Diabetes Screening in U.S. Women with a History of Gestational Diabetes

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THESIS

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This thesis is dedicated to my family, who inspire me everyday.

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LIST OF ABBREVIATIONS

ACOG	American College of Obstetricians and Gynecologists
ADA	American Diabetes Association
BMI	Body mass index
FIPR	Family income to poverty ratio
GDM	Gestational diabetes mellitus
HbA_{1c}	Hemoglobin A1c
NHANES	National Health and Nutrition Examination Survey
MEC	Mobile exam center
OGTT	Oral glucose tolerance test
SES	Socioeconomic
WIC	Women, Infants and Children's program

SUMMARY

A secondary analysis of the National Health and Nutrition Examination Survey (NHANES), was conducted to examine individual, socioeconomic and healthcare utilization characteristics of women with a history of gestational diabetes mellitus and their associations with diabetes screening, and to estimate their rates of undiagnosed prediabetes and diabetes.

The prevalence of gestational diabetes in the U.S. population was 7.2%. More than half of these women are obese and one - third are of reproductive age. Sixty-seven percent of U.S. women with a history of gestational diabetes without a diagnosis of diabetes reported diabetes screening within the prior three years. Screened women differed from unscreened women in measured body mass category and the number of health visits in the prior year. In multivariable analysis, screening was associated with a greater number of health visits in the prior year and higher income. Women reporting four or more visits in the prior year were 5.8 times more likely to report diabetes screening. Overall, 24.4% of women had undiagnosed prediabetes and 6.5% of women had undiagnosed diabetes.

In conclusion, more health visits in the prior year was associated with diabetes screening in women with a history of gestational diabetes. Fewer opportunities for screening may delay early detection, clinical management and prevention of diabetes.

I. BACKGROUND

Gestational diabetes mellitus (GDM) is defined as the onset or first recognition of diabetes during pregnancy, typically diagnosed by an abnormal oral glucose tolerance test (OGTT) during the second trimester (1; 2). Prevalence rates of GDM are estimated to range from 2-10% (3-5). Although glucose intolerance resolves in 90% of women with GDM immediately after delivery, their risk of developing type 2 diabetes is estimated to be 35-60% within 5-10 years (6; 7). This is a 5-7 fold increase in risk compared to women without a history of GDM. The American Diabetes Association (ADA) and American College of Obstetricians and Gynecologists (ACOG) recommend diabetes screening at 6-12 weeks post-partum with a 2-hour, 75-gram OGTT (1; 2). Post-partum screening with a fasting glucose, although less sensitive, is also acceptable per ACOG guidelines (2). Moreover, both ACOG and ADA recommend lifelong screening for diabetes at least once every three years, and annual screening for those with prediabetes (1; 2).

It is estimated that approximately 50% of women with a history of GDM obtain diabetes screening, with rates ranging from 30-70% (8). Screening with the recommended OGTT is remarkably uncommon - most studies recognize or consider any marker of glucose measure as a screening test. In a population-based Canadian cohort, Shah et al reported a screening rate of 4.5% with OGTT within six months postpartum, which rose to 16% over a 14-year period (9). A U.S. study conducted at a

university healthcare system found a screening rate of 38% with any test of glucose marker at least 6 weeks postpartum during a five-year period (10). Another study found 67% of women with previous GDM had some type of screening, but only 37% were tested with an OGTT or fasting blood glucose within two years (11). Health coverage may play a significant role in postpartum screening. Using Medicaid claims data, Hale et al found only 3.4% of women with Medicaid with previous GDM were screened for diabetes by 13-weeks postpartum (12).

Prior studies have found that postpartum diabetes screening in U.S. women was positively associated with women who were of Asian ethnicity, had higher education or income, were diagnosed with GDM at a young age, and had more provider contacts (13; 14). However, obesity and higher parity were associated with lower screening rates (13; 15). Inconsistent results with screening have been associated with age, use of diabetes medications during pregnancy and health provider specialty (8; 16-18). Findings from previous U.S. studies have been limited to single academic centers or managed care organizations subject to local practice patterns and policies. Also, little is known about women with GDM who disengage from the health care system after delivery (12; 19). Finally, many studies have focused on screening events during the immediate postpartum period, and less is known about lifelong screening in these women.

