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Increasing Prevalence of Diabetes During Pregnancy in South Carolina

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Abstract

Background: The objective of our study was to examine the prevalence of diabetes during pregnancy at the population level in SC from January 1996 through December 2008.

Methods: The study included 387,720 non-Hispanic white (NHW), 232,278 non-Hispanic black (NHB), and 43,454 Hispanic live singleton births. Maternal inpatient hospital discharge codes from delivery (91.59%) and prenatal information (i.e., Medicaid [42.91%] and SC State Health Plan [SHP] [5.98%]) were linked to birth certificate data. Diabetes during pregnancy included gestational and preexisting, defined by prenatal and maternal inpatient International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnostic codes (i.e., 64801–64802, 64881–64882, or 25000–25092) or report on the birth certificate.

Results: Diabetes prevalence from any source increased from 5.02% (95% confidence interval [CI]: 4.82–5.22) in 1996 to 8.37% (95% CI: 8.15–8.60) in 2008. Diabetes prevalence, standardized for maternal age and race/ethnicity from 1996 through 2008, increased from 3.38% (95% CI: 3.29–3.47) to 5.81% (95% CI: 5.71–5.91) using birth certificate data, from 3.99% (95% CI: 3.89–4.10) to 6.69% (95% CI: 6.58–6.80) using hospital discharge data, and from 4.74% (95% CI: 4.52–4.96) to 8.82% (95% CI: 8.61–9.03) using Medicaid data. Comparing birth certificate to hospital discharge, Medicaid, and SHP data, Cohen's kappa in 2008 was 0.73 (95% CI: 0.72–0.75), 0.64 (95% CI: 0.62–0.66), and 0.59 (95% CI: 0.54–0.65), respectively.

Conclusions: An increasing prevalence of diabetes during pregnancy is reported, as well as substantial lack of agreement in reporting of diabetes prevalence across administrative databases. Prevalence of reported diabetes during pregnancy is impacted by screening, diagnostic, and reporting practices across different data sources, as well as by actual changes in prevalence over time.

Introduction

The prevalence of diabetes during pregnancy, both prepregnancy and gestational, has increased with the diabetes and obesity epidemics.[1] The glucose intolerance that develops during 2%–18% of pregnancies, called gestational diabetes mellitus (GDM), represents an early warning sign that exists for few chronic conditions and allows early identification of high-risk women before the onset of clinically defined type 2 diabetes.[2,3] Women with GDM have substantial future risk of developing type 2 diabetes, with a 7.4-fold increased risk and incidence estimates of 35%–60% in the 2 decades following delivery.[2,4–6]

Certain characteristics are known to increase the likelihood for development of GDM and progression from GDM to type 2 diabetes. Age, race/ethnicity, obesity, and family history are associated with development of GDM[2,7,8]; obesity, use of insulin during pregnancy, and early gestational age at diagnosis of GDM (<24 weeks) are associated with progression from GDM to type 2 diabetes.[9,10] Current US clinical guidelines recommend screening for GDM between 24 and 28 weeks gestation.[11] Whether screening, detection, and treatment of GDM may reduce future risk of type 2 diabetes is not known.[12]

In recognition of the increasing prevalence of chronic diseases such as type 2 diabetes, registries have been

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established to provide more accurate epidemiologic estimates of disease burden. Yet, in being faced with the adverse impact of increasing prepregnancy diabetes and GDM,[13,14] registries for GDM and prepregnancy diabetes are virtually nonexistent. US-based studies often use birth certificate data to identify estimates of GDM and prepregnancy diabetes.[1,15] Gestational and prepregnancy diabetes are also increasingly being tracked in administrative databases; however, there is significant variability in detecting and monitoring prepregnancy and GDM and their potential impact on the health outcomes of reproductive-age women and their unborn children.

