Gestational Diabetes Mellitus Prevalence, Screening, and Treatment Practices in American Samoa, 2016

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Abstract

Gestational diabetes mellitus (GDM) is a serious pregnancy complication and understudied public health issue in American Samoa. The goals of this study were to (1) estimate the prevalence of GDM in American Samoa, (2) evaluate current screening practices for GDM, and (3) evaluate obtainment of GDM treatments in 2016. This cross-sectional study used 3 data sources: electronic health records, a labor and delivery logbook, and the American Samoa Department of Health (ASDOH) Maternal and Children's Health (MCH) Postpartum database. Out of 995 women with a singleton birth in American Samoa during the study period, 60.1% (n=598) completed a glucose tolerance test for GDM. Of these women, 41.8% (n=250) completed the testing within the recommended 24-28 weeks gestation timeframe. The estimated prevalence of GDM was 14.0% (95% confidence interval: 11.2-16.8) but has many limitations due to missing data. There were 4 treatments analyzed: nutrition counseling, insulin, metformin, and diabetes counseling. Of all women diagnosed with GDM (n=84), 76% were prescribed any of the 4 treatments. However, only 52% of those women obtained the treatment prescribed. Access to testing and treatment needs to be expanded to provide adequate prenatal care to women in American Samoa.

Keywords

Gestational diabetes, diabetes, female, pregnancy, American Samoa, prenatal care

Abbreviations

ASDOH = American Samoa Department of Health
BMI = body mass index
CHC = community health center
HER = Electronic health records
GDM = Gestational diabetes mellitus
L&D Log Book = Labor and delivery log book
LBJ = Lyndon B. Johnson Tropical Medical Center
MCH = Maternal and children's health
NCD = Non-communicable disease
OGTT = Oral glucose tolerance test
PNC = Prenatal care

Introduction

Gestational diabetes mellitus (GDM) is glucose intolerance that was not present or recognized prior to pregnancy.[1] Women with excessive gestational weight gain, family history of type 2 diabetes, or obesity have increased risk for GDM.[2,3] Women with GDM are at increased risk for future urinary tract infections, pre-eclampsia, and type 2 diabetes.[4] Children born to mothers with GDM have an increased risk of adverse birth outcomes such as macrosomia (high birth weight [>4000g]), shoulder dystocia, neonatal hypoglycemia, and cesarean deliveries.[4,5] Children born to mothers with GDM have an increased risk of obesity, insulin resistance, and impaired motor function later in childhood.[4,5]

These chronic diseases and other non-communicable diseases (NCD) disproportionately occur in low- to middle-income countries. The Pacific Islands, in particular, have a high NCD burden and lower capacity to manage these conditions.[6] This causes increased concern surrounding the effects of obesity and diabetes on maternal and child health.

American Samoa is a Pacific Island territory of the United States (US) with one of the highest NCD burdens in the world.[6,7] Located 2600 miles southeast of Hawai'i, American Samoa consists of 7 islands including the main island of Tutuila, home to the majority of the population (approximately 60 000 residents).[8] About 58% of families have incomes below the US poverty line and face issues with provisions of health care like many other Pacific Island jurisdictions.[9] The Lyndon B. Johnson Tropical Medical Center (LBJ) and 7 community health centers (CHCs) offer health services including prenatal care.

The most recently published analysis of mortality and morbidity data in American Samoa from 2018 revealed the leading causes of death are malignancy, followed by diabetes and heart disease.[10] More specifically, 93.5% of adults in American Samoa are overweight or obese and 33.6% have diabetes.[10] In the US, Pacific Islander women are at an increased risk of developing GDM compared to non-Hispanic White women.[12] Given the high prevalence of overweight/obesity and diabetes in American Samoa, and higher risk for developing GDM among Pacific Islander women in the US, GDM is an issue that should be investigated in American Samoa.