We analyzed the National Health and Nutrition Examination Survey (NHANES) from 2007-2012, a data set representative of the U.S. population that includes interviews, physical examination and laboratory measures. We examined individual, socioeconomic and healthcare utilization characteristics associated with self-reported diabetes screening in U.S. women with a history of GDM.

II. STUDY OBJECTIVES

Our study objectives were (1) to determine the diabetes screening rate and identify characteristics associated with screening, and (2) to determine the proportion of women with a history of GDM with undiagnosed prediabetes and diabetes.

III. RESEARCH DESIGN AND METHODS

A. Survey Design and Oversampling

The NHANES is an ongoing longitudinal, cross-sectional survey of the civilian, non-institutionalized U.S. population. Participants are selected through a complex multistage probability cluster sampling design. Sampling methodology and data collection procedures have been published in detail previously (20). Publicly released data from three NHANES cycles, 2007-08, 2009-10 and 2011-12, were combined for analysis. As of 2007, oversampling of Hispanics was included in the sample design and, beginning in 2011, oversampling of Asians was added, to improve the reliability and precision of estimates for these population subgroups. For our analysis, ethnicity was categorized as non-Hispanic white, non-Hispanic black, Hispanic, and other/multiracial.

B. Survey Components

Survey components included interviews administered at home for all participants and a visit to the mobile examination center (MEC) for a subsample. A standardized physical exam, laboratory tests and the administration of the reproductive health questionnaire to female participants 12 years and older via computer-assisted personal interview were conducted in the MEC. Data from 12-19 year olds for select reproductive health variables were excluded from public files due to disclosure concerns. Hemoglobin A1c (HbA_{1c}) level was measured and body mass index (BMI)

was calculated based on measured height and weight for each MEC participant. Fasting glucose, OGTT and plasma insulin levels were measured in a subsample of the MEC participants but were not included in the analysis due to the small number of eligible women selected for the fasting protocol.

C. Variable Selection

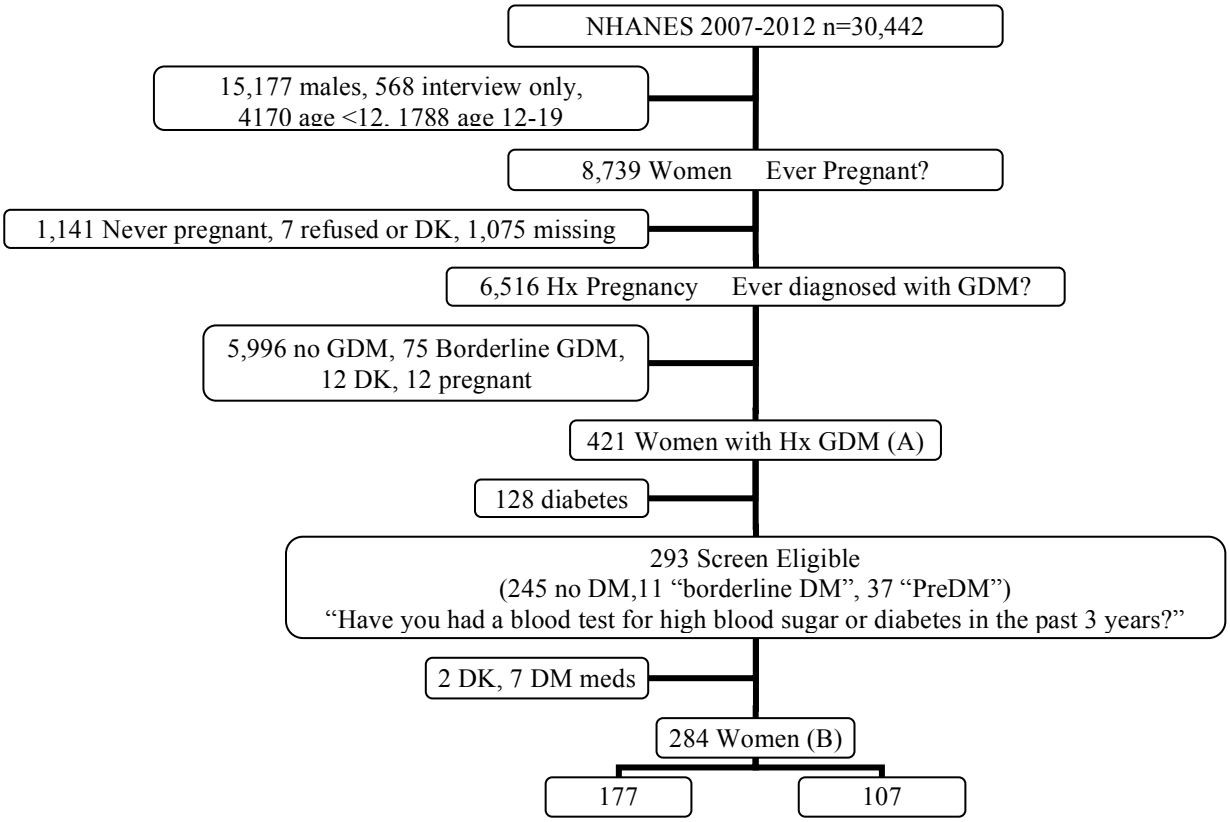
We examined the following variables: ethnicity, age, education level, family income to poverty ratio (FIPR), marital status, BMI, foreign-born status, language preference, age at GDM diagnosis, having health insurance, type of health insurance, place for routine health care, number of health visits in prior year, number of pregnancies, number of live births, age at first and last birth, and having a baby with a birth weight of nine pounds or greater. A non-English language preference was defined for subjects who reported a non-English language spoken at least 50% of the time at home or if a non-English language was used for any part of the survey. Education level and FIPR were examined as measures of socioeconomic status (SES) in the bivariate analysis. The FIPR index is recommended for comparing income data over time and was categorized by Women, Infants and Children program (WIC) eligibility. In multivariable analyses, education level was categorized as either high school graduate or less than high school graduate.

