



Pregnancy and Gestational Diabetes Mellitus (GDM) in North American Indian Adolescents and Young Adults (AYA): Implications for Girls and Stopping GDM

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Abstract

Purpose of Review To provide an updated synopsis of the research and clinical practice findings on pregnancy and gestational diabetes mellitus (GDM) in American Indian and Alaska Native (AIAN) adolescents and to describe the newly developed “Stopping GDM,” an early intervention, culturally tailored risk reduction program for AIAN girls and their mothers.

Recent Findings Five research articles met our inclusion criteria. Three retrospective quantitative studies published in the past 10 years corroborated a 1.5 to 2 times higher prevalence for GDM for all age groups in the AIAN population as compared to other ethnic groups, and that the percentage of GDM cases attributable to overweight and obesity was highest for AIs (52.8%). Moreover, First Nations women across all age groups had more adverse pregnancy risk factors than non-First Nations women. Out of the five selected articles, two were qualitative research articles: one examined AIAN women’s experiences of having GDM or type 2 diabetes (T2D) during pregnancy and the other appraised the understanding of GDM and reproductive health of at-risk AIAN girls.

Summary There is a paucity of research published on this topic. AIAN females are at high risk for developing GDM. Early, culturally responsive interventions and cohort follow-up studies are needed among adolescents and young adults, using technology that appeals to this age group.

Keywords Pregnancy · Gestational diabetes · Native American · American Indian · Adolescents · Preconception counseling

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Introduction

American Indian and Alaska Native (AIAN) adolescents have nearly twice the US prevalence of adolescent obesity, pregnancy, and gestational diabetes mellitus (GDM) [1, 2]. Obesity increases the risk of GDM [3]. GDM is the most common complication of pregnancy [3] affecting 3–7% of pregnant women in the USA [4]. In the AIAN population, GDM affects up to 15.3% of pregnant women among one tribe in the Southwest [5].

GDM and obesity are associated with increased risk of complications including maternal high blood pressure, preeclampsia, morbidity from operative delivery, and high maternal risks of developing type 2 diabetes (T2D) in the future [6]. Moreover, maternal GDM and obesity increase the risk of fetal macrosomia, birth trauma, hypoglycemia, hyperbilirubinemia, hypocalcemia, erythremia, and poor feeding [6, 7]. GDM also increases the risk of obesity and type 2 diabetes in the offspring, creating a vicious cycle [8]. The adolescent period poses an additional risk, whereby adolescent women are at higher risk of pregnancy-related complications [9]. Thus, the need for early interventions to prevent GDM in AIAN adolescents and young women is compelling.

The purpose of this paper is to present the findings of a literature review on pregnancy and GDM in AIAN adolescent females, and to describe the newly developed gestational diabetes risk reduction and preconception counseling program, entitled *Stopping Gestational Diabetes in Daughters and Mothers* (Stopping GDM), an early intervention, culturally tailored program for AIAN adolescent girls and their mothers.

Methods

We identified articles for this review by conducting a search in PubMed. The search string was developed in consultation with a medical librarian and utilized both controlled vocabulary (Medical Subject Headings; MeSH) and natural language to represent the concepts of “gestational diabetes” and “American Indian or Alaska Native.” (The actual search string was “pregnancy,” “gestational diabetes,” “American Indian,” “Alaska Native,” “Native American,” “adolescents,” “young adults,” “teen,” “female,” and “preconception counseling”). A date limit of January 01, 2009, to April 31, 2019, was applied, as was a limit to English language publication.

A total of 155 citations were retrieved. Abstracts were distributed to five reviewers who independently selected relevant articles by using all three of the following inclusion criteria: (1) sample must include AIAN adolescent females age \leq 21 years old (distinguishes this age group in their results); (2) “type of paper” could include data-based and non-data-based papers: research study (quantitative or qualitative), literature review, clinical practice guideline, clinical descriptive

report, or editorial/letters; (3) outcome or main concept must include pregnancy or gestational diabetes mellitus, or gestational diabetes, or diabetes and pregnancy. More specific selection criteria were applied for the inclusion into the AIAN category, namely, Native American, American Indian, Alaska Native, First Nations, Inuit, Aboriginal, Metis, USA, Canada, and Greenland. Twenty-three abstracts met all 3 criteria.

Of those 23 abstracts selected, all 23 full articles were then further evaluated by the reviewers using the same criteria. It was determined that only seven articles met all the inclusion criteria. Each article was then further evaluated by two reviewers who rated them independently. The reviewers were asked to populate the information in Table 1. Discussion of the final selection was conducted via a conference call with all five reviewers and the two senior authors (KM and DC-P). Discussion ensued until consensus was reached.