Despite these increased risk factors, the prevalence of GDM in American Samoa is still unknown. Multi-ethnic studies have suggested that the global incidence of GDM among Pacific Islanders is 9.9%-14.8%, which is relatively high compared to an estimated GDM prevalence of 2%-6% among European ethnic groups.[12,13] Previous research has examined GDM prevalence and screening rates in American Samoa. However, barriers to adequate prenatal care and healthcare documentation have limited research thus far.[11,14] In an evaluation of records by Hawley, et al, in 2014, 85.4% of women in American Samoa

received inadequate prenatal care.[9] Factors such as parity, unemployment, and lack of knowledge about prenatal care limited women's access to services.[9] Based on data collected from 2008-2009, 16.1% of women received adequate GDM screening in American Samoa.[15] Consequently, current screening rates, prevalence of GDM, and treatment outcomes are still unknown in this high-risk population.

Due to the established high prevalence of risk factors for developing GDM and lack of adequate prenatal care, GDM is an important area of public health concern in American Samoa. The goals of this study were to (1) estimate the prevalence of GDM in American Samoa, (2) evaluate current screening practices for GDM, and (3) evaluate initiation and receipt of GDM treatments in American Samoa.

Methods

Data Collection

This was a cross-sectional study of women who gave birth in American Samoa from January 2016 through December 2016. Data sources included the labor and delivery logbook (L&D logbook) from the LBJ Tropical Medical Center, patient records from the electronic health records (EHR) system, and the American Samoa Department of Health (ASDOH) Maternal and Children's Health (MCH) Postpartum database.

The L&D logbook was the primary data source for all women who gave birth in 2016. Patients who give birth at LBJ or were evaluated there after a home birth (very rare) have data entered into the EHR and further documented into the paper logbook located at LBJ in the Labor and Delivery Department. The appendix contains a complete list of variables from this data source. The second data source was the MCH Postpartum database. This is a record of women who gave birth in 2016 that was collected by the ASDOH MCH program. Nursing staff at the LBJ nursery complete cards documenting mother and baby prenatal care information. MCH staff collect these cards weekly to create this database. These data were collected for all mothers who gave birth in 2016.

The third data source was the EHR system. The EHR system, implemented in 2015, is the primary health records system used by the CHCs and LBJ. All patient records prior to 2015 were collected via a separate database.

All 3 data sources were merged using maternal hospital ID numbers (Figure 1). The data set was merged by the primary author (Meyer) and verified by checking maternal first and last name and date of delivery by a second author (Ropeti). Maternal date of birth was not used to verify because this variable was missing from the labor and delivery logbook. Therefore, the authors could not verify across all 3 data sources. Though a rare occurrence, these data sources do not include women who had home births and did not receive medical care at LBJ. These merged data were de-identified prior to analysis by removing the hospital ID numbers and patient names. After data sources were merged, an EHR individual patient systematic record review was performed to collect missing variables and confirm EHR data that were entered in the L&D logbook.