State-specific efforts to document diabetes during pregnancy and distinguish between GDM and established concurrent diabetes were not mandated until the 1990s. For example, the prevalence of GDM in North Dakota increased at least 10-fold among reproductive-age women between 1980 and 1992 (from 0.1% to 1.5% among women <30 years and from 0.2% to 2.8% among women 30 years and older, respectively) when a mandate was established to distinguish GDM from preexisting diabetes.[16] Since 1994, Kaiser Permanente of Colorado (KPCO) has used a standard protocol to universally screen for GDM and has examined trends in GDM prevalence based on laboratory test results from oral glucose tolerance and challenge tests among women with singleton pregnancies from diverse ethnic backgrounds. From 1994 to 2002, the prevalence of GDM doubled (2.1%–4.1%, $p<0.001$) in the KPCO population, with significant increases in all racial/ethnic groups.[17] The age-adjusted prevalence of GDM increased more than 3-fold (from 14.5 cases per 1,000 women in 1991 to 47.9 cases per 1,000 in 2003) among women across all age and racial/ethnic groups in Los Angeles County, CA.[18] In the multivariable regression analysis, the annual rate increase for GDM was 8.3% overall and was highest among Hispanics (9.9%).[18]

Although increasing trends of diabetes during pregnancy are clear, information is lacking about the prevalence of diabetes during pregnancy in the southeastern United States, which has one of the highest rates of obesity and diabetes in the nation. Although the reliability of vital records is variable, birth certificates continue to be an important source of data for examining GDM at the population level. Our study had two purposes: reporting diabetes prevalence, including gestational and prepregnancy, during pregnancy in the southeastern United States; and determining the reliability of prevalence rates across different data sources (i.e., birth certificates, hospital discharge records, Medicaid, and the SC State Health Plan [SHP]). There has been a clear, clinical distinction between a diagnosis of GDM and established diabetes. However, because of the difficulty in tracking gestational and prepregnancy diabetes across multiple data sources and because GDM and prepregnancy diabetes were not differentiated on the SC birth certificate until 2004, we chose to analyze these diagnoses together and separately but to focus on the combined endpoint of prepregnancy diabetes or GDM for the majority of the current article.

Materials and Methods

Study design and population

The eligible sample population included SC-resident mothers who self-reported their racial/ethnic group as Hispanic, non-Hispanic white (NHW), or non-Hispanic black (NHB) and who delivered live singleton births between January 1996 and December 2008. Birth certificate information was obtained from the SC Department of Health and Environmental Control and linked by the SC Office of Research and Statistics (ORS) to inpatient hospital discharge records for the state to obtain maternal inpatient procedure and diagnostic codes pertaining to delivery. Additionally, outpatient diagnostic codes were available for the prenatal period for mothers who received prenatal care through either Medicaid or the SHP. The linkage between databases is based on an algorithm developed by SC ORS and relies on personal identifying information. The Institutional Review Board of the Medical University of South Carolina approved the study as exempt research.

Variable definition

Diabetes during pregnancy was defined by either gestational or prepregnancy diabetes reported on the birth certificate or if it was coded for on the inpatient hospital discharge records or during the prenatal period. The prenatal period was defined by the date of delivery and gestational age of the infant at delivery and included the year prior to conception in defining prepregnancy diabetes. Additionally, for a diagnosis of diabetes during pregnancy based on the prenatal data alone, two or more International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnostic codes indicative of diabetes were required in the medical record. This criterion was based on a validated algorithm developed for use in the Veterans Health Administration, which requires two or more codes to improve specificity of diabetes classification.[19] Primary and up to nine secondary inpatient hospital and prenatal ICD-9-CM diagnosis codes used to define diabetes included those for prepregnancy and GDM (i.e., 64801–64802, 25000–25092, 64881–64882).

Maternal race/ethnicity, education (categorized based on less than high school graduate, high school graduation or general educational development [GED], and more than high school), and medical coverage (i.e., Medicaid, private insurance, self-pay, and other or unknown) were defined as reported on the birth certificate. Race/ethnicity was assessed because diabetes prevalence during pregnancy is known to vary by race/ethnicity. Adequacy of prenatal care was defined based on the revised graduated index (GINDEX), which combines information from the birth certificate on the trimester when prenatal care was first received and the total number of prenatal visits.[20]

