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Diabetes During Pregnancy: Surveillance, Preconception Care, and Postpartum Care

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Abstract

Diabetes during pregnancy can adversely affect the health of women and infants. In this report, we provide an overview of the state of the science, and highlight Centers for Disease Control and Prevention (CDC) activities related to (1) surveillance of preexisting and gestational diabetes mellitus (GDM); (2) preconception care for women with preexisting diabetes; (3) postpartum diabetes screening among women with GDM-affected pregnancies; and (4) preventing the progression to Type 2 diabetes among women with GDM-affected pregnancies through lifestyle intervention programs. Improving preconception care, increasing postpartum diabetes screening rates, and promoting lifestyle interventions in the postpartum period all provide opportunities to improve the health of women and their infants.

Keywords

diabetes; surveillance; preconception care; lifestyle intervention; postpartum screening

Introduction

In the United States, the prevalence of diabetes has increased by over 35% from 1988 through 2012[1]; in 2015, an estimated 12 million women ages 18 years or older had diagnosed diabetes and ~3 million had undiagnosed diabetes.[2] Diabetes during pregnancy can adversely affect the health of women and their infants. Women with Type 1 or Type 2 diabetes diagnosed before entering pregnancy, referred to in this article as preexisting diabetes, are at risk for elevated glucose levels and/or insulin resistance around the time of conception; this early exposure increases infants' risk of congenital anomalies, stillbirth, and premature birth.[3] Gestational diabetes mellitus (GDM) is diabetes that is first diagnosed during pregnancy,[4] and could be a detection of undiagnosed preexisting diabetes or onset of diabetes at 24–28 weeks gestation, the latter typically reverting back to normal after delivery.[5,6] For both women with preexisting diabetes or GDM, elevated glucose levels throughout pregnancy increases their risk of having a cesarean delivery, and increases

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infants' risk of being born too large (or macrosomic), hypoglycemic, and developing obesity or diabetes in the future.[7–9] Women with GDM are also more likely to have recurrent GDM in subsequent pregnancies[10,11] and to develop Type 2 diabetes later in life.[12]

In this report, we provide an overview of the state of the science, and describe select Centers for Disease Control and Prevention (CDC) activities related to (1) surveillance of preexisting diabetes and GDM; (2) preconception care for women with preexisting diabetes; (3) postpartum diabetes screening among women with GDM-affected pregnancies; and (4) preventing the progression to Type 2 diabetes among women with GDM-affected pregnancies through lifestyle intervention programs. We conclude by highlighting opportunities to improve each of these areas for promoting optimal maternal and infant health.

Surveillance of preexisting and gestational diabetes

Preexisting diabetes—Preexisting diabetes has been identified as a priority preconception health indicator by the National Preconception Health and Healthcare Initiative's Surveillance and Research group.[13,14] Few studies have specifically focused on the surveillance of Type 1 and Type 2 diabetes among reproductive aged women. Surveillance reports using Behavioral Risk Factor Surveillance System (BRFSS) data from 50 states and the District of Columbia found the overall prevalence of self-reported Type 1 and Type 2 diabetes among women ages 18–44 years was 3.0% in 2009[15] and 3.1% in 2014–2015,[14] with non-Hispanic black and older women having higher prevalence of diabetes compared to other race/ethnicity or age groups, respectively.[15] Similarly, 2007–2010 data from the National Health and Nutrition Examination Survey (NHANES) indicate that 3.2% of women ages 20–44 years had diabetes based on self-report or a fasting blood test.[16] For surveillance purposes, BRFSS and NHANES are limited in that neither can discern Type 1 from Type 2 diabetes, and both provide self-reported diabetes status, which may be subject to respondent biases; however, both data sources provide national estimates of preexisting diabetes among reproductive age women, and BRFSS can also provide state-specific estimates.

