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Folic Acid Supplementation before Pregnancy: Reasons for Non-Use and Association with Preconception Counseling

Paul J. Bixenstine, BA¹,

Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD

Tina L. Cheng, MD, MPH,

Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD

Diana Cheng, MD,

Maryland Department of Health and Mental Hygiene, Baltimore, MD

Katherine A. Connor, MD, MSPH, and

Department of Pediatrics, The Herman & Walter Samuelson Children's Hospital at Sinai, Baltimore, MD

Kamila B. Mistry, PhD

Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD

Paul J. Bixenstine: pbixens1@jhmi.edu

Abstract

Objective—To examine the relationship between preconception counseling (PCC) on folic acid and folic acid use and reasons for non-use.

Methods—We analyzed Maryland Pregnancy Risk Assessment Monitoring System (PRAMS) survey responses from women with live births from 2009-2011. Multivariable weighted logistic regression models (n=4426) adjusting for maternal sociodemographics were used to explore the associations between PCC receipt and folic acid use and reasons for non-use.

Results—Less than 30% of women received folic acid PCC and only 32% of women took folic acid daily prepregnancy. The most common reasons for non-use were “not planning pregnancy” (61%) and “didn't think needed to take” (41%). PCC receipt was associated with three times the odds of folic acid use (adjusted odds ratio [aOR] 3.17, 95% CI 2.48-4.06) and half the odds of reporting “didn't think needed to take” (aOR 0.47, 95% CI 0.28-0.78) as a reason for non-use.

Corresponding Author: Paul Bixenstine, BA, Johns Hopkins School of Medicine, Baltimore, MD UNITED STATES.

¹Division of General Pediatrics and Adolescent Medicine, Department of Pediatrics, Johns Hopkins University School of Medicine, Baltimore, MD, USA.

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Conclusions—Folic acid use remains low. Folic acid PCC was associated with increased folic acid use but few women received it. Our data support initiatives to promote provision of folic acid PCC to all women of childbearing age.

Keywords

folic acid; preconception counseling; preconception care

Introduction

Neural tube defects (NTDs) remain common, affecting over 2500 births annually in the United States.¹ They are the second most common cause of serious birth defects and are costly, associated with more than \$85 million in hospital costs per year.² There is strong evidence that taking folic acid prior to conception and during the first trimester of pregnancy can reduce the risk of NTDs by up to 70%.³ Recommendations from the Centers for Disease Control and Prevention (CDC),⁴ United States Preventive Services Task Force (USPSTF)⁵ and others⁶⁻⁸ therefore encourage daily folic acid supplementation (0.4 mg) for all women of childbearing age. Although rates of NTDs have fallen since these clinical guidelines were established⁹ and following grain fortification,¹⁰ the rate of NTDs remains 60% above the Healthy People 2010 goal¹¹ and continues to be a high priority for 2020.¹²

The lack of decline in NTDs is likely in part because, despite recommendations, the majority of women do not take folic acid daily before pregnancy. The most recent national estimates suggest that only 30% of women with a recent pregnancy used folic acid daily before they became pregnant,¹¹ with lower rates among those who are non-White, younger, or have unintended pregnancies.^{13,14} Prior studies of the reasons women do not take folic acid have been limited in size^{15,16} or have not focused on women before pregnancy, when use is most important.¹⁷

One potentially effective strategy to increase folic acid use and address reasons for not taking folic acid, as well as to promote other healthy behaviors, is preconception counseling (PCC).¹⁸⁻²³ PCC has shown promise in promoting healthy prepregnancy behaviors and even affecting birth outcomes in mothers with chronic disease.^{24,25} However, though PCC is recommended for all women of childbearing age,²⁶ studies estimate that only 30% of women receive PCC during the 12 months before pregnancy.¹³

Few large-scale studies have explored the association between PCC receipt and folic acid use.^{14,25} Previous studies have estimated the effect of PCC in general^{14,20,25} rather than the effect of PCC which specifically addresses folic acid supplementation, which is most relevant to efforts to increase folic acid use. Additionally, no previous population-based studies have explored the reasons women do not take folic acid before pregnancy, when it is most important for preventing NTDs, or how these reasons vary by maternal characteristics. The objective of this study is to examine the relation between folic acid PCC and prepregnancy daily folic acid use, as well as to describe the reasons women do not take folic acid prepregnancy, using data from a population-based survey.