Statistical analysis

The prevalence of diabetes during pregnancy (i.e., gestational and prepregnancy) was examined in SC between January 1996 and December 2008. Information on diabetes during pregnancy was obtained from four sources: the SC birth certificate, inpatient hospital discharge codes from delivery, Medicaid, and data from the SHP. First, we examined demographic and clinical characteristics of participants with information from each of the four data sources. Next, we examined unadjusted diabetes prevalence (i.e., grouping gestational or prepregnancy diabetes together) by year for each of the four data sources. Next, we examined unadjusted

diabetes prevalence across the four sources of information stratified by GDM only, prepregnancy diabetes only, and both, mentioned by year for 2004 through 2008. Using Cohen's kappa (95% CI), we also compared agreement on diabetes diagnosis (i.e., grouping gestational or prepregnancy diabetes together) between the birth certificate and each of the three other sources of information (i.e., hospital discharge diagnoses codes, Medicaid, and SHP data) by year. We examined unadjusted diabetes prevalence (i.e., grouping gestational or prepregnancy diabetes together) at the population level according to source by race and ethnicity from 1996 through 2008. Finally, owing to differences in the distributions of age and ethnicity from each source of data (birth certificate, inpatient hospital discharge diagnostic codes, and Medicaid), diabetes prevalence rates by year were further standardized to account for these imbalances. Compared to women with hospital discharge information, women missing information on hospital discharge were of similar age (25.8 compared to 26.0 years), more likely to be Hispanic (11.3% compared to 6.1%), less likely to be NHW (53.5% compared to 58.9%), and similarly likely to be NHB (35.2% compared to 35.0%). Compared to those receiving Medicaid, women without Medicaid were older (27.9 compared to 23.4 years), more likely to be Hispanic (9.6% compared to 2.5%), more likely to be NHW (67.3% compared to 46.6%), and less likely to be NHB (23.1% compared to 50.9%). Yearly age- and ethnicity-adjusted prevalence rates were calculated across sources, using model-based estimates from SAS PROC SURVEYREG (SAS Institute Inc., Cary, NC). Information from the SHP was not included in this final age- and ethnicity-adjusted analysis, owing to the low numbers of Hispanics within this category.

Results

Study population

Of 677,803 live singleton births to SC-resident mothers, 7,158 (1.06%) were excluded because maternal race or ethnicity was missing from the birth certificate or listed as unknown, and 7,193 (1.06%) were excluded because maternal race was identified as ''other'' (i.e., not white, black, or Hispanic). Of 663,452 births to NHW, NHB, and Hispanic mothers, maternal inpatient hospital procedure and diagnostic codes from delivery were successfully linked and available for 607,676 (91.59%) births. Prenatal information was available for 284,690 (42.91%) births to mothers with Medicaid and 39,696 (5.98%) births to mothers with the SHP.

Demographic and clinical characteristics for subgroups of the population are shown in Table 1. In the entire sample, defined by those having information from the birth certificate, the mean maternal age at delivery was 26.0 years, 76.2%

Table 1. Demographic and Clinical Data for Subgroups of the Population

	BC n = *663,452*	*HD* n = *607,676*	*MC* n = *284,690*	*SHP* n = *39,696*
Age (years, std)	26.0 ± 6.0	26.0 ± 6.0	23.4 ± 5.3	30.2 ± 4.7
Ethnicity (%)				
NHW	58.4	58.9	46.6	75.9
NHB	35.0	35.0	50.9	23.0
Hispanic	6.6	6.1	2.5	1.1
Education level (%)				
Less than high school	22.9	22.5	33.1	1.2
High school	31.8	31.6	40.2	12.3
More than high school	45.4	45.9	26.7	86.6
Medical coverage (%)[a]				
Medicaid	49.6	49.7	85.7	10.0
Private insurance	36.6	36.9	9.1	80.4
Self-pay	7.0	5.4	2.5	1.3
Other or unknown	6.9	1.4	2.8	8.4
Gestation age				
Weeks (std)	39.7 ± 4.0	38.7 ± 3.9	38.5 ± 3.3	38.7 ± 3.3
Preterm (%)	12.7	12.4	14.7	10.6
Term (%)	81.3	81.6	78.2	85.2
Postterm (%)	6.0	5.9	7.1	4.2
Prenatal care[b] (%)				
Intensive utilization	10.3	10.4	12.9	11.1
Adequate utilization	37.0	37.2	34.6	50.0
Intermediate utilization	36.6	36.7	39.3	33.9
Inadequate utilization	9.1	9.0	11.4	3.8
No care	5.8	5.7	1.4	1.0
Missing required data	1.2	1.0	0.4	0.2

Groups are not mutually exclusive.