D. Cohort Selection

A total of 30,442 participants were enrolled. Our cohort was selected from the

29,353 individuals who attended the MEC portion of the survey (mean MEC response rate was 74%). After excluding males and females less than 20 years old, a total of 8,739 women were eligible for the reproductive survey. There were 6,516 women, age 20 years and older, who reported having been pregnant or having at least one pregnancy. It was noted that 1,075 responses were categorized as “missing,” which may have included some MEC nonresponses but more likely reflected nonresponse to a question of sensitive nature. Women who reported at least one prior pregnancy were asked, “Were you ever told by a doctor or other health professional that you had diabetes, sugar diabetes or gestational diabetes? Please do not include diabetes that you may have known about before the pregnancy.” Excluded from the analysis were women who answered “no” (n=5,996), “don’t know” (n=12), and “borderline GDM” (n=75). Women who had a positive pregnancy test at the MEC or reported a current pregnancy were excluded (n=12). There were 421 women who reported a history of GDM and a prior pregnancy (Figure 1, group A).

Figure 1. Flow Diagram for Cohort Selection from NHANES 2007-2012



Abbreviations
NHANES National Health and Nutrition Examination Survey
DK "don't know"
Hx history
GDM gestational diabetes mellitus

Women with a history of GDM were considered eligible for diabetes screening if they did not have a self-reported diagnosis of diabetes. Of the 421 women with a history of GDM, 128 women reported a diagnosis of diabetes and were excluded from the analytic subsample. Women who reported a diagnosis of borderline diabetes or prediabetes (n=49) were included; however those who reported using medications to

lower blood glucose (n=7) were excluded from the analytic subsample. Diabetes screening status was determined by the response to "Have you had a blood test for high blood sugar or diabetes within the past three years?" Individuals who responded "don't know" to prior screening (n=2) were excluded from our analytic subsample (n=284, Figure 1, group B). Of the 284 non-diabetic, at-risk women eligible for diabetes screening, 177 reported having a blood test for diabetes within the prior three years.

Women who reported no prior diagnosis of prediabetes or borderline diabetes but whose HbA_{1c} was measured in the range of 5.7-6.4% (39 – 46 mmol/mol) were characterized as having undiagnosed prediabetes. Women who had an $HbA_{1c} \geq 6.5\%$ (48 mmol/mol) were characterized as having undiagnosed diabetes.

E. Statistical Analysis

All statistical analyses utilized survey design variables and were weighted with the exam subsample MEC six-year weight to account for the complex sampling scheme, oversampling, and survey nonresponse to produce nationally representative estimates per NHANES analytic guidelines.