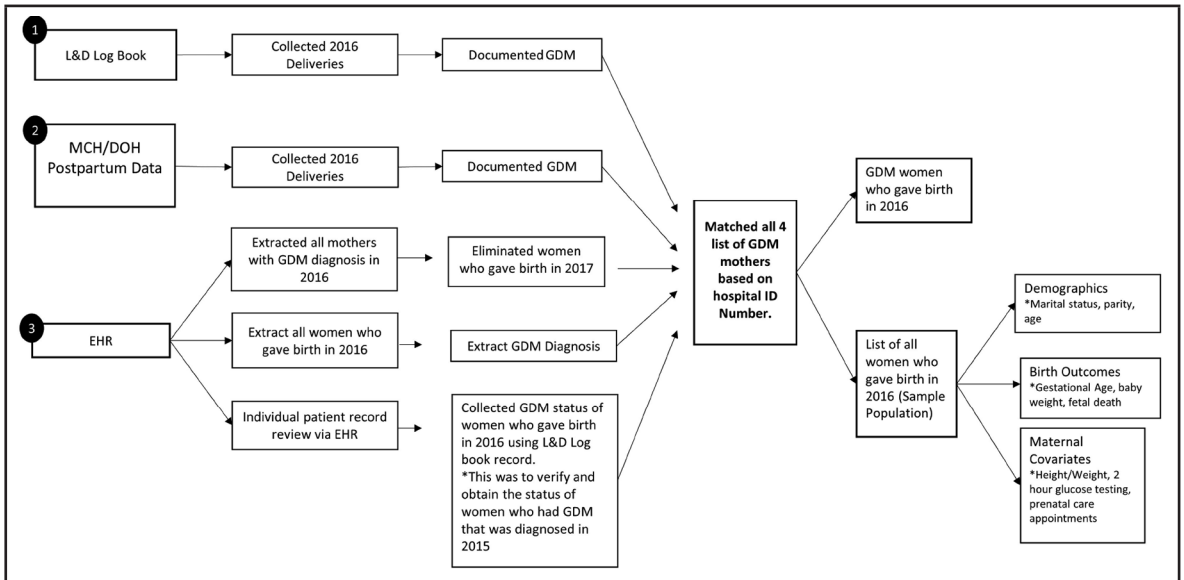

Figure1. Overview of Data Collection Methods in American Samoa GDM Prevalence Analysis.

Abbreviations: L&D= Labor and Delivery, MCH = Maternal and Childrens Health, DOH= Department of Health, EHR= Electronic Health Records, GDM = Gestational Diabetes Mellitus

Sample

Data were available for 1016 women. Women who were identified in the MCH Postpartum database but not identified as having given birth in 2016 by either the EHR system or L&D logbook were excluded from this study (n=2). Women with multiple births; defined as twin or triplet births, were excluded (n=3).

Screening and Prevalence Estimates

American Samoa LBJ GDM screening protocols follow recommendations outlined by the American Diabetes Association. Pregnant women are screened using fasting blood glucose or HbA1c test followed by a confirmatory 2-hour 100g glucose tolerance test (GTT) at 24-28 weeks gestational age.[1]

The EHR was reviewed to determine if a woman received a GTT. Gestational age was determined based on a woman's last menstrual period and obstetric measures. This dataset did not include that information but did include the gestational age at birth and date of birth. Approximate gestational age at which the GTT was performed was determined by counting back the number of weeks from the approximated gestational age at delivery to the date of the GTT. Women were identified as being tested within the recommended 24-28 weeks if the date of the completed lab test was within their calculated timeframe.

GDM diagnosis was defined as any a positive GTT diagnostic for GDM, documented in any of these 3 data sources. Women who had a GTT that was negative for GDM were categorized as having no GDM (Figure 1). The prevalence of GDM was estimated among women who had GDM testing, did not have preexisting type 2 diabetes, and gave birth in 2016.

Treatment Analysis

Four GDM treatments were analyzed for both prescription and obtainment of treatment: prescription of metformin, prescription of insulin, nutrition counseling, and diabetes education. Women could have received more than 1 type of treatment. EHR patient and pharmacy records were reviewed to determine treatment outcomes. Women prescribed metformin or insulin after the date of GDM diagnosis were determined to have been prescribed the treatment. Women were classified as having obtained the treatment if their EHR pharmacy records indicated a "completed" or filled prescription. Nutrition counseling is provided by LBJ registered dieticians. Women who were referred for nutrition counseling after the date of GDM diagnosis were determined to have been prescribed the treatment. They were classified as having obtained treatment if their EHR records contained a completed nutrition consultation form. The diabetes education program, provided by ASDOH, is provided to patients who are diagnosed with type 2 diabetes or GDM. Patients were identified as being referred to and attending the program as indicated in their EHR.

Demographic Variables

Variables collected included: mother's age at delivery, number of prenatal care (PNC) visits, gestational age at delivery, date of delivery, gravida, marital status, GDM status, and all glucose tolerance test results. Age was dichotomized based on the classification of advanced maternal age at 35 years or older. At the time of data collection there were no indicators of income or education status for patients in the clinical records. BMI status was dichotomized based on classification of normal weight BMI <25 or overweight/ obese BMI ≥25. Marriage was dichotomized as married or not married. Not married was defined as divorced, never married, or widowed. Gestational age at delivery was considered preterm if <37 weeks or full-term if ≥37 weeks at delivery. Prenatal care was dichotomized as having prenatal care if there was 1 or more prenatal care appointments documented and not having prenatal care if there were 0 documented prenatal care appointments.