[a]Available only on births that occurred from 2004 through 2008 (n = 270,446).

[b]Prenatal care was defined based on the revised GINDEX as reported by Alexander and Kotelchuck, which combines information from the birth certificate on the trimester when prenatal care was first received and the total number of prenatal visits.[20]

BC, birth certificate; GINDEX, graduated index; HD, hospital discharge; MC, Medicaid; NHB, non-Hispanic black; NHW, non-Hispanic white; SHP, State Health Plan; std, standard deviation.

were high school educated, 35.0% were NHB, and 6.6% were Hispanic. Based on information from the birth certificate, 49.6% were covered by Medicaid, 36.6% by private insurance, 7.0% by self-pay, and 6.9% by other or unknown sources.

Increasing diabetes prevalence wthin each data source

Based on information from the birth certificate, the prevalence of reported diabetes during pregnancy increased from 3.27% (95% CI: 3.11, 3.43) in 1996 to 5.75% (95% CI: 5.55, 5.94) in 2008 (Fig. 1A). (See also Supplementary Table S1; Supplementary Data are available online at www.liebertonline.com/jwh.) Importantly, the major increase occurred in 2004, when the new birth certificate, which differentiated between gestational and prepregnancy diabetes, was introduced. Based solely on information from the maternal hospital discharge record, the prevalence of reported diabetes during pregnancy increased from 3.85% (95% CI: 3.66, 4.03) in 1996 to 6.58% (95% CI: 6.37, 6.80) in 2008.

Focusing on the population with prenatal data available through Medicaid, mean maternal age was 23.4 years, 67.8% were high school educated, 50.9% were NHB, and 2.5% were Hispanic. In the Medicaid subgroup, 14.7%, and 12.8% had inadequate or no utilization of prenatal care. In the population that received prenatal care through Medicaid, the prevalence of diabetes, based on Medicaid data, increased from 3.66%