Age-adjusted GDM prevalence rates and standard errors were generated with the direct method for age standardization using 2000 Census population data for 20-year-olds and older, with ten-year age intervals. Next, bivariate analyses of cohort characteristics with diabetes screening were performed. Associations of categorical

variables were analyzed by X^2 test of independence. Associations of normally distributed continuous variables -survey age and age at first pregnancy- were assessed by Student's *t* test. For non-normally distributed continuous variables- age at GDM diagnosis and age at last birth- non-parametric t-tests (Mann- Whitney) were used. All tests were two-tailed, and $p < 0.05$ was considered significant.

A backward selection approach was used to analyze the multivariable logistic regression models constructed to examine the association of diabetes screening with independent variables, adjusted for age, education, income, ethnicity, BMI category, and age at GDM diagnosis. Independent variables were evaluated for collinearity by examining the variance inflation factor before inclusion in the models. All analyses were performed with STATA, version 13.1. The Institutional Review Board of the University of Illinois at Chicago reviewed the study protocol and determined this study exempt from human subjects research oversight.

IV. RESULTS

A. Prevalence of Gestational Diabetes Mellitus in the United States Population

The estimated age-standardized prevalence rate of GDM was 7.26% (95% CI 6.28-8.24) for U.S. women age 20 and older during 2007-2012. Thirty-six percent of the women were less than 40 years old at the time of survey and more than half (56%) were obese (BMI $\geq$ 30 kg/m^2). Among identified ethnic groups, Hispanics had the highest age-standardized prevalence rates (8.5%, 95% CI 6.48-10.56), followed by non-Hispanic whites (6.9%, 95% CI 5.43- 8.44) and non- Hispanic blacks (6.6%, 95% CI 5.36-7.84). Women categorized as other or multiracial had the highest GDM prevalence rate (9.5%, 95% CI 6.12-12.84).

B. Rate of Diabetes Screening in Women with a History of Gestational Diabetes Mellitus

Sixty-seven percent (95% CI 58.9-75.1) of U.S. women with a history of GDM without a diagnosis of diabetes reported blood test screening for diabetes within the prior three years. Of the 284 non-diabetic women with history of GDM, 177 reported having a blood test for diabetes in the prior three years. Table I summarizes the individual, socioeconomic, and health care utilization characteristics of screened and unscreened women.

TABLE I. WEIGHTED BIVARIATE ANALYSIS OF CHARACTERISTICS OF WOMEN WITH A HISTORY OF GDM BY DIABETES SCREENING STATUS, NHANES (2007-2012). ALL PERCENTAGES ARE WEIGHTED

Variable	Screened n =177	Unscreened n =107	p value
Mean survey age, years (SE)	42.4(.89)	42.3(1.07)	0.91
Age Category, n (%)			
20-39	82(45.55)	47(44.48)	
40- 59	82(47.56)	54(51.68)	0.51
≥60	13(6.88)	6(3.84)	
Mean age at GDM diagnosis, years (SE)	28.1 (0.57)	27.3 (0.59)	0.45*
Non-married, † n (%)	48(22.97)	31(25.14)	0.76
Ethnicity n (%)			
Non Hispanic White	67(62.5)	50(66.46)	
Hispanic	50(14.64)	37(21.14)	0.08
Non Hispanic Black	41(13.59)	11(6.74)	
Other /multiracial	19(9.27)	9(5.65)	
Not US born, n (%)	60(21.54)	35(22.35)	0.88
Preferred language, n (%)			
English	126(81.94)	77(83.3)	0.07
Spanish	40(11.79)	26(14.94)	
Asian/other	11(6.27)	4(1.75)	
Education level, n (%)			
Less than 9th	13(4.94)	17(10.41)	
9th to 11th	28(11.96)	20(14.22)	
High school graduate	35(22.01)	23(25.12)	0.39
Some college	60(32.53)	33(32.81)	
College graduate or more	41(28.57)	14(17.44)	
High School Graduate or more, n (%)	136(83.11)	70(75.37)	0.15
Family income to poverty ratio, ‡ n (%)			
0.00-1.85	77(31.42)	64(42.7)	
>1.85-3.5	33(22.63)	18(26.86)	.21
≥3.5	52(45.95)	22(30.44)	
Health insurance, n (%)	137(80.49)	70(71.28)	0.13
Insurance coverage type, n (%)			
Private	91(63.72)	46(57.35)	
Medicaid	20(7.08)	9(4.65)	0.31
Medicare/Medigap	7(2.47)	6(4.0)	
Other	19(7.22)	9(5.28)	
No coverage	40(19.51)	37(28.72)	
Has place for routine care, n (%)	159(88.33)	79(78.54)	0.12
Place often visits for care, n (%)			
Clinic or health center	43(18.86)	26(20.88)	
Office or HMO	106(64.88)	49(55.26)	0.24
Other (ER, hospital, urgent care)	10(4.59)	4(2.4)	
none	18(11.67)	28(21.46)	