In the United States preexisting diabetes is estimated to affect 0.75%–2.1% of births,[15,17] with Type 2 diabetes more prevalent than Type 1.[17–19] Furthermore, the prevalence of preexisting diabetes during pregnancy has increased. For example, one study using hospital discharge data from 19 states found preexisting diabetes increased from an age-adjusted prevalence of 0.65% in 2000 to 0.89% in 2010—a relative increase of 37%.[20] Prevalence of preexisting diabetes in pregnancy varies by maternal age and race/ethnicity; specifically, older women[17,21] and non-Hispanic black or Hispanic[18,20] women are more likely to have pregnancies affected by this condition. Hospital discharge databases, which are often used for surveillance purposes, have been found to provide more sensitive estimates of preexisting diabetes than the birth certificate[22]; however, hospital discharge data often lack demographic information, such as complete data on race/ethnicity, education level, information on prenatal care, and previous birth outcomes, which are useful for understanding health disparities and guiding interventions. Although the 2003 revised birth certificate differentiates preexisting diabetes from GDM, national surveillance of preexisting diabetes

is limited because not all states adopted the revised birth certificate until 2016. Adoption by all states will enable national estimates of preexisting diabetes and GDM; unfortunately, these data will not enable discerning Type 1 from Type 2 diabetes. Studies have found that linking hospital discharge and birth certificate data provides a wider range of data and a more accurate source for identifying maternal diagnoses than a single source alone.[22,23]

Undiagnosed diabetes is a challenge to surveillance. In 2015, an estimated 4.0% of men and women ages 18–44 years in the United States had diabetes, of which approximately one-third were undiagnosed.[2] With continued increases in obesity and cardiovascular disease, there may be concurrent increases in undiagnosed diabetes. To our knowledge, NHANES is the only data system able to measure undiagnosed diabetes because it collects blood specimens on a subsample of participants in addition to self-reported diabetes. However, due to sample size limitations, undiagnosed diabetes estimates in pregnant women may not be reliable. Moreover, multiple years are needed to have a sufficient sample size to estimate undiagnosed diabetes among women of reproductive age.

Gestational diabetes—GDM is defined as diabetes with onset or first recognition during pregnancy.[4] In the United States, 5.7%–8.7% of pregnancies are complicated by GDM[24,25] that represents 85%–90% of all pregnancy-related diabetes (Type 1, Type 2, and gestational).[21] Among delivery hospitalizations, the prevalence of GDM increased more quickly than preexisting diabetes from 2000 to 2010; GDM prevalence increased 56% while preexisting diabetes increased 37%.[26] Several studies have found that racial/ethnic minority women, especially Asian and Hispanic women, have a higher prevalence of GDM than non-Hispanic white women.[24,26–28] Further, women who experienced GDM are 50%–80% more likely to develop GDM in a subsequent pregnancy,[10] and even without GDM recurrence in the subsequent pregnancy, offspring from subsequent pregnancies are more likely to experience adverse health outcomes compared to offspring of mothers who never had GDM.[29] A major challenge to surveillance of GDM is that screening practices and diagnostic thresholds for identifying women with GDM may vary by institution, which makes it difficult to determine whether changes in prevalence estimates reflect variation in clinical practice or true changes in the proportion of women with GDM. Revised birth certificate and hospital discharge data may be used for GDM surveillance; however, similar to preexisting diabetes, these data sources are limited by data quality concerns and lack of select demographic indicators, respectively.[22]

Preconception care

Preconception care is the provision of healthcare and medical interventions that that optimize women's health and the health of an infant, should a pregnancy occur.[30] For women with preexisting diabetes, preconception care provides an opportunity to review diabetes management to ensure appropriate glucose levels, adjust medications if needed, and evaluate and treat any medical complications. Women with preexisting diabetes intending to become pregnant may benefit from working with a dietitian to develop healthy practices such as logging meals and developing individualized meal plans.[30] Consultation with a doctor and dietitian before pregnancy is important as diabetes management (*e.g.*, medications) during pregnancy may differ from diabetes management before pregnancy.

A Pregnancy Risk Assessment Monitoring System (PRAMS) study examining 10 states in 2009–2010 found that 53% of women with preexisting diabetes, 32% with GDM, and 31% with no diabetes received preconception care before their pregnancy; preconception care was defined, as before pregnancy, talking with a doctor, nurse, or other healthcare worker to prepare for a healthy pregnancy and baby.[31] A recent modeling study of 69,357 births to women with preexisting diabetes estimated that preconception care (which was defined as some combination of glycemic control, glucose monitoring, counseling, screening and treatment of diabetic complications, or contraception until glycemic control is achieved) could prevent 8397 preterm deliveries, 3725 birth defects, and 1897 perinatal deaths annually.[32] Further, provision of the previously mentioned types of preconception care to an estimated 18,723 women with undiagnosed diabetes might avert an additional 2267 preterm deliveries, 1006 birth defects, and 505 perinatal deaths annually. For women of reproductive age, clinical assessment of associated risk factors and provision of recommended screening can identify undiagnosed diabetes. Reproductive age women can work with clinicians to achieve a healthy weight, engage in at least 150 minutes per week of moderate-intensity aerobic activity, and address other health behaviors that may put them at risk for developing or worsening diabetes.[33]

