0.001
2021	624/7240	8.6	446/7465	6.0	49/209	24.3	0.032
Total	3458/48,722	7.5	2548/45,274	5.8	282/1700	19.1	<0.001
Age-standardized[b]		15.5		13.9		23.0	<0.001
p values (trend)		<0.001		<0.001		<0.001	

No./No., numbers of GDM cases/numbers of first-time pregnancies.
[a]The 2019 dataset consisted of dates from 2019 until the COVID-19 pandemic in February 2020. The 2020 dataset consisted of dates from March 2020 until December 2020.
[b]Age adjusted for the direct method to the year 2000 Census population using the age groups 15–19, 20-24, 25–29, 30–34, 35–39, and 40–50 years.

for Asian women, as it lacked sensitivity and precision.[55] The result of Asian women exhibiting a greater incidence of GDM was also supported by national data.[56,57] Poor health and genetic factors may contribute to a higher incidence of GDM in Asian women.[8] In addition, the average maternal age for Asian women is typically higher than that for other races, which is a prominent risk factor for GDM.[58] A meta-analysis study observed that the risk of GDM directly increases with successive age groups.[59] Every 1-year increase in maternal age from the age of 18 increases the risk of GDM for Asian women by 12.7%.[59]

The main strengths of this study consist of utilizing a well-characterized Louisiana Medicaid database of pregnant women. In addition, a large sample size of African American, White, and Asian women, with accessible information on GDM and pre-pregnancy diabetes, makes our findings more robust. A limitation of this study is that the data come from the Medicaid program. Therefore, the generalizability of the findings of this study may not translate to the non-Medicaid population. Another limitation is that we did not know which criteria were used for the diagnosis of GDM.

Conclusion

Our study indicated that the incidence of GDM increased from 10.2% in 2016 to 14.8% in 2020 and decreased to 14.0% in 2021 in the Louisiana Medicaid population. The prevalence of pre-pregnancy diabetes increased from 2.8% in 2016 to 3.4% in 2018 and decreased to 2.3% in 2021 in the Louisiana Medicaid population. There is evidence that the incidence of GDM increased due to sedentary behavior and obesity during the COVID-19 pandemic. As GDM is associated with worse pregnancy outcomes and an exceptionally high risk for type 2 diabetes later in life, a strong emphasis should be placed on understanding these processes. This study raises the question of how the increase in the incidence of GDM will affect the long-term health of both the mother and child. Future longitudinal follow-up studies may help to understand these metabolic outcomes further. Meanwhile, increased efforts should be made in GDM prevention, especially in the Louisiana Medicaid population, as the population typically faces more health adversities and has an increase in GDM risk factors.

Authors' Contributions

G.H.: Had full access to all the data in the study and took responsibility for the integrity of the data and the accuracy of the data analysis. J.L., R.H., G.H.: Concept and design. J.L., R.H., G.H.: Acquisition, analysis, or interpretation of data. J.L.: Drafting of the article.: All authors: Critical revision of the article for important intellectual content. J.L., R.H., G.H.: Statistical analysis. G.H.: Administrative, technical, or material support. G.H.: Supervision.

Author Disclosure Statement

No competing financial interests exist.

Data Sharing Statement

Data available: Yes.

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The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the article; and decision to submit the article for publication.

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