TABLE I. (continued) WEIGHTED BIVARIATE ANALYSIS OF CHARACTERISTICS OF WOMEN WITH A HISTORY OF GDM BY DIABETES SCREENING STATUS, NHANES (2007-2012). ALL PERCENTAGES ARE WEIGHTED

Number of health care visits prior year, n (%)			
None	17(9.3)	31(24.2)	
1	28(14.6)	28(30.7)	0.002
2-3	58(36.5)	23(20.52)	
≥4	74(39.58)	25(24.58)	
Number of pregnancies, n (%)			
1	18(12.79)	8(10.63)	
2	37(25.23)	22(25.5)	0.93
3	37(26.35)	25(24.54)	
≥ 4	85(35.63)	52(39.34)	
Number of live births, n (%)			
0	1(0.31)	0	
1	32(24.33)	13(16.69)	
2	60(39.59)	33(38.85)	0.51
3	45(22.36)	38(30.51)	
≥ 4	39(13.41)	22(13.95)	
Mean age at first birth, years (SE)	23.1(.56)	23.2(.63)	0.91
Mean age at last birth, years (SE)	30.4(.53)	30.1(.63)	0.74*
Had baby with birth weight ≥ 9 lbs, n(%)	44(29.86)	26(30.58)	0.93
BMI category, n (%)			
<25	40(27.77)	21(22.77)	
25- 29.9	40(18.63)	42(41.55)	0.010
≥ 30	97(53.61)	44(35.68)	
HbA_{1c}, n(%)			
< 5.7 (39 mmol/mol)	100(68.64)	69(67.66)	
5.8-6.4 (39-46mmol/mol)	59(24.19)	27(25.81)	0.96
≥ 6.5 (48 mmol/mol)	15(7.18)	11(6.52)	
Undiagnosed prediabetes, n (%)	53(22.41)	27(25.81)	0.59

* Mann-Whitney Wilcoxon rank sum test
† Single, separated, or divorced
‡ FIPR based on WIC eligibility categories

A greater number of visits to a health provider in the prior year was associated with diabetes screening in women with a history of GDM (p = 0.002). Also, compared to unscreened women, screened women differed in their distribution of BMI categories with 53.6% vs. 35.7% obese, 18.6% vs. 41.6% overweight, and 27.8% vs. 22.8% normal weight in the screened and unscreened women, respectively (p = 0.01).

Screening was not associated with age, ethnicity, marital status, education level, FIPR, foreign-born status, non-English language preference, pregnancy history, having health coverage, type of health insurance, or type of place visited for health care.

After adjusting for age, ethnicity, education, income (FIPR), BMI category, and age at GDM diagnosis, diabetes screening was associated with a greater number of health provider visits in the prior year, higher income (FIPR > 3.5) and a non-English language preference (Asian or other). Compared with women who reported 0 visits, women who reported 2-3 visits were 7.05 (95% CI 2.18 – 22.8) times more likely to report having had diabetes screening and those reporting 4 or more visits were 5.83 (95% CI 2.35 – 14.46) times more likely to report screening (Table II).

TABLE II. ASSOCIATION OF DIABETES SCREENING WITH NUMBER OF HEALTH VISITS IN THE PRIOR YEAR AND PREFERRED LANGUAGE[1]