Methods

Study Design

We analyzed 2009-2011 data from the Maryland Pregnancy Risk Assessment Monitoring System (PRAMS), a population-based survey of postpartum women two to nine months after delivery, designed to assess selected maternal behaviors and experiences that occur before, during, and shortly after pregnancy. PRAMS is an ongoing survey conducted by the Maryland Department of Health and Mental Hygiene with the support of the Centers for Disease Control and Prevention (CDC). A stratified random sample of approximately 200 new mothers is drawn every month from eligible birth certificates. Women are first contacted by mail and if there is no response to three mailed surveys, telephone interviews are attempted. The weighted response rate for the 2009-2011 surveys was 67.0%. Details regarding the PRAMS design and methods have been previously published²⁷ and are also available at <http://www.cdc.gov/prams/Methodology.htm>.²⁸ Maryland PRAMS 2009-2011 is unique in that it is the only available large dataset from those years describing both receipt of PCC on folic acid and reasons for not taking folic acid.

Measures

Dependent Variables—The primary outcome, preconception daily folic acid use, was assessed by response to the question: “During the month before you got pregnant with your new baby, how many times a week did you take a multivitamin, a prenatal vitamin, or a folic acid vitamin?” Responses were dichotomized to indicate daily versus not daily intake. Additionally a secondary outcome, reasons for not taking folic acid, was examined. Women who reported not taking folic acid at all in the month before pregnancy were asked: “What were your reasons for not taking multivitamins, prenatal vitamins, or folic acid vitamins during the month before you got pregnant with your new baby?” Response categories included: (1) “I wasn't planning to get pregnant,” (2) “I didn't think I needed to take vitamins,” (3) “The vitamins were too expensive,” (4) “The vitamins gave me side effects (such as constipation)” and (5) “Other.” Women who indicated not taking folic acid but did not choose any of the five reasons were classified as reporting “no reason.” Respondents could check all reasons that applied and thus each reason was coded as a distinct dichotomous variable indicating “yes” or “no.”

Independent Variables—The primary independent variable of interest was receipt of folic acid PCC. This was assessed by response to the question, “Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk with you about how to prepare for a healthy pregnancy and baby?” Women with a “yes” response were prompted to respond to the question, “Before you got pregnant with your new baby, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? Please count only discussions, not reading materials or videos.” Women could respond “yes” or “no” for 11 content areas of preconception counseling, including “taking vitamins with folic acid before pregnancy.” Women were considered to have received PCC in general if they answered “yes” to the first question and to have received folic acid PCC if they answered “yes” to the first question and “yes” for counseling about taking vitamins with folic acid for the second question.

Covariates—We considered covariates using an adaptation of the framework of predisposing, enabling and need factors proposed by Aday and Andersen.²⁹ For predisposing factors, we included age (<30 or ≥30 years), race/ethnicity (White Non-Hispanic, Black Non-Hispanic, Asian Non-Hispanic, Hispanic, or Other), education (≤12 grades or >12 grades), and marital status (married or other). The enabling factors included were health insurance (Medicaid, other or none; month before pregnancy), WIC during pregnancy (yes or no), and stressful events prepregnancy (yes or no; 12 months before pregnancy). Finally we included as need factors chronic conditions (yes or no; 3 months before pregnancy), smoking prepregnancy (yes or no; 3 months before pregnancy), previous live birth (yes or no) and pregnancy intention (intended or unintended). Intended pregnancy was defined as women responding that they wanted to be pregnant “sooner” or “then” while unintended pregnancy meant they wanted to be pregnant “later” or “didn’t want to be pregnant then or later.” Additional covariates that were considered included body mass index, previous low birth weight infant, and previous preterm infant but these were excluded due to lack of significance in bivariate models.