For reproductive aged women with diabetes, consulting with a healthcare provider is an opportunity to appropriately plan for pregnancy, as poor glucose control at conception and possibly early pregnancy increases the risk of congenital anomalies and stillbirth.[3] For women with diabetes who want to delay or avoid pregnancy, the 2016 U.S. Medical Eligibility Criteria for Contraceptive Use provides recommendations for using specific contraceptive methods by women and men who have certain characteristics or medical conditions, including diabetes.[34]

Improve postpartum diabetes screening

Because 3%–14% of women who had a pregnancy affected by GDM will be diagnosed with overt Type 2 diabetes when tested 6 weeks postpartum and an additional 17%–25% will be diagnosed with impaired glucose tolerance,[35–37] screening immediately postpartum and then periodic monitoring is important for early detection of Type 2 diabetes. The American College of Obstetricians and Gynecologists (ACOG) recommends screening women at 4–12 weeks postpartum.[7] If results are normal at 4–12 weeks, women are recommended to be tested every 1–3 years as part of lifelong monitoring. For women with impaired glucose tolerance, but not overt diabetes, yearly testing is recommended by the American Diabetes Association to monitor for the development of Type 2 diabetes.[38] Women diagnosed with Type 2 diabetes at the postpartum screen are recommended to be referred for timely and appropriate follow-up care.

Nationally representative surveillance data on postpartum diabetes screening are not currently available. Estimates of postpartum diabetes screening range from 3.4% to 51.7% depending on the method of data collection and population studied.[39–42] For example, a 2011 study using Medicaid claims data from South Carolina found only 3.4% of women with GDM-affected pregnancies received diabetes screening 5–13 weeks postpartum[39]; in contrast, a study using 2000–2012 claims data from a nationwide commercial insurance

database found approximately one-quarter of women over the study period were screened in the year postpartum.[42] In 2009–2010, roughly half of women with GDM-affected pregnancies from three states and one jurisdiction participating in PRAMS reported receiving diabetes screening postpartum.[41] While postpartum diabetes screening on PRAMS is assessed *via* self-report and has not been validated, PRAMS provides state-representative estimates, and beginning in 2016, all 47 states participating in PRAMS will include questions on postpartum diabetes screening.

Overall, postpartum diabetes screening appears to be less than optimal, suggesting missed opportunities to diagnose, monitor, and provide appropriate medical care or interventions to treat Type 2 diabetes or that may prevent women from progressing to Type 2 diabetes.[40] Barriers to postpartum diabetes screening may be related to clinicians not providing appropriate referrals for the diabetes screening test; lack of health insurance and high out of pocket costs; or women not understanding the reason for postpartum testing, not having the time, or not wanting to get tested in the postpartum period after being tested for GDM during pregnancy.[43,44] As women with a history of GDM transition from pregnancy to postpartum, establishing communication between obstetrical and primary care providers is key to improving postpartum diabetes screening and monitoring.[45] A multilevel approach may need to be considered, which could include a reminder system incorporated into electronic medical records and an effective hand-off system of patient's medical records involving a variety of healthcare settings, specialties, and levels of practitioners.[43,45,46]

Identifying alternative approaches to postpartum diabetes screening may improve screening rates. For example, the CDC Division of Reproductive Health funded researchers to investigate delivery hospitalizations as an opportunity for conducting postpartum diabetes screening. One study comparing diabetes screening at 6 weeks postpartum, the researchers found diabetes screening at delivery had a sensitivity of 100% and specificity of 94%,[47] thus screening during delivery hospitalization may be a viable alternative to screening later in the postpartum period. Innovative methods are needed to address barriers to postpartum screening and improve related surveillance of postpartum diabetes screening.