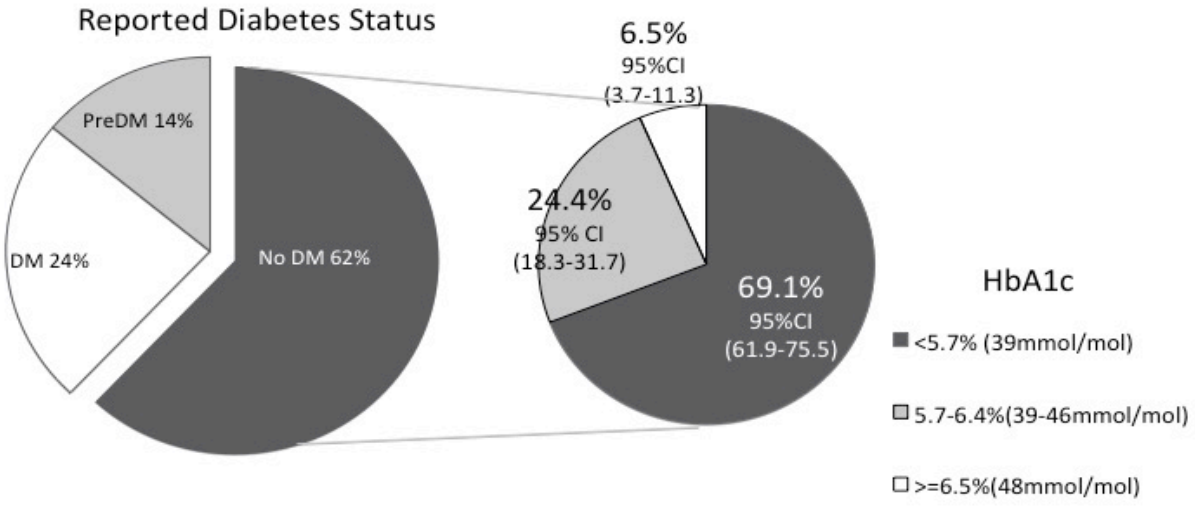
Independent Variable		**AOR[2]**	**95% CI**	**p value**
Survey age		0.98	(0.95-1.01)	0.12
GDM age		1.04	(0.99-1.1)	0.10
Ethnicity	White	reference		
	Hispanic	0.50	(0.13-1.86)	0.29
	Black	1.93	(0.81-4.62)	0.14
	Other/multiracial	0.61	(0.17-2.18)	0.44
HS graduate		1.17	(0.61-2.24)	0.63
Income level (FIPR)	0.00-1.85	reference		
	>1.85- 3.5	1.46	(0.58-3.57)	0.43
	>3.5	2.49	(1.07-5.78)	0.03
BMI category	normal	reference		
	overweight	0.58	(0.22-1.53)	0.26
	obese	1.63	(0.69-3.85)	0.26
Preferred Language	English	reference		
	Spanish	3.34	(0.66-16.85)	0.14
	Asian/other	8.93	(1.55-51.44)	0.02
Visits in prior year	None	reference		
	1	1.91	(0.71-5.18)	0.20
	2-3	7.05	(2.18-22.8)	<0.01
	4 or more	5.83	(2.35-14.46)	<0.001

[1]Multivariable logistic regression model adjusted for all factors in table.
[2]AOR=adjusted odds ratio

C. Rates of Undiagnosed Prediabetes and Undiagnosed Diabetes

Forty-one women reported a diagnosis of prediabetes or borderline diabetes. Of the 243 women with a history of GDM who did not report a diagnosis of borderline diabetes or prediabetes, 24.4% (95% CI 18.27-31.74) had undiagnosed prediabetes and 6.5% (95% CI 3.66-11.31) had undiagnosed diabetes (Figure 2). There were no differences in the proportion of undiagnosed prediabetes or undiagnosed diabetes between the screened and unscreened groups (Table I). Overall, a third of the women with a history of GDM had diagnosed or undiagnosed prediabetes.

Figure 2. Rates of Undiagnosed Prediabetes and Diabetes in Women with a History of Gestational Diabetes



V. CONCLUSIONS

A. Characteristics Associated with Diabetes Screening

A greater number of health visits in the prior year was associated with diabetes screening after adjustment for other characteristics such as age, ethnicity, education, income, BMI category and age at GDM diagnosis. Greater provider contact was also found to be a predictor of screening in prior studies (10; 13; 21).

Twenty-four percent of unscreened women had no visits in the prior year compared to 9.3% of screened women. These findings suggest there may be disengagement from the health care system for unscreened women. Prior qualitative studies reported a lack of time and childcare as perceived practical barriers, but some women also expressed fear of a diagnosis of diabetes or were largely uninformed of their risk (22; 23). Moreover, the recommended interval for cervical cancer screening has lengthened to every 3-5 years, such that postpartum women age 30 years and older may seek preventive health care less frequently (24). Inadequate or lack of health coverage may cause some women to involuntarily disengage from the healthcare system. In fact, approximately 50% of pregnancies are covered by Medicaid (12; 25). Prior to its expansion under the Affordable Care Act, health visits more than 60 days after pregnancy for diabetes screening and care were not available to women in some states, which may explain the low rate of postpartum screening observed among

Medicaid women (12). However, we did not find an association between type of health insurance and screening status in our analysis.