Data Analysis

The prevalence of GDM was estimated among women who gave birth in 2016, acquired GDM testing and did not have pre-existing type 2 diabetes. Descriptive statistics were used to describe the final dataset of women. Chi-squared tests identified differences in demographic factors between women with and without GDM. The data analysis for this paper was generated using SAS software Version 9.3 (SAS Institute Inc., Cary, NC).

Ethics

Institutional Review Board (IRB 00001249, FWA 00024252) approval was obtained by the American Samoa Department of Health along with approval from the LBJ Tropical Medical Center and the American Samoan Department of Health Maternal and Children's Health Program. None of the authors identify any conflict of interest.

Results

Sample Summary

Out of 1011 women who had a singleton birth in American Samoa in 2016, 16 women had a previous diagnosis of type 2 diabetes and were therefore excluded from analysis. Among the 995 women included in the analysis, the mean age was 26.4 years, and 14.5% were 35 years or older (Table 1). The majority of women (53.1%) with a recorded BMI were overweight or obese (BMI ≥25). The mean gestational age at delivery was 39.2 weeks, and 7.3% of all births were pre-term. The mean gravida was 3.2, with 25.4% of women delivering gave birth to their first child. More than half (56.1%) of women were classified as married. The mean number of prenatal appointments was 7.9, and 8.7% of women delivering did not receive any prenatal care.

Table 1. Sample Demographics for Women Who Gave Birth in American Samoa in 2016, by GDM Status.				
Characteristic	**Total Sample N (%)**	**GDM Status**		**Test of Association**
		GDM N (%)	**No GDM N (%)**	
Age				
Mean Age (years)	26.4	26.4	26.4	$\chi2$= .007
<35 years	850 (85.4)	54 (5.4)	796 (80.0)	*P* = .068
≥ 35 years	145 (14.5)	30 (3.0)	115 (11.5)	
BMI				
BMI <25	67 (46.9)	2 (1.3)	65 (45.5)	$\chi2$=4.79
BMI >25	76 (53.1)	10 (7.0)	66 (46.1)	P =.029
Missing values	*852*			
Marital Status				
Married	541 (56.1)	57 (5.9)	484 (50.2)	$\chi2$= <.001
Not Married	422 (43.2)	17 (1.8)	405 (42.1)	*P* = .010
Missing values	*32*			
Gestational Age at Delivery				
Mean age at delivery (weeks)	39.2	39.1	39.2	$\chi2$ = .304
Preterm	71 (7.3)	14 (1.4)	57 (5.8)	*P* = .419
Full-term	908 (92.7)	69 (7.1)	839 (85.7)	
Missing Values	*16*			
Gravida				
Mean	3.2	3.3	2.5	$\chi2$ = .018
1	253 (25.4)	12 (1.2)	241 (24.2)	*P* = .109
>1	741 (74.5)	71 (7.1)	670 (67.4)	
Missing Values	*1*			
Prenatal Care				
Mean number of appointments	7.9	8	7.9	$\chi2$=.175
Prenatal Care	908 (91.2)	80 (8.0)	828 (83.2)	*P* = .324
No Prenatal Care	87 (8.7)	4 (0.4)	83 (8.3)	
Total	995	84 (8.4)	911 (91.5)	

Note: Columns may not sum to total due to missing data
Abbreviations: GDM = Gestational Diabetes Mellitus, BMI= Body Mass Index

Screening Practices

In 2016, 598 (60.1%) out of 995 women completed a 2-hour OGTT during their pregnancy (Figure 2). Among those women who completed a 2-hour OGTT during their pregnancy, 250 (41.8%) completed the 2-hour OGTT within the recommended 24-28 weeks gestation. It should be noted that of the 16 women who had a previous diagnosis of type 2 diabetes, 5 were still screened for GDM, even though their previous diagnoses should have excluded them from this test.