Lifestyle interventions to prevent type 2 diabetes

Women who experience GDM are up to 70% more likely to develop Type 2 diabetes within 10 years after a GDM-affected pregnancy.[12] For women with a GDM history, the postpartum period is an opportunity to mitigate the risk of developing Type 2 diabetes by engaging in healthy dietary and physical activity behaviors and returning to prepregnancy weight.[48,49] Women are encouraged to return to their prepregnancy weight because weight gained during pregnancy and maintained postpartum can increase body mass index and GDM risk in subsequent pregnancies. Although national estimates of postpartum weight retention are unavailable, studies across the United States report a range of 13%–20% of pregnant women retained at least 5 kg by 1 year postpartum.[50] In a large cohort study of 12,583 women in the United Kingdom, 73% retained at least some of the weight gained during pregnancy at 6 months postpartum.[51] Furthermore, postpartum weight retention among women with GDM-affected pregnancies may increase the risk of mothers developing Type 2 diabetes later in life. For example, one study followed women for 18 years and found for each 5 kg increase

in weight after diagnosis of GDM, the risk of developing Type 2 diabetes increased by 27%.[52]

Lifestyle interventions that include diet and physical activity have been shown to reduce postpartum weight retention and reduce the risk of developing Type 2 diabetes.[53] However, new mothers face unique barriers to engaging in lifestyle interventions, including time constraints, childcare responsibilities, and fatigue.[54] To address these challenges, CDC funded researchers to develop a lifestyle intervention program for women with a recently GDM-affected pregnancy called Balance After Baby. This year-long pilot program provided women in the intervention group with a lifestyle coach, a pedometer, and access to online modules modeled after the Diabetes Prevention Program.[55] In addition, the program included dietary suggestions to assist in transitioning from a GDM diet and an exercise component with activities involving the baby. Women in the control group received usual care from their healthcare providers.[56] The pilot results showed that women in the intervention group lost a mean of 2.8 kg from 6 weeks to 12 months postpartum compared to the control group who gained a mean of 0.5 kg. The study is currently being scaled up to include more sites, English and Spanish language versions, and 2 years of follow-up to examine maintenance of weight loss after the intervention is complete. Balance After Baby was specifically designed for women in the first year postpartum, with a goal to reduce postpartum weight retention and ultimately prevent women from developing future prediabetes or Type 2 diabetes. However, women with a history of GDM, or women who develop prediabetes, are also eligible to participate in the National Diabetes Prevention Program (National DPP), which includes a yearlong lifestyle change program designed to prevent or delay type 2 diabetes. The National DPP is an evidence-based intervention coordinated by CDC, and includes thousands of CDC-recognized organizations delivering the program to hundreds of thousands of people in-person, virtually, or through a combination of virtual and in-person modalities to accommodate different learning styles and preferences.

Summary and Conclusion

Glucose intolerance before, during, and after pregnancy has important health implications for both mothers and their babies. In this overview, we highlight work related to surveillance, preconception care, and postpartum care and opportunity for improvements. To strengthen surveillance, efforts may need to focus on improving current data sources by linking existing data sources (such as birth certificate and hospital discharge data), improving quality of data to increase sensitivity of preexisting diabetes and GDM estimates, and accurately capture postpartum screening rates. By improving surveillance systems, public health researchers, practitioners, and clinicians may better understand the prevalence and related public health burden of diabetic conditions during pregnancy; in turn, this will allow improved development and targeting of interventions, programs, and policy.

In addition to surveillance, opportunities exist to improve preconception and postpartum healthcare for women with preexisting or gestational diabetes. Preconception care for women with preexisting diabetes to obtain proper glucose control might prevent potential adverse pregnancy and birth outcomes. In the postpartum period, improvements to

healthcare are needed to ensure women with a GDM-affected pregnancy are screened for diabetes. These improvements may require a multilevel approach that addresses barriers at the patient, clinician and healthcare-system level. Finally, given the high progression rate of GDM to Type 2 diabetes, improved availability of lifestyle interventions are needed, especially those that address the unique barriers postpartum women face.

We have a unique opportunity to prevent future development of Type 2 diabetes among women whose pregnancies are affected by GDM. By identifying ways to improve preconception care for women with preexisting diabetes, ensure appropriate postpartum diabetes screening and postpartum care among women with a GDM-affected pregnancy, and provide opportunities for changes in lifestyle, we might significantly improve the health of women and prevent future adverse pregnancy outcomes.