Five research studies were agreed upon (with no reviews or clinical articles). The selected publications are summarized in Table 1. Four publications came from within the USA and one was from Canada.

Recent Findings

Research Articles A total of five original research articles were selected based on our inclusion criteria outlined above for pregnancy and GDM. Three articles were retrospective quantitative studies utilizing large data sets for pregnancy and GDM [4, 10, 11]. Although no articles were found that included new information on pregnancy among AIAN adolescents, Oster et al. reported that more than half of First Nations pregnancies were in young adult women < 25 years of age [11]. The retrospective articles confirmed that the overall prevalence for GDM was 1.5 to 2 times [10] higher for all age groups in the AIAN population as compared to other ethnic groups and that the percentage of GDM cases attributable to overweight and obesity was highest for American Indians (52.8%) [4]. The risk of GDM increased with age in these 3 studies [9, 11]. In addition, First Nations women across all age groups had more adverse pregnancy risk factors than non-First Nations women [11]. Data from the 2014–2016 US Birth File confirmed that the AIAN group had the highest prevalence for high birth weight, a risk factor that is associated with both early life unfavorable outcomes and a long-term increased risk of chronic diseases such as diabetes and asthma [10].

Two of the five articles were qualitative focus group studies [12, 13]. The first focus group study [12] examined AIAN women’s experiences of having GDM or T2D during pregnancy; and they provided suggestions for the Stopping GDM program. Four themes emerged: (1) lack of knowledge about GDM and opportunities for health information, (2) traditional Native culture and how to incorporate this into a GDM risk reduction education program, (3) reproductive health

Table 1 Articles selected from studies on pregnancy and gestational diabetes in American Indian and Alaska Native adolescents

Author/Date/Country	Purpose	Type of Paper and Design	Population Characteristics	Specific to adolescent pregnancy or GDM or Both	Outcomes and variables	Intervention	Results	Conclusion
Dennis, 2019 USA	To explore whether the “weathering hypothesis,” which is represented by findings of disproportionately increasing rates of LBW, applies to AIAN populations.	Retrospective study - using data from the 2014–2016 U.S. Birth File on singleton first births.	N=23,926, all ages, stratified by under 14 years (n= 118), 15–19 years (n=7,443), 20–24 years (n=9,619) Analyzed data on singleton first births in the US from 2014–2016.	GDM	Prevalence of normal birthweight (NBW), LBW and HBW. Logistic regression odds ratios predicting NBW, age, ethnicity, smoking status, and presence of GDM.	N/A	GDM rates increased in AIAN population vs non AIAN, within AIAN, higher in older ages vs younger ages GDM % [n], by age: Under 14 = 2.54 (< 10) 15–19 = 3.51 (261) 20–24 = 5.84 (560) Total AIAN = 6.55 (1563)	The rate of GDM and smoking both increased with age amongst AIAN mothers. Age patterns in birth weight are similar in NH Black and AIAN mothers, although the former has much higher levels of LBW, whereas the latter has higher levels of HBW.
Oster et al 2014 Canada	To generate a comprehensive epidemiological profile of diabetes in pregnancy over a 10-year period among the First Nations population of Alberta, Canada.	Retrospective study - administrative data	Women that gave birth in Alberta, Canada between 2000 and 2009 (N=427,058 total complete records, 28,306 First Nations women) all ages, reported stratified data in Figure 2 by <15, 15–19, 20–24.	Both	Age-adjusted prevalence values for GDM and pre-existing diabetes by ethnicity. Longitudinal changes in GDM over time. Multivariate analysis included maternal age, smoking, high blood pressure, maternal weight, previous birth history.	N/A	Women ages ≤ 17 had an OR of 0.48 (0.34–0.67) p<0.001 for developing GDM in comparison to women ages 18–34. Over half [52.3%] of First Nations pregnancies were among women < 25 years of age. First Nations women tended to have more risk factors and poorer outcomes than non-First Nations women and the overall crude and age-adjusted GDM prevalence values were significantly elevated for First Nations women compared with non-First Nations women.	First Nations women have a higher prevalence of diabetes in pregnancy, and more adverse pregnancy outcomes. Both prevalence of GDM and magnitude of difference in GDM rates between First Nations and non-First Nations women increase with increasing maternal age. The prevalence of GDM for First Nations women has been stable over time.
Kim et al 2012 USA	To estimate the racial/ethnicity specific percentage of GDM attributable to overweight and obesity in Florida	Retrospective study - using 2003 US Standard Certificate of Live Birth and Florida Hospital Inpatient Discharge database for	N=656,925 records of birth certificate data linked to Florida Hospital Inpatient Discharge database for	GDM	2.3% of women with GDM were underweight, 31.4% were normal weight, 26.9% were overweight and 39.4% were obese.	N/A	Interaction between BMI and race/ethnicity was significant. Adjusted Relative Risk for class III obesity was	Elevated prepregnancy BMI contributed to GDM risk in most racial/ ethnic groups. Non-Hispanic Black and AI women may benefit