Prevalence of GDM

Out of 598 women who gave birth in 2016 who were screened for GDM and did not have pre-existing type 2 diabetes, 84 (14.0%, 95% confidence interval [CI]: 11.2%-16.8%) were diagnosed as having GDM (Figure 2).

Treatment Adherence

Of the 84 women diagnosed with GDM, 53 (63%) were prescribed the diabetes education program, however, none attended the program (Table 2). Forty-three women (51%) were prescribed nutrition counseling. This treatment had the highest attendance at 61%. Seven (8%) women were given an insulin prescription, but only 2 (29%) of those women obtained the prescription. Ten (12%) women were prescribed metformin, and 5 (50%) of them obtained the prescription. Out of the 84 women diagnosed with GDM, no woman obtained diabetes education, 31% obtained nutrition counseling, 2% obtained insulin, and 6% obtained metformin. Out of all women diagnosed with GDM, 64 (76%) were prescribed any treatment and 33 (52%) of those who were prescribed a treatment obtained at least 1 treatment (Table 2).

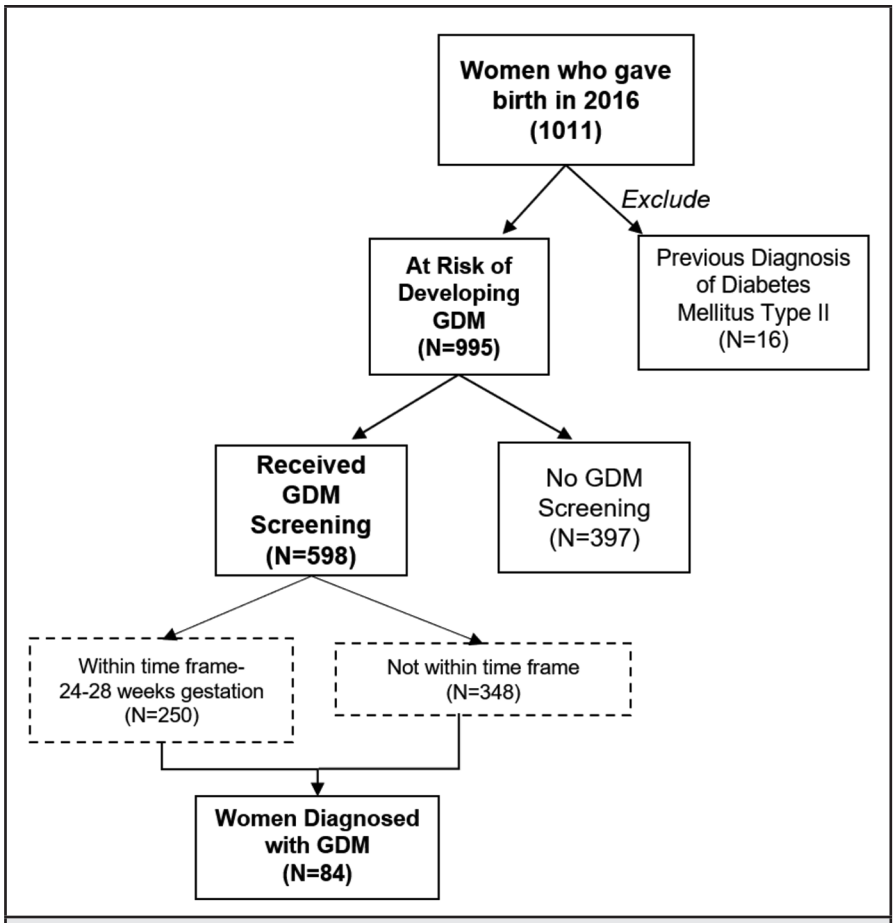

Figure 2. Analysis of GDM Prevalence Among Women in American Samoa Who Gave Birth in 2016.

Abbreviation: GDM= Gestationatal Diabetest Mellitus

Table 2. Treatment Coverage among Women Diagnosed with GDM in American Samoa in 2016.