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References

1. Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and trends in diabetes among adults in the United States, 1988–2012. JAMA. 2015; 314:1021–1029. [PubMed: 26348752]
2. Centers for Disease Control and Prevention. National Diabetes Statistics Report. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; Atlanta, GA: 2017.
3. Correa A, Gilboa SM, Besser LM, et al. Diabetes mellitus and birth defects. Am J Obstet Gynecol. 2008; 199:237–239. [PubMed: 18674752]
4. Hartling L, Dryden DM, Muise M. , et al. Evidence Report/Technology Assessment No. 210. Rockville, MD: 2012. Screening and Diagnosing Gestational Diabetes Mellitus. AHRQ Publication No. 12 (13)-E021-EF
5. Diabetes Care. Classification and diagnosis of diabetes. Diabetes Care. 2015; 38(Suppl 1):S8–S16.
6. Barahona MJ, Sucunza N, Garcia-Patterson A, et al. Period of gestational diabetes mellitus diagnosis and maternal and fetal morbidity. Acta Obstet Gynecol Scand. 2005; 84:622–627. [PubMed: 15954869]
7. Practice bulletin no. 180 summary: Gestational diabetes mellitus. Obstet Gynecol. 2017; 130:244–246. [PubMed: 28644329]
8. Ovesen PG, Jensen DM, Damm P, Rasmussen S, Kesmodel US. Maternal and neonatal outcomes in pregnancies complicated by gestational diabetes. A nation-wide study. J Matern Fetal Neonatal Med. 2015; 28:1720–1724. [PubMed: 25228278]
9. Pettitt DJ, McKenna S, McLaughlin C, Patterson CC, Hadden DR, McCance DR. Maternal glucose at 28 weeks of gestation is not associated with obesity in 2-year-old offspring: The belfast Hyperglycemia and Adverse Pregnancy Outcome (HAPO) family study. Diabetes Care. 2010; 33:1219–1223. [PubMed: 20215449]
10. Kim C, Berger DK, Chamany S. Recurrence of gestational diabetes mellitus: A systematic review. Diabetes Care. 2007; 30:1314–1319. [PubMed: 17290037]
11. England LJ, Kotelchuck M, Wilson HG, et al. Estimating the recurrence rate of Gestational Diabetes Mellitus (GDM) in Massachusetts 1998–2007: Methods and Findings. J Matern Child Health. 2015; 19:2303–2313.
12. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: A systematic review. Diabetes Care. 2002; 25:1862–1868. [PubMed: 12351492]