Data Analysis

Our sample included women with available data on prepregnancy daily folic acid use and receipt of folic acid PCC, which excluded 122 women (2.7%) from analysis. We calculated the percentages of women reporting prepregnancy daily folic acid use and each of the reasons for not taking folic acid. Chi-square and F-statistic were used to examine differences in proportions by selected maternal characteristics. Next, associations between maternal characteristics and prepregnancy daily folic acid use were explored using logistic regression to compute unadjusted prevalence odds ratios (ORs) and 95% confidence intervals.

Multivariable logistic regression was then used to assess associations between prepregnancy daily folic acid use and reasons for not taking folic acid, respectively, and receipt of folic acid PCC, adjusting for the covariates discussed above. Additionally, we included an interaction term to explore the potential of effect modification by pregnancy intention; however, there was no evidence of an interaction. Multi-collinearity was examined and was not a factor in any of the models.

All analyses were performed on weighted data, accounting for the complex survey design, non-response and non-coverage, using STATA 10 SE software (StataCorp LP, College Station, TX). The study was approved by the Institutional Review Boards of the Maryland Department of Health and Mental Hygiene and Johns Hopkins School of Medicine.

Results

Of the 4426 women in our sample, 31.5% took folic acid daily during the month before their most recent pregnancy and 26.7% reported receiving prepregnancy PCC on folic acid. PCC in general, i.e. on any topic, was reported by 32.0%. The majority of women were less than 30 years old (55.2%), White non-Hispanic (46.5%), educated more than 12 grades (64.0%), and married (59.0%). Approximately 14.4% were on Medicaid, 43.7% received WIC during pregnancy and a majority reported one or more stressful events prepregnancy (71.7%). Most reported no chronic condition the 12 months before pregnancy (63.0%), not smoking the 3

months before pregnancy (77.8%), and a previous live birth (57.3%). About half of respondents reported that their most recent pregnancies were intended (54.7%) (Table 1). The most common reason reported for not taking folic acid was, “I wasn't planning to get pregnant” (60.9%), followed by, “I didn't think I needed to take vitamins” (40.9%). “Other” reasons were written in by 11.6% of women. There were significant differences in reasons reported by all maternal characteristics (Table 2).

In bivariate models, folic acid PCC was associated with four and a half times the odds of preconception daily folic acid use (adjusted odds ratio [aOR] 4.54; 95% CI 3.66-5.62) as noted in Table 1. In multivariable analysis, receipt of folic acid PCC remained significant and was associated with three times greater odds of daily folic acid use (aOR 3.17; 95% CI 2.48-4.06). Age 30 years or older (aOR 1.65; 95% CI 1.29-2.12) and having an intended pregnancy (aOR 1.83; 95% CI 1.41-2.38) also remained significantly associated with greater odds of daily folic acid use. Asian Non-Hispanic race/ethnicity, receiving WIC during pregnancy, having a stressful event prepregnancy, smoking prepregnancy, and having a previous live birth remained significantly associated with lower odds of daily folic acid use (Table 3).

Folic acid PCC was also associated with two times lower odds of reporting “didn't think needed” (aOR 0.47; 95% CI 0.28-0.78) and two times greater odds of reporting “other” reasons (aOR 2.04, 95% CI 1.17-3.53). Reason 1, “not planning pregnancy,” had lower odds of being reported by women who were married, of non-Hispanic Black race/ethnicity or with an intended pregnancy. Reason 2, “didn't think needed to take,” had greater odds of being endorsed by women who were less than 30 years of age, non-White, received WIC during pregnancy, or had an unintended pregnancy. Reason 3, that folic acid vitamins were “too expensive,” had lower odds of being endorsed by non-Hispanic Black women and greater odds among women who were unmarried, uninsured, had chronic conditions or had a previous live birth. Reason 4, “side effects” had over five times lower odds of being endorsed by Asian women than White women. Reason 5, “other” had twice the odds of being reported by women with an intended pregnancy. “No reason” had almost three times the odds of being reported by unmarried women (Table 4).