Treatment	Women Prescribed Treatment	Women Who Obtained Treatment
	N (% of Total Women with GDM)*	N (% of Number of Women Prescribed Treatment)**
Any treatment	64 (76)	33 (52)
Diabetes education	53 (63)	0 (0.0)
Nutrition Counseling	43 (51)	26 (61)
Insulin	7 (8)	2 (29)
Metformin	10 (12)	5 (50)

* Total Women with gestational diabetes mellitus (GDM) = 84. ** Women could have received more than 1 type of treatment.

Discussion

The prevalence of GDM in American Samoa was estimated to be 14.0% (95% CI: 11.2%-16.8%) in 2016. Approximately 2%-10% of pregnancies in the US are affected by GDM.[16] In the Pacific, the most recently estimated prevalence of GDM was 5.5% in the Republic of Palau.[17] The global prevalence of GDM is approximately 7%, ranging from 1%-14%.[1] This suggests that GDM prevalence in American Samoa is high and should be prioritized as a significant health concern in American Samoa.

This study is the first of its kind to establish a prevalence of GDM in American Samoa, however, there are limitations. Despite our ability to establish a prevalence of GDM, this estimate is potentially biased and underestimated. Only 25% of women (n=250) were screened for GDM as recommended. Those who

were excluded from the study had increased maternal age, gravida, PNC, and decreased gestational age at birth. This is expected because those excluded were women with higher risk pregnancies such as multiple births or pre-existing diabetes. These demographics suggest that those included in the sample may not represent the true population of all pregnant women in American Samoa in 2016 and indicative of selection bias. This sample was based on only 1 year of births. Future research is needed to expand data collection for a more representative and comprehensive prevalence estimate.

There were changes to screening practices compared to a 2009 study of GDM. The current findings show an improvement in the percentage of women screened for GDM in the correct time frame from 12.8% in 2009 to 41.8% in 2016.[15] However, there was a drop in the total percentage of women who received any GDM screening, from 86.5% in 2009 to 60.1% in 2016.[15] Barriers such as: parity, lack of prenatal care education, health literacy, familial and social support, and unemployment limit women's ability to obtain GDM testing.[9,18] Despite increased funding in 2016 for prenatal care, there was a large portion of women not receiving appropriate GDM screening.

GDM treatment is essential to improve mother and child outcomes. The 2018 American Diabetes Association guidelines recommend lifestyle management, medical nutrition therapy, and pharmacologic therapy.[19] Left untreated, GDM carries an increased risk of perinatal morbidity along with increased risk of pregnancy complications.[16,20] The current findings revealed few women diagnosed with GDM initiated and received treatment. Barriers to treatment are similar to those for prenatal care: lack of social support, unemployment, and transportation to the hospital and pharmacy.[9] The highest compliance was for nutrition counseling. Nutritionists based at the hospital reduce the need for additional appointments. Reducing barriers and increasing accessibility to treatment can improve treatment outcomes.

A limitation to this study was poor data quality, including high amounts of missing data. Although all mothers had age at delivery recorded, some women did not have a marital status (n=39, 3.8%), gestational age at delivery (n=16, 1.6%), and gravida (n=1, 0.1%) recorded. A major demographic limitation was the lack of socioeconomic status and limited BMI documentation. Only 14% of the records included height and weight measurements or a calculated BMI. Excessive gestational weight gain and BMI are associated with adverse outcomes such as cesarean delivery, abnormal size for gestational age, and infant obesity.[2] Considering these outcomes is imperative to accurately document pre-pregnancy height and weight. Village or residency status could be a valuable variable. However, only 66 women had this documented. This limited documentation restricted the scope of this analysis and provides areas for future research.

Despite these limitations, multiple data sources were included to improve completeness. Further, women with pre-existing type 2 diabetes were identified and excluded from prevalence analysis. The inclusion of treatment outcomes provides valuable feedback to clinicians.