Table 1 (continued)

Author/Date/Country	Purpose	Type of Paper and Design	Population Characteristics	Specific to adolescent pregnancy or GDM or Both	Outcomes and variables	Intervention	Results	Conclusion
Stotz et al 2019 USA	To examine AIAN women's experiences of having GDM or T2D during pregnancy, inform the development of a GDM risk reduction and preconception counseling (PC) program tailored to AIAN girls, and enhance mother daughter communication and support within the program	Discharge database for live singleton deliveries. Qualitative methodology Focus group and individual interviews Participants viewed video clips, booklet excerpts from the original READY-Girls Interviews were digitally recorded, transcribed verbatim, and analyzed using the constant comparison method to construct themes across the interviews.	live, singleton deliveries between 2004-2007 American Indian, age <20 years n= 200 AIAN women with T2D or a history of GDM (N = 5) 1 focus group (n = 2) and individual interviews (n = 3) All of the participants had daughters between the ages of 6 months and 20 years.	Both	N/A	N/A	highest among American Indians (AI). Adjusted percentage of GDM deliveries attributable to overweight and obesity was 52.8% among AI. Four themes: 1) Lack of knowledge about GDM and opportunities for health information, 2) Traditional Native culture and how to incorporate this into a GDM risk reduction education program, 3) Reproductive health communication with AIAN girls. 4) The emotional impact of having diabetes during pregnancy as an AIAN woman.	from pre-pregnancy reduction in obesity to lower GDM risk. Participants wished they had known about risk factors for GDM and how to reduce their own risk of developing GDM. Implications: Findings from this study have been used to adapt an existing PC program, originally developed for non-AIAN girls with diabetes, for AIAN girls who do not have diabetes but have risk factors for developing GDM in future pregnancies.
Moore et al 2019 USA	To explore the perspectives of adolescent AIAN girls who are at risk for gestational diabetes (GDM) on their awareness and understanding of GDM and reproductive health; and on an existing validated diabetes and preconception counseling (PC)	Qualitative methodology Focus groups Participants viewed video clips, booklet excerpts from the original READY-Girls Focus groups were digitally recorded, transcribed	AIAN adolescent girls (n=13) (age 15.5±1.8 years) Participants were all currently urban living, though some reported they had lived on reservations in the past. Each girl (12-18 years old) was accompanied by an AIAN female adult caregiver (mother,	Both	N/A	N/A	Three themes: 1) Lack of awareness and knowledge of GDM 2) The need for pregnancy planning and culturally relevant GDM and reproductive health resources; 3) The importance of using empower-ment frameworks to promote	Participants' lack of awareness and understanding of GDM could increase their risk of developing GDM and possible subsequent pregnancy outcome complications. Implications: These findings have been used in conjunction with findings of focus groups

Table 1 (continued)

Author/ Date Country	Purpose	Type of Paper and Design	Population Characteristics	Specific to adolescent pregnancy or GDM or Both	Outcomes and variables	Intervention	Results	Conclusion
	education program for non-AIAN teen girls with diabetes. Inform the development of a GDM risk reduction and preconception counseling (PC) program tailored to AIAN girls.	verbatim, and analyzed using the constant comparison method to construct themes across the interviews.	grandmother, aunt, older sister).				positive reproductive health behaviors	of other key stakeholders to inform the development of a culturally tailored GDM risk reduction program for AIAN adolescents.

communication with AIAN girls, and (4) the emotional impact of having diabetes during pregnancy as an AIAN woman. Participants wished they had known about risk factors for GDM and how to reduce their own risk of developing GDM. Findings from this study have been used to adapt an existing preconception counseling program (originally developed for non-AIAN girls with diabetes), for AIAN girls who do not have diabetes but have risk factors for developing GDM in future pregnancies [12].

The second focus group study [13•] examined the understanding of GDM and reproductive health among adolescent AIAN girls who were at risk for GDM. Their input was also gathered on an existing validated diabetes and preconception counseling education program for non-AIAN teen girls with diabetes. While the adolescent girl participants understood health during pregnancy, they knew little about GDM, preconception counseling, or the relationship between prepregnancy weight and the risk for GDM. Instead, their understanding of diabetes was based upon knowing adults living with T2D. Their preference for GDM education was from “relatable” AIAN women or older teens with an understanding and appreciation of AIAN culture. They also shared that empowering girls to make healthy choices and building self-esteem are important. In addition, domestic violence and peer pressure were raised as reproductive health safety concerns. The need for culturally responsive resources and educational materials about reproductive health and GDM for AIAN girls was also highlighted as the girl participants relied on the Internet, mothers, cousins, and aunts for reproductive health information as school-based “sex ed” primarily focuses on sexually transmitted infection prevention [13•].