Discussion

Our findings from a population-based survey of over 4,400 women with recent live births show that less than one-third (31.5%) of women in Maryland reported daily folic acid use in the month before their most recent pregnancy, consistent with national estimates.¹¹ Our results identifying lower folic acid use among women who are younger,^{13,14,30} have a previous live birth,¹⁴ or have an unintended pregnancy^{13,14,30,31} are also consistent with previous studies.

However, our study also shows lower odds of folic acid intake among women smoking prior to pregnancy, a finding previously reported in unadjusted results by Rosenberg et al.³⁰ This finding is relevant because chronic smoking has been associated with lower folic acid blood levels;³² therefore, these women may be at even greater risk of having children with NTDs.

Additionally, our results suggest stressful events and WIC receipt as potential risk factors that may need to be addressed.

We found the most common reasons for not taking folic acid were “not planning pregnancy” and “didn't think needed to take.” These findings are similar to those of two smaller-scale studies, one focused on folic acid intake among women with recent pregnancies¹⁶ and another on women reporting to gynecologic visits,²² which found “not planning pregnancy” to be the most common reason for not taking folic acid. Surveys of women 18-45, who may or may have been planning pregnancy, have also found “not think needed” as a common reason, endorsed by 16-20% of women among this population, second only after “forgetting.”¹⁷

Our findings regarding factors associated with daily folic acid intake and reasons for not taking folic acid can provide important clues to inform the design of interventions aimed at raising awareness and knowledge, such as folic acid public health campaigns or PCC. The characteristics associated with low use represent populations at-risk that should be the focus of messaging efforts and for whom targeted educational initiatives are likely needed. For example, women less than 25 years old have been suggested to be less receptive to folic acid recommendations and so successful health promotion among this age group may require emphasis on healthy lifestyle choices rather than on pregnancy and birth defect prevention.³³

Results regarding the reasons women do not use folic acid can also inform how best to message to increase supplementation. Given that the most common reason for not taking folic acid before pregnancy in our population is “not planning pregnancy,” and that 45% of women in our sample, and roughly 50% of women nationwide, have unintended pregnancies,^{34,35} public health campaigns should not just emphasize the need to take folic acid before pregnancy, but rather communicate that *all* women of childbearing age should be taking folic acid as part of their daily health routine.^{30,36}

To our knowledge, our study is the first population-based study to examine the association between PCC on folic acid and prepregnancy daily folic acid use. Other studies examining general PCC receipt,²⁵ not specifically focused on folic acid, or “pre-pregnancy consultation,”¹⁴ have similarly found a positive association with folic acid use. Our study, looking specifically at PCC on folic acid, found women receiving this counseling were three times more likely to take folic acid daily and two times less likely to report “didn't think needed to take.” The effect of counseling on reasoning is similar to the results reported by Robbins et al who, in a randomized controlled trial of women attending routine gynecologic visits, found physician counseling on folic acid led to a decrease in women being “unsure about the benefits of folic acid,” in addition to increasing folic acid use.²² These results suggest that counseling specifically on folic acid is effective.

Also, given that unintended pregnancy is such a strong risk factor for folic acid non-use and that the most common reason for not taking folic acid in our data is “not planning pregnancy,” it is critical to provide PCC not just in scheduled visits for those planning pregnancy,²¹ but to all women of childbearing age, whether they are planning pregnancy or

not.^{21,25,26,30,37} Pregnancy intention did not modify the association between PCC on folic acid and folic acid use; therefore, counseling appeared to be equally effective whether women were planning pregnancy or not.