Still, some studies have concluded that disengagement is unlikely to be a barrier to screening. Smirnakis showed that more than 94% of women had a Papanicolaou test, but only 37% underwent postpartum diabetes screening within 6 months (9; 11). Health provider inaction may be contributing to suboptimal screening rates. Provider unawareness of GDM diagnosis, fragmentation in care, and non-adherence to guidelines have been suggested to play a role in suboptimal screening rates (10; 13; 17; 26). Electronic health reminders did not increase the rate of diabetes screening (27). Only one-third of women with GDM were referred for a screening test or given a referral to a primary physician by their obstetrician/gynecologist (16). There is evidence to suggest that screening is not performed even when women were engaged with the healthcare system (11; 28).

Our findings also suggest that more contact with the healthcare system presents more opportunities for screening, or that screening may occur in conjunction with other provider-directed evaluations. Among those screened, 39.6% had four or more health care visits in the prior year. The rising prevalence of diabetes and obesity has contributed to a greater awareness in the general public, and may have prompted health providers to screen for diabetes more often, irrespective of a GDM diagnosis.

Providers consider obesity a key risk factor for diabetes, and obese women are more frequent utilizers of health care services (29). Indeed, we found higher rates of obesity among screened vs unscreened women (53.6% vs. 35.7%). However, one-fourth of the women were normal weight, underscoring the reality that some women may not have an obvious diabetes risk factor. Furthermore, competing issues that may steer the visit agenda toward more urgent concerns and away from preventive screening were not studied. More health encounters may offer exposure to different providers, or different specialists and/or more opportunities to address preventive care such as diabetes screening. Encouraging routine health care utilization and improving the transition from postpartum care to primary care may also contribute to better screening rates.

Higher income level was also associated with screening. Women who preferred speaking another language other than Spanish or English were also more likely to be screened. Presumably, this finding suggests that language may not be a uniform barrier to screening.

B. Undiagnosed Prediabetes and Diabetes

Approximately a quarter of U.S. women with a history of GDM had undiagnosed prediabetes, and approximately 6.5% had undiagnosed diabetes. None of these women were taking diabetes medications and all denied a prior diagnosis of diabetes, prediabetes, or borderline diabetes. Furthermore, the number of women with

undiagnosed prediabetes is likely an underestimation due to the lower sensitivity of the HbA1c. For women with a history of GDM and with prediabetes, current ADA guidelines recommend treatment with intensive lifestyle interventions or metformin to prevent diabetes. Of the women with a history of GDM, 18.4% reported a diagnosis of prediabetes or borderline diabetes, but only 9.1% of them reporting the use of glucose lowering medications. In a subgroup analysis of the Diabetes Prevention Program (DPP), women with a history of GDM and with prediabetes were 48% more likely to progress to diabetes, compared to women with similar glucose intolerance without GDM (30). Investigators also found that women with GDM had a significant and positive response to either lifestyle changes or metformin (compared to placebo), which may reduce the risk of developing diabetes for up to 10 years (31). In women with a history of GDM, both intensive lifestyle intervention and metformin reduced progression to diabetes compared with placebo by 35% and 40% respectively (30). Interestingly, metformin may be more effective in prediabetic women with a history of GDM compared to similar women without GDM (30; 31).

These findings support the ADA position on prediabetes screening and treatment. Notwithstanding, our findings show the distribution of HbA_{1c} was not statistically different among screened and unscreened women. A recent study showed that prediabetes awareness in adults has been associated with a greater likelihood of engaging in risk-reducing behaviors (32). However, the use of metformin in the

prevention of diabetes is uncommon (33). Prediabetes in women with a history of GDM may be under recognized and inadequately treated.

C. Early Intervention for Prediabetes

Early intervention offers reproductive-age women opportunities to optimize any glucose intolerance during their interconception period, potentially decreasing subsequent diabetes-related pregnancy complications. Additionally, delaying the onset of or preventing diabetes may have profound and prolonged effects in the health and productivity of these women in later life (34). Therefore, women of reproductive age with a history of GDM may need to be screened more frequently. An emphasis on prediabetes screening may be considered in this high-risk population given the high risk of progression to diabetes and positive response to intervention (32). Systematic methods to improve prediabetes screening are being investigated.