Since the time of data collection in 2016, American Samoa has experienced nutritional and chronic disease transitions. Compared to a 2004 NCD population survey, an updated survey in 2019 showed obesity increased from 80.2% to 82.7% among women. Hypertension increased from 27.5% (+/-5) to 38.4%. Diabetes decreased from 42.4% (+/-4.2) to 32.3%.[10] Notably, a higher diabetes cut off value was used in 2019; 126 g/dl compared to 110 g/dl in 2004. These positive NCD trends increase concern surrounding GDM and maternal health outcomes. A declining economy and collectivist familial structure provide even more barriers for women to adhere to diet, exercise habits, and positive health changes during pregnancy.[18,21] The prevalence has likely increased since the current measurement in 2016 due to increased health burden, possibly increased GDM testing, and social transitions.

Due to the high estimated prevalence of GDM in American Samoa and lack of appropriate testing, it is recommended that prenatal GDM screening is conducted for all women. Free prenatal care is now provided in CHCs, making them the ideal point of care for testing. It is recommended that EHR training be expanded to increase efficiency and be used for patient care and data management. Increasing the completeness of the EHRs will provide reliable records to increase quality of care and reliable research.

Conclusion

Non-communicable disease is increasingly affecting vulnerable populations in the Pacific Islands, American Samoa among them.[22,23] This study highlighted the need to focus attention on GDM in American Samoa. Based on the current sample, the estimated prevalence of GDM in American Samoa was 14.0%. Low GDM screening rates and poor treatment coverage increases concern for adverse outcomes. Expanding access to GDM testing and providing clinician EHR education are steps to provide better GDM care. These findings suggest that GDM is highly prevalent in American Samoa necessitating future research surrounding GDM, barriers to prenatal care, GDM treatment, and NCD risk among mothers and children.

Conflict of Interest

None of the authors identify a conflict of interest.

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Appendix Data Collection Elements

	Labor and Delivery Log Book	Postpartum Data Set	EHR
Party responsible for data collection and management	*Labor and Delivery Department LBJ Hospital*	*Department of Health- Maternal and Children's Health Program*	*LBJ Hospital and Community Clinics*
Maternal Variables			
Mothers Hospital ID No.	x	x	x
Delivery No.	x		
Patient Last Name	x	x	x
Patient First name	x	x	x
Maiden Name	x		x
Mothers DOB		x	x
Mothers Age		x	
Residency Status	x		x
Village		x	x
Gestational Age at Birth	x	x	x
Full Term (Yes, No Status)		x	
Fetal Death/ Fetal Demise	x	x	x
Twin/ Multiple Birth	x	x	x
Grava	x		x
Para	x		x
Membrane Rupture	x		x
Induction	x		x

	Labor and Delivery Log Book	Postpartum Data Set	EHR
Zika Status	x	x	x
Sections	x		x
Delivery Date	x	x	x
Deliver Time	x		x
Episiotomy and Repair	x		x
APGAR/1	x		x
APGAR/2	x		x
Number of Prenatal Care Visits	x		x
Maternal Age at Delivery	x		x
Placenta delivery time	x		x
STD (Chl Status)	x		x
GBS Status	x		x
Mothers Hep B Status	x		x
Mothers Height			x
Mothers Weight			x
Nutrition Consultations			x
Diabetic Program Consultations			x
Prescriptions			x
Prescription Status			x
Lab Results			x
Labor Oxytoxic Drugs Received	x		x
Complications/ Notes	x		x
Anesthesia received	x		x
Anesthetist	x		x
Patients Nurse	x		x
Physician	x		x
Marital Status			x
Education Status			
Religion			x
Teen Pregnancy (Y/N)		x	
Initiation of Prenatal Care		x	
Gestational Age at 1st PNC Visit (Weeks)		x	
Number of Observed PNC Visits		x	
Number of Expected PNC Visits		x	
Trimester Number at 1st Visit		x	
Adequacy Services Received		x	
Adequacy PNC Services Received		x	
Adequacy of PNC Utilization (Kotelchuch Index)		x	
Baby Variables			
Baby Hospital ID No.	x	x	x
Baby Sex	x		x
Color at birth	x		x
Baby Weight(kg/lbs)	x	x	x
Baby Length	x	x	x
Rh Factor	x		x