Our data, together with previous findings, then suggest that PCC shows promise as an effective strategy to inform women of the importance of taking folic acid and increase folic acid use before pregnancy, both among women planning pregnancy and all other women of childbearing age. Yet, only 26.7% of Maryland women received PCC on folic acid in the year before their most recent pregnancy. Low rates of PCC continue to be noted nationally, as well.^{13,25} Multiple barriers to preconception care counseling conversations, such as feasibility, time constraints and reimbursement, have been noted.²¹ Still data have shown that doctor recommendation is the single greatest reason women would start taking a multivitamin with folic acid.¹⁷ Moreover, there is evidence that brief, 30-60 second counseling on folic acid by clinicians directed at all women of childbearing age, not just those considering pregnancy, is effective in increasing folic acid use.²²

Therefore despite these hurdles, all public health professionals who routinely interact with women, including counselors, social workers, nurses, pharmacists, internists, obstetrician/gynecologists, and pediatricians should be encouraged to make every effort to provide PCC on folic acid at every visit.^{18,19,37,38} The lack of counseling of these women is a large missed opportunity for the public health community. It may be necessary to direct campaigns specifically toward public health professionals as part of a multifaceted approach to reach women. The message to practitioners and providers should underscore the importance of providing counseling to every woman of childbearing age at every visit,^{19,37} not just when discussing pregnancy, and highlight that less than one minute of counseling can have a positive impact on folic acid use.²²

There are several limitations to this study. This study includes data from a single state, potentially limiting generalizability. Also PRAMS data are retrospective and self-reported and therefore subject to recall bias. Despite these limitations, 2009-2011 Maryland PRAMS data allow a unique opportunity to use population-based data to assess receipt of folic acid PCC, folic acid use, and reasons for folic acid non-use, all of which are not available in any other large data set from these years.

In conclusion, less than one-third of women in Maryland took folic acid daily before pregnancy, with lower rates of use among women who were younger, non-White, smokers, had a previous live birth or had an unintended pregnancy. Public health efforts to increase folic acid intake targeted toward these women are important. Yet, messaging should also emphasize that all women need to consistently take folic acid daily when they reach childbearing age, particularly given that half of pregnancies are unintended and most women do not take folic acid before pregnancy because they are not planning pregnancy. To date, public health prevention strategies have largely focused on educational initiatives and folic acid grain fortification, however, our results show that PCC on folic acid is another key, potentially effective strategy to address reasons for non-use and increase daily folic acid supplementation. The fact that only 27% of women receive PCC on folic acid before pregnancy is large missed opportunity to reduce the incidence of devastating and costly

NTDs. Further efforts are needed to overcome barriers to the provision of PCC by public health professionals and provide targeted folic acid PCC to every woman of childbearing age at every opportunity.

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Table 1
Association of Maternal Characteristics and Daily Folic Acid Use

Characteristic	Total		Used Folic Acid Daily		
	n	Col %	n	Row %	Weighted Bivariate OR (95% CI)
Overall	4426	--	1666	31.5	--
Folic Acid PCC					
No	3038	73.3	750	22.3	1.00
Yes	1388	26.7	916	56.6	4.54 (3.66-5.62) ***
Predisposing Factors					
Age (years)					
<30	1479	55.2	363	23.4	1.00
30	2947	44.8	1303	41.5	2.32 (1.90-2.83) ***
Race/Ethnicity ^					
White, Non-Hispanic	2007	46.5	935	39.8	
Black, Non-Hispanic	1464	32.0	413	22.0	0.43 (0.34-0.54) ***
Asian, Non-Hispanic	363	6.7	148	29.6	0.64 (0.44-0.92) *
Hispanic	533	14.6	154	28.1	0.59 (0.44-0.80) **
Education					
12 grades	1358	36.0	314	21.9	1.00
>12 grades	3050	64.0	1347	37.0	2.09 (1.67-2.62) ***
Marital Status					
Married	2932	59.0	1344	40.6	1.00
Other	1493	41.0	322	18.4	0.33 (0.26-0.41) ***
Enabling Factors					
Insurance					
Medicaid	538	14.4	141	23.1	1.00
Other	3126	67.2	1381	37.3	1.97 (1.42-2.74) ***
None	687	18.3	128	18.3	0.74 (0.49-1.13)
WIC During Pregnancy					