13. Broussard DL, Sappenfield WB, Fussman C, Kroelinger CD, Grigorescu V. Core state preconception health indicators: A voluntary, multi-state selection process. Matern Child Health J. 2011; 15:158–168. [PubMed: 20225127]
14. Robbins CL, D'Angelo D, Zapata L, et al. Preconception health indicators for public health surveillance. J Womens Health. 2018; 27:430–443.
15. Robbins CL, Zapata LB, Farr SL, et al. Core state preconception health indicators—Pregnancy risk assessment monitoring system and behavioral risk factor surveillance system, 2009. MMWR Surveill Summ. 2014; 63:1–62.
16. Menke A, Rust KF, Fradkin J, Cheng YJ, Cowie CC. Associations between trends in race/ethnicity, aging, and body mass index with diabetes prevalence in the United States: A series of cross-sectional studies. Ann Intern Med. 2014; 161:328–335. [PubMed: 25178569]
17. Albrecht SS, Kuklina EV, Bansil P, et al. Diabetes trends among delivery hospitalizations in the U.S., 1994–2004. Diabetes Care. 2010; 33:768–773. [PubMed: 20067968]
18. Peng TY, Ehrlich SF, Crites Y, et al. Trends and racial and ethnic disparities in the prevalence of pregestational type 1 and type 2 diabetes in Northern California: 1996–2014. Am J Obstet Gynecol. 2017; 216:177. [PubMed: 27751798]
19. Jovanovic L, Liang Y, Weng W, Hamilton M, Chen L, Wintfeld N. Trends in the incidence of diabetes, its clinical sequelae, and associated costs in pregnancy. Diabetes Metab Res Rev. 2015; 31:707–716. [PubMed: 25899622]
20. Bardenheier BH, Imperatore G, Devlin HM, Kim SY, Cho P, Geiss LS. Trends in pre-pregnancy diabetes among deliveries in 19 U.S. States, 2000–2010. Am J Prev Med. 2015; 48:154–161. [PubMed: 25326417]
21. Correa A, Bardenheier B, Elixhauser A, Geiss LS, Gregg E. Trends in prevalence of diabetes among delivery hospitalizations, United States, 1993–2009. J Matern Child Health. 2015; 19:635–642.
22. Devlin HM, Desai J, Walaszek A. Reviewing performance of birth certificate and hospital discharge data to identify births complicated by maternal diabetes. J Matern Child Health. 2009; 13:660–666.
23. Salemi JL, Tanner JP, Bailey M, Mbah AK, Salihu HM. Creation and evaluation of a multi-layered maternal and child health database for comparative effectiveness research. J Regist Manag. 2013; 40:14–28.
24. Bardenheier BH, Elixhauser A, Imperatore G, et al. Variation in prevalence of gestational diabetes mellitus among hospital discharges for obstetric delivery across 23 states in the United States. Diabetes Care. 2013; 36:1209–1214. [PubMed: 23248195]
25. DeSisto CL, Kim SY, Sharma AJ. Prevalence estimates of gestational diabetes mellitus in the United States, Pregnancy Risk Assessment Monitoring System (PRAMS), 2007–2010. Prev Chronic Dis. 2014; 11:E104. [PubMed: 24945238]
26. Bardenheier BH, Imperatore G, Gilboa SM, et al. Trends in gestational diabetes among hospital deliveries in 19 U.S. States, 2000–2010. Am J Prev Med. 2015; 49:12–19. [PubMed: 26094225]
27. Hedderson MM, Darbinian JA, Ferrara A. Disparities in the risk of gestational diabetes by race-ethnicity and country of birth. Paediatr Perinat Epidemiol. 2010; 24:441–448. [PubMed: 20670225]
28. Kim SY, Saraiva C, Curtis M, Wilson HG, Troyan J, Sharma AJ. Fraction of gestational diabetes mellitus attributable to overweight and obesity by race/ethnicity, California, 2007–2009. Am J Public Health. 2013; 103:e65–e72. [PubMed: 23947320]
29. Kim SY, Kotelchuck M, Wilson HG, Diop H, Shapiro-Mendoza CK, England LJ. Prevalence of adverse pregnancy outcomes, by maternal diabetes status at first and second deliveries, Massachusetts, 1998–2007. Prev Chronic Dis. 2015; 12:E218. [PubMed: 26652218]
30. ACOG Practice Bulletin. Clinical Management Guidelines for Obstetrician-Gynecologists. Number 60, March 2005. Pregestational diabetes mellitus. Obstet Gynecol. 2005; 105:675–685. [PubMed: 15738045]
31. Kachoria R, Oza-Frank R. Receipt of preconception care among women with prepregnancy and gestational diabetes. Diabet Med. 2014; 31:1690–1695. [PubMed: 24984802]