D. Study Strengths and Limitations

Our findings are based on a large nationally representative sample. Survey administration, laboratory measurements and medical examinations were conducted by highly trained personnel using standardized protocols. Conversely, our study had a number of limitations. Survey data was predominantly self-reported with the exception of weight, height and hemoglobin A1c. The diagnosis of GDM, history of health care utilization, and the performance of diabetes screening were not verified. Additionally, temporal changes in the diagnostic criteria of GDM and standard of care for diabetes

screening in these women were not accounted for in the analysis; however, we noted no significant differences in screening by survey cycle. The ability to detect significant differences between screened and unscreened women may have been limited due to our small sample size.

In conclusion, women with GDM reporting higher healthcare utilization were more likely to report diabetes screening. Limited engagement with the healthcare system likely reduces opportunities for screening. An emphasis on increasing prediabetes screening may also delay progression to diabetes and improve diabetes detection for women with a history of GDM. Once diagnosed, efforts to promote lifestyle changes and increase metformin use may help delay or prevent diabetes and its complications.

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Education / Post Graduate Training

2010 -	School of Public Health, University of Illinois, Chicago, Illinois Candidate for MS in Clinical and Translational Science
1995 -1998	Internal Medicine/ Primary Care Residency University of California, San Francisco
1990 -1995	Stanford University School of Medicine, Stanford, California Doctor of Medicine, June 1995
1984 -1988	Cornell University, Ithaca, New York B.A., Biology, June 1988

Present Academic Position

2008-	Assistant Professor of Clinical Medicine Division of Academic Internal Medicine Department of Medicine University of Illinois Chicago, Illinois

Previous Academic / Professional Positions

2008-2010	Attending Physician Division of General Medicine Jesse Brown VA Medical Center Chicago, Illinois
2001-2007	Attending Physician Division of General Medicine/Primary Care Stroger Hospital of Cook County Chicago, Illinois

Assistant Professor
Department of Medicine
Rush University Medical School
Chicago, Illinois

2000-2001 Staff Physician
Ambulatory Care
Kaiser Permanente Medical Group
Santa Rosa, California

1998-2000 Staff Physician
Asian Health Services
Oakland, California

Licensure and Certification

2001- Illinois Medical License, DEA certified
2015-2017 Basic Life Support
1998-2018 Board Certified, American Board of Internal Medicine
1997-2001 California Medical License, DEA certified

Academic Activities

2006-2007 Screening, Brief Intervention and Referral to Treatment (SBIRT) &
Depression Screening Project
Physician Lead, General Medicine Clinic
Stroger Hospital of Cook County

2002-2006 Minimizing Error and Maximizing Outcome (MEMO)
Project Site Coordinator
Section of General Internal Medicine
University of Wisconsin, Madison

2003-2004 Co-Investigator, Asian American Healthcare Utilization
Project Stroger/RUSH Collaborative Grant

1992-1993 Research Assistant, Department of Hematology,
Stanford School of Medicine

1991-1992 Project Director, Health Education Curriculum
Center for Research in Disease Prevention, Stanford University

1988-1990	Research Assistant, Laboratory of Genetics Rockefeller University

Teaching Activities

2008-2010	Clinic Preceptor, General Medicine Resident Clinic Jesse Brown VA Medical Center, Chicago
2001-2007	Lecturer, Core Curriculum, Ambulatory Medicine and Woman's Health Clinic Preceptor, General Medicine Resident Clinic Stroger Hospital of Cook County, Chicago
2003-2004	Instructor, Physical Diagnosis, Rush University Medical School, Chicago

Committees

2008-2010	Medication Utilization Committee, Jesse Brown VA Medical Center
2002-2003	Division Leadership Roundtable Division of General Medicine Stroger Hospital of Cook County

Honors and Awards

1995	Commitment to Community Service, Stanford School of Medicine
1988	Bachelor of Arts, with distinction, Cornell University
1988	Award for Academic Excellence, Cornell University

Publications

Linzer, M, et al. Working Conditions in Primary Care: Physician Reactions and Care Quality. Annals of Internal Medicine 618:28-36, 2009.

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Scientific Presentations

Man B, Turyk M, Gerber B. Diabetes Screening in Women with a History of Gestational Diabetes. UIC Women's Health Research Day. Chicago, Illinois April 2015. UIC Department of Medicine Scholarly Activities. Chicago, Illinois, May 2015. [poster].

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