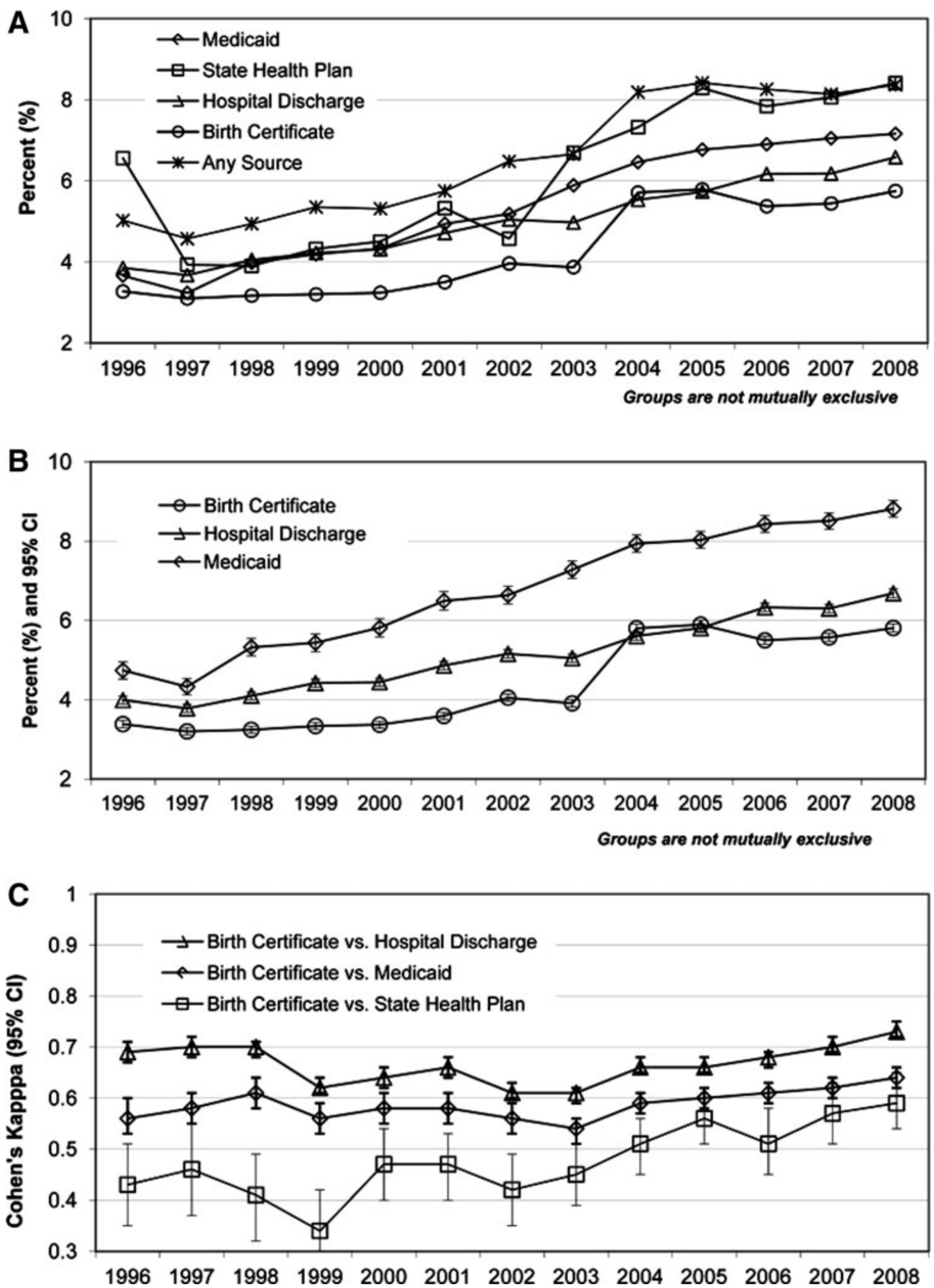

FIG. 1. Diabetes Prevalence During Pregnancy. **(A)** Prepregnancy and Gestational by Year and Source, Unadjusted. **(B)** Standardized for Age and Race/Ethnicity. **(C)** Agreement in Reporting of Diabetes by Source. CI, confidence interval.

Table 2. Diabetes Prevalence (Percentage and 95% Confidence Interval), Including Either Gestational or Prepregnancy Diabetes at the Population Level, According to Source by Race and Ethnicity from 1996 Through 2008

	Overall n = *663,452*	*NHW* n = *387,720*	*NHB* n = *232,278*	*Hispanic* n = *43,454*
Individual source				
BC	4.31 (4.26, 4.36)	4.13 (4.06, 4.19)	4.59 (4.50, 4.67)	4.45 (4.25 4.64)
HD	4.64 (4.59, 4.69)	4.61 (4.55, 4.68)	4.67 (4.59, 4.76)	4.67 (4.48 4.87)
MC	2.38 (2.34, 2.42)	1.78 (1.73, 1.82)	3.64 (3.56, 3.71)	1.03 (0.93 1.12)
SHP	0.37 (0.35, 0.38)	0.44 (0.42, 0.46)	0.30 (0.28, 0.32)	0.08 (0.05 0.11)
Combined sources				
BC or HD	6.00 (5.94, 6.06)	5.89 (5.82, 5.97)	6.15 (6.05, 6.25)	6.13 (5.90 6.35)
BC or MC	5.36 (5.31, 5.41)	4.94 (4.87, 5.01)	6.16 (6.06, 6.25)	4.85 (4.65 5.05)
BC or SHP	4.50 (4.45, 4.55)	4.36 (4.30, 4.42)	4.73 (4.64, 4.81)	4.50 (4.31 4.70)
BC, HD, MC, or SHP	6.64 (6.58, 6.70)	6.45 (6.38, 6.53)	7.02 (6.92, 7.12)	6.34 (6.11 6.57)

''At the population level'' indicates the denominator for calculating prevalence; includes everyone in a given population and is not limited to those with data available from a specified source.