32. Peterson C, Grosse SD, Li R, et al. Preventable health and cost burden of adverse birth outcomes associated with pregestational diabetes in the United States. Am J Obstet Gynecol. 2015; 212:74–79. [PubMed: 25439811]
33. Johnson K, Posner SF, Biermann J, et al. Recommendations to improve preconception health and health care—United States. A report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. MMWR Recomm Rep. 2006; 55(RR-6):1–23.
34. Curtis KM, Tepper NK, Jatlaoui TC, et al. U.S. Medical eligibility criteria for contraceptive use, 2016. MMWR Recomm Rep. 2016; 65:1–103.
35. Schaefer-Graf UM, Klavehn S, Hartmann R, et al. How do we reduce the number of cases of missed postpartum diabetes in women with recent gestational diabetes mellitus? Diabetes Care. 2009; 32:1960–1964. [PubMed: 19641163]
36. Kitzmiller JL, Dang-Kilduff L, Taslimi MM. Gestational diabetes after delivery. Short-term management and long-term risks. Diabetes Care. 2007; 30(Suppl 2):S225–S235. [PubMed: 17596477]
37. Catalano PM, Vargo KM, Bernstein IM, Amini SB. Incidence and risk factors associated with abnormal postpartum glucose tolerance in women with gestational diabetes. Am J Obstet Gynecol. 1991; 165(4 Pt 1):914–919. [PubMed: 1951553]
38. Diabetes Care. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2018. Diabetes Care. 2018; 41(Suppl 1):S13–S27. [PubMed: 29222373]
39. Hale NL, Probst JC, Liu J, Martin AB, Bennett KJ, Glover S. Postpartum screening for diabetes among Medicaid-eligible South Carolina women with gestational diabetes. Womens Health Issues. 2012; 22:e163–e169. [PubMed: 21963202]
40. Tovar A, Chasan-Taber L, Eggleston E, Oken E. Postpartum screening for diabetes among women with a history of gestational diabetes mellitus. Prev Chronic Dis. 2011; 8:A124. [PubMed: 22005617]
41. Oza-Frank R. Postpartum diabetes testing among women with recent gestational diabetes mellitus: PRAMS 2009– 2010. Matern Child Health J. 2014; 18:729–736. [PubMed: 23775251]
42. Eggleston EM, LeCates RF, Zhang F, Wharam JF, Ross-Degnan D, Oken E. Variation in postpartum glycemic screening in women with a history of gestational diabetes mellitus. Obstet Gynecol. 2016; 128:159–167. [PubMed: 27275787]
43. Vesco KK, Dietz PM, Bulkley J, et al. A system-based intervention to improve postpartum diabetes screening among women with gestational diabetes. Am J Obstet Gynecol. 2012; 207:283–286. [PubMed: 23021689]
44. Van RE, Middleton P, Shute E, Hague W, Crowther C. Women's views and knowledge regarding healthcare seeking for gestational diabetes in the postpartum period: A systematic review of qualitative/survey studies. Diabetes Res Clin Pract. 2015; 110:109–122. [PubMed: 26421361]
45. Martinez NG, Niznik CM, Yee LM. Optimizing postpartum care for the patient with gestational diabetes mellitus. Am J Obstet Gynecol. 2017; 217:314–321. [PubMed: 28455081]
46. Hunt KJ, Logan SL, Conway DL, Korte JE. Postpartum screening following GDM: How well are we doing? Curr Diab Rep. 2010; 10:235–241. [PubMed: 20425588]
47. Werner EF, Has P, Tarabulsi G, Lee J, Satin A. Early postpartum glucose testing in women with gestational diabetes mellitus. Am J Perinatol. 2016; 33:966–971. [PubMed: 27120481]
48. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002; 346:393–403. [PubMed: 11832527]
49. Ratner RE. Prevention of type 2 diabetes in women with previous gestational diabetes. Diabetes Care. 2007; 30(Suppl 2):S242–S245. [PubMed: 17596479]
50. Gunderson EP. Childbearing and obesity in women: Weight before, during, and after pregnancy. Obstet Gynecol Clin North Am. 2009; 36:317–32. ix. [PubMed: 19501316]
51. Hollis JL, Crozier SR, Inskip HM, et al. Modifiable risk factors of maternal postpartum weight retention: An analysis of their combined impact and potential opportunities for prevention. Int J Obes (Lond). 2017; 41:1091–1098. [PubMed: 28337028]
52. Bao W, Yeung E, Tobias DK, et al. Long-term risk of type 2 diabetes mellitus in relation to BMI and weight change among women with a history of gestational diabetes mellitus: A prospective cohort study. Diabetologia. 2015; 58:1212–1219. [PubMed: 25796371]

53. Guo J, Chen JL, Whittemore R, Whitaker E. Postpartum lifestyle interventions to prevent type 2 diabetes among women with history of gestational diabetes: A systematic review of randomized clinical trials. J Womens Health (Larchmt). 2016; 25:38–49. [PubMed: 26700931]

54. Nicklas JM, Zera CA, Seely EW, Abdul-Rahim ZS, Rudloff ND, Levkoff SE. Identifying postpartum intervention approaches to prevent type 2 diabetes in women with a history of gestational diabetes. BMC Pregnancy Childbirth. 2011; 11:23. [PubMed: 21435246]

55. Orchard TJ, Temprosa M, Goldberg R, et al. The effect of metformin and intensive lifestyle intervention on the metabolic syndrome: The Diabetes Prevention Program randomized trial. Ann Intern Med. 2005; 142:611–619. [PubMed: 15838067]

56. Nicklas JM, Zera CA, England LJ, et al. A web-based lifestyle intervention for women with recent gestational diabetes mellitus: A randomized controlled trial. Obstet Gynecol. 2014; 124:563–570. [PubMed: 25162257]