Stopping Gestational Diabetes in Daughters and Mothers Program

The need for early interventions to reduce the risk of GDM in AIAN girls and young women is compelling. *Stopping Gestational Diabetes in Daughters and Mothers* (Stopping GDM) is a GDM risk reduction and preconception counseling intervention tailored for at-risk AIAN adolescent females. Stopping GDM is based on Reproductive health Education and Awareness of Diabetes in Youth for Girls (READY-Girls), a validated theory-based preconception counseling (PC) program for teens with diabetes that aims to raise awareness and prevent unplanned pregnancies and pregnancy-related complications [14]. READY-Girls was originally developed for non-Native teens at the University of Pittsburgh for adolescents with type 1 diabetes, then adapted for adolescents with T2D and utilized by the Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study. Stopping GDM builds on the content of READY-Girls; however, instead of targeting girls who have preexisting diabetes,

the focus is on AIAN girls at high risk for GDM and reducing their risk for GDM. Stopping GDM includes an educational eBook, video, mother-daughter communication booklet, and toolkit which includes both regional and general resources. The content focuses on changes during puberty and reproductive health, increasing awareness and knowledge of GDM and its risk factors among AIANs, healthy weight management principles through nutrition and physical activity, enhancing communication between health care providers, parents, and adolescent females on reproductive health, and family planning. Cultural tailoring of reproductive health education materials for AIAN girls and their mothers is important to increase engagement and effectiveness of such a program [12].

Conclusions

There is a paucity of published research on this topic, with no newly published information specifically on pregnancy among AIAN adolescents. However, in the past decade, considerable progress has been made in describing the burden of GDM in AIANs and other indigenous groups of North America [4, 10•, 11]. Our review confirmed that the overall prevalence for GDM was 1.5 to 2 times [10•] higher for all age groups in the AIAN population as compared to other ethnic groups and that cases of GDM among AIAN women have the highest percentage of GDM attributable to overweight and obesity [4]. North American Indian women also experience an increased risk of adverse birth outcomes [11]. However, only a few of these articles specifically addressed issues or needs of adolescents and young adults. The two articles that did address needs of adolescents and young adults were qualitative in nature [12, 13•]. One examined AIAN women’s experiences of having GDM or T2D during pregnancy and the other appraised the understanding of at-risk AIAN girls on GDM and reproductive health [12, 13•]. Cross-cutting themes included the lack of awareness of GDM and their risk for developing GDM, as well as the need for culturally responsive resources on GDM for AIANs.

It was noted that more emphasis is needed on providing preconception counseling and healthy weight management prior to pregnancy that is developmentally appropriate and culturally tailored for at-risk audiences [4, 11, 12, 13•]. Results also support the need for early, culturally responsive reproductive health interventions that are attuned to the best ways of delivering health information technologically to adolescents and young adult women. More cohort follow-up studies are needed to measure the long-term effects of preconception counseling provided in early adolescence.

Adolescents and young adults continue to represent a group highly susceptible to unplanned pregnancies and poor reproductive health outcomes. The benefits of enhanced knowledge, family planning strategies, and increased self-

efficacy from preconception counseling point to the importance of developing culturally tailored and developmentally appropriate preconception counseling interventions for ethnic groups at a higher risk for developing T2D, such as Latinas, AIANs, Native Hawaiians and Pacific Islanders, and other indigenous groups. These populations are also vulnerable to GDM, which requires additional information specific to its treatment and prevention. Furthermore, programs designed specifically for adolescents and young adults, such as Stopping GDM, should include the roles of support networks, such as mothers, other female relatives, or caring adults in their lives, that may increase the efficacy of these programs.

This literature review collected all studies from the past decade investigating pregnancy and GDM in AIAN adolescent females. On its own, the small number of papers on this topic highlights the need for more research in this area, as do the findings in the identified papers that confirm a higher prevalence of GDM among AIANs across all age groups. Future research is needed to generate a more robust body of data on the prevalence of pregnancy and GDM as well as elucidate the causes and short- and long-term impacts of GDM in adolescent AIAN females. Only with this information can programs be created that effectively decrease the prevalence of GDM and achieve the overall goal of breaking the cycle of T2D in Native communities.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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