(95% CI: 3.39, 3.93) to 7.16% (95% CI: 6.85, 7.46) over the 13-year period.

Focusing on those with prenatal data available through the SHP, mean maternal age was 30.2 years, 98.8% were high school educated, 23.0% were NHB, 1.1% were Hispanic, the prevalence of preterm birth was 10.0%, and only 4.8% had inadequate or no utilization of prenatal care. In the population that received prenatal care through the SHP, the prevalence of diabetes, based on SHP data, was uncharacteristically high in 1996 (i.e., 6.56% [95% CI: 5.57, 7.54]), decreased to 3.93% (95% CI: 3.17, 4.68) in 1997, but increased again and was over 7% from 2004 through 2008.

Diabetes prevalence combined across sources and standardized

Combining information across all sources, the prevalence of reported diabetes during pregnancy increased from 5.02% (95% CI: 4.82, 5.22) in 1996 to 8.37% in 2008 (95% CI: 8.15, 8.60) (Fig. 1A and Table S1). Population-level prevalence of diabetes during pregnancy by race and ethnicity by individual and combined sources is given in Table 2. Using information from multiple sources to identify individuals with any record of diabetes during pregnancy increases the prevalence identified in the population. Because birth certificate data were required for inclusion in the study population and hospital discharge data were available on a high percentage, the prevalence of diabetes identified by both of these sources at the population level is higher than the prevalence identified through Medicaid or the SHP (i.e., available only on 42.9% and 5.98%, respectively). Combining information from the birth certificate with all other data sources (i.e., hospital discharge, Medicaid, and the SHP), the prevalence of diabetes during pregnancy increases from 4.13% to 6.45% in NHW, from 4.59% to 7.02% in NHB, and from 4.45% to 6.34% in Hispanics (Table 2).

Diabetes prevalence during pregnancy, standardized for maternal race/ethnicity and age at delivery from 1996 through 2008, is shown in Figure 1B. From 1996 to 2008, the standardized prevalence of diabetes during pregnancy increased from 3.38% (95% CI: 3.29, 3.47) to 5.81% (95% CI: 5.71, 5.91) based on birth certificate data, from 3.99% (95% CI: 3.89, 4.10) to 6.69% (95% CI: 6.58, 6.80) based on hospital discharge data, and from 4.74% (95% CI: 4.52, 4.96) to 8.82% (95% CI: 8.61, 9.03) based on Medicaid data. Standardized prevalence is not provided for the SHP, owing to limited data points.

GDM versus prepregnancy diabetes

For the years 2004 through 2008, information distinguishing between prepregnancy and GDM was available from all data sources, but there was often not concordance across data sources with respect to timing of diabetes onset (Table 3). Across all sources, the prevalence of GDM without a record of prepregnancy diabetes ranged from 4.77% (95%

Table 3. Diabetes Prevalence (Percentage and 95% Confidence Interval) Stratified by Gestational Diabetes Mellitus Only, Prepregnancy Diabetes Only, and Both Mentioned Across All Sources of Information by Year for 2004 Through 2008 (Total *n* = 270,446 Across 5 Years)

Year	*All DM: any source*	*GDM only: any source*	*PPDM only: any source*	*GDM and PPDM:any source*
2004	8.19 (7.95, 8.43)	5.11 (4.91, 5.30)	0.74 (0.66, 0.81)	2.35 (2.22, 2.48)
2005	8.42 (8.18, 8.65)	5.09 (4.90, 5.28)	0.81 (0.73, 0.89)	2.51 (2.38, 2.65)
2006	8.26 (8.03, 8.49)	4.88 (4.70, 5.06)	0.77 (0.70, 0.85)	2.60 (2.47, 2.73)
2007	8.14 (7.92, 8.37)	4.77 (4.60, 4.95)	0.79 (0.72, 0.87)	2.58 (2.45, 2.71)
2008	8.37 (8.15, 8.60)	5.05 (4.87, 5.24)	0.72 (0.65, 0.79)	2.61 (2.48, 2.74)
Total	8.28 (8.17, 8.38)	4.98 (4.90, 5.06)	0.77 (0.73, 0.80)	2.53 (2.47, 2.59)

Sources of information include birth certificate, hospital discharge diagnoses, Medicaid, and the State Health Plan.
DM, diabetes mellitus; GDM, gestational diabetes mellitus; PPDM, prepregnancy diabetes mellitus.

CI: 4.60, 4.95) to 5.11% (95% CI: 4.91, 5.30). The prevalence of prepregnancy diabetes without a record of GDM ranged from 0.72% (95% CI: 0.65, 0.79) to 0.81% (95% CI: 0.73, 0.89). Finally, the prevalence of having at least one record of GDM and at least one record of prepregnancy diabetes ranged from 2.35% (95% CI: 2.22, 2.48) to 2.61% (95% CI: 2.48, 2.74).

Agreement and reliability across data sources

Cohen's kappa was used to evaluate agreement between the birth certificate and our other sources of information on diabetes during pregnancy for each year (Fig.1B and Table S2). Comparing birth certificate to hospital discharge data, Cohen's kappa indicated strong agreement, ranging from 0.61 (95% CI: 0.60, 0.63) in 2002 to 0.73 (95% CI: 0.72, 0.75) in 2008. Comparing birth certificate to Medicaid data, Cohen's kappa indicated intermediate to strong agreement, ranging from 0.54 (95% CI: 0.51, 0.56) in 2003 to 0.64 (95% CI: 0.62, 0.66) in 2008. Comparing birth certificate to SHP data, Cohen's kappa also indicated intermediate to strong agreement, ranging from 0.34 (95% CI: 0.26, 0.42) in 1999 to 0.59 (95% CI: 0.54, 0.65) in 2008.

Focusing on the 272,710 women with information available from the birth certificate, hospital discharge, and Medicaid, the prevalence of diabetes across the study time period was 7.40% (95% CI: 7.30, 7.50) from any source, 4.48% (95% CI: 4.40, 4.55) from birth certificate data alone, 5.13% (95% CI: 5.05, 5.21) from hospital discharge data alone, and 5.50% (95% CI: 5.42, 5.59) from Medicaid alone (Table S3). Assessing reliability among these women using diagnosis of diabetes from any source as the gold standard, the diagnosis of diabetes during pregnancy was missed 39.46% of the time on the birth certificate, 30.68% of the time on hospital discharge, and 25.68% of the time using Medicaid data.

Discussion

In this examination of data sources, agreement with birth certificate data was strongest for hospital discharge data and weakest with the SHP data (Fig. 1C; Table S2). Moreover, when assessing reliability, the diagnosis of diabetes was missed 25% to 40% of the time, depending on data source. Importantly, for each comparison with birth certificate data, agreement was strongest for our final data point in 2008. At specific points in the years between 2002 and 2004, each data source showed a substantial increase in the proportion of women with diabetes during pregnancy, possibly owing to policies that called for better documentation in distinguishing established diabetes from GDM, more widespread use of standardized criteria for diagnosis of GDM, and a greater awareness of the importance of reporting diabetes during pregnancy. The increasing prevalence of diabetes during pregnancy mirrors the rising rates of diabetes and obesity in the general population. GDM, which accounts for the majority of diabetes during pregnancy, is known to increase the risk of adverse birth outcomes and presents high future risk of type 2 diabetes.[2,4–6]

Over the 13-year analysis of trend, SHP data generally had the highest estimates of diabetes during pregnancy, followed by Medicaid, hospital discharge, and birth certificates (Fig. 1A and B). Depending on the source from which diabetes prevalence estimates are provided, one needs to consider what population is represented. For instance, birth certificate and hospital discharge data are available on over 90% of the population and not specifically to a population subgroup. Medicaid is more specific to low-income and racial/ethnic minority subgroups (particularly NHB); not unexpectedly, the SHP is more representative of an insured NHW population (Table 1).

Utilizing information across all our data sources for prepregnancy diabetes and GDM combined, our prevalence estimates of 5.31% in 2000 and 8.37% in 2008 in SC are lower than results from a study we conducted that simulated national estimates of prepregnancy diabetes and GDM combined of 8.1% (NHW) and 8.9% (NHB) in 2000 and 8.7% (NHW) and 9.6% (NHB) in 2008.[21] Our prevalence estimates for diabetes during pregnancy of 8.42% (i.e., prepregnancy diabetes only (0.81%), GDM only (5.09%), and prepregnancy diabetes/GDM both (2.51%) in SC in 2005 are slightly higher than results from a study in southern California that reports 2005 prevalence estimates for prepregnancy diabetes of 1.5% in NHW and 2.6% in NHB and prevalence estimates for GDM of 5.3% in NHW and 5.0% in NHB.[22] In contrast, our estimates are much higher but follow similar increasing trends as in a national study, based solely on hospital discharge data, that reported diabetes prevalence during pregnancy (i.e., prepregnancy and GDM combined) increasing from 3.49% in 1994 to 5.47% in 2004.[23] Similarly, a study based on National Hospital Discharge Surveys reported that the prevalence of GDM increased from 2.0% to 3.6% in white women and from 1.5% to 4.1% in black women from 1989 to 2004.[24]

Our study, based on multiple administrative databases, enabled us to examine agreement and reliability across administrative data sources. In 2004, the SC birth certificate was revised: check boxes were added to differentiate between gestational and prepregnancy diabetes. Previously, a validation study was conducted on a population-based sample of 54,541 women who had live births in 2000 in Washington State, which uses a birth certificate comparable to the SC birth certificate.[25] The reported true-positive fractions combining information across the birth certificate with hospital discharge data and using medical record review as the gold standard was 93.3 (95% CI: 86.9, 99.7) for GDM and 96.9 (95% CI 91.6,100) for established diabetes in the validation study.[25] Respective false-positive fractions were 0.9 (95% CI 0.5, 1.4) and 0.5 (95% CI 0, 1.1).[25]

A limitation of our study is that we were not able to use medical record review as a gold standard. A second limitation is that the quality of the data available differentiating between prepregnancy diabetes and GDM, as well as our inability to discriminate between type 1 and type 2 diabetes, prevented us from completing an exhaustive analysis of prevalence over time of specific subtypes of diabetes. Additionally, because timing and consistency of prenatal care may be associated with the quality of data pertaining to prepregnancy and GDM, we include information on prenatal care, using the revised GINDEX.[20]

A large registry or administrative database facilitates public health research efforts by allowing examination of both overall population and subgroup estimates for determination of the utility of screening and detection of risk. Importantly, Health Sciences South Carolina (HSSC) has recently launched the first statewide clinical data warehouse, allowing providers and researchers to follow patient

conditions in real time.[26] However, the added burden of standardization and widespread use of criteria for detection of prepregnancy diabetes and GDM still needs to be overcome.[11]

In an effort to promote reproductive health and control risk factors for development of type 2 diabetes, the expanded health coverage for women of reproductive age was mandated by the Patient Protection and Affordable Care Act (PPACA) (and advocated by the American Diabetes Association in its health equity initiative). This legislative piece, called the Gestational Diabetes Act, calls for improved tracking, surveillance, and public health research on GDM to gain a better understanding of which women are at the greatest risk and to work on prevention of both incident and recurrent GDM cases.[27,28] Greater attention to the detection of GDM may result in another steep incline in the proportion of women with GDM.[28] Registries of diagnosed GDM and prepregnancy diabetes or interlinked hospital/clinical administrative records, such as what is being created through the HSSC data warehouse, could likely be used to provide more accurate estimates of GDM and associated outcomes. For instance, Medicaid is a primary source of insurance during pregnancy for many SC women; however, a database created based on Medicaid data alone is limited because women often lose Medicaid coverage shortly following delivery of their infant.

An increasing prevalence of diabetes during pregnancy is reported; however, in examining changes in prevalence over time, it is important to remember that prevalence of reported diabetes during pregnancy is impacted by screening, diagnosing, and reporting practices, which have evolved over time, as well as by actual changes in prevalence over time. The observed lack of agreement across administrative databases indicates that there remain opportunities for improvement in the standardization of the diagnosing, screening, and reporting practices for diabetes during pregnancy. Improved standardization of those practices would enhance our ability to assess the public health impact of diabetes during pregnancy.

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Author Disclosure Statement

No competing financial interests exist.

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