Characteristic	Total		Used Folic Acid Daily			
	n	Col %	n	Row %	Weighted Bivariate OR (95% CI)	
No	2743	56.3	1292	41.1		1.00
Yes	1644	43.7	360	19.4		0.35 (0.28-0.43) ***
Stressful Event Prepregnancy						
No	1327	28.3	650	43.2		1.00
Yes	3017	71.7	985	27.0		0.49 (0.40-0.60) ***
Need Factors						
Chronic Conditions						
No	2620	63.0	1047	33.3		1.00
Yes	1762	37.0	605	28.3		0.79 (0.65-0.97) *
Smoking Prepregnancy						
No	3498	77.8	1439	35.0		1.00
Yes	875	22.2	205	18.9		0.43 (0.33-0.57) ***
Previous Live Birth						
No	1802	42.7	789	35.0		1.00
Yes	2606	57.3	868	28.8		0.75 (0.62-0.91) **
Pregnancy Intention						
Unintended	1668	45.3	311	17.1		1.00
Intended	2674	54.7	1337	43.8		3.78 (3.02-4.73) ***

* p<0.05,

** p<0.01,

*** p<0.001

^ Other race/ethnicity n=59 (0.46%) excluded

Table 2
Reasons for Folic Acid Non-Use by Maternal Characteristics and PCC Receipt

Characteristic	Reason 1 - Not planning pregnancy		Reason 2 - Didn't think needed		Reason 3 - Too expensive		Reason 4 - Side effects		Reason 5 - Other		Reason 6 - No reason	
	n	Row %	n	Row %	n	Row %	n	Row %	n	Row %	n	Row %
Overall (n=2093)	1281	60.9	777	40.9	144	6.6	137	5.0	267	11.6	102	5.8
Folic Acid PCC												
No	1178	62.3	710	42.5	129	7.0	106	4.9	218	10.5	89	5.4
Yes ^{a,b,e}	103	47.2	67	27.6	15	6.6	31	7.5	49	23.0	13	9.1
Predisposing Factors												
Age (years) ^{b,b,e}												
<30	619	63.0	371	43.9	70	7.1	56	4.6	88	10.4	38	5.5
30	662	56.4	406	35.0	74	6.7	81	6.4	179	14.7	64	6.3
Race/Ethnicity ^{b,c}												
White, Non-Hispanic	474	63.1	219	33.5	60	9.1	57	7.1	113	14.1	24	4.1
Black, Non-Hispanic	523	62.1	340	45.2	43	3.8	48	4.2	94	10.2	42	5.8
Asian, Non-Hispanic	79	51.3	79	47.4	4	3.0	8	1.1	25	14.2	8	5.5
Hispanic	185	57.6	132	45.6	36	10.5	23	5.7	29	9.1	26	8.5
Education ^e												
12 grades	575	61.9	352	43.6	83	8.8	60	5.0	99	10.0	42	6.1
>12 grades	700	59.5	418	38.5	58	5.3	76	5.4	167	13.6	59	5.5
Marital Status ^{a,c,d,e,f}												
Married	601	53.0	394	40.6	54	4.0	94	7.6	173	15.0	49	4.0
Other	680	67.3	383	41.1	90	9.4	43	3.2	93	9.1	53	7.4
Enabling Factors												
Insurance ^c												
Medicaid	218	62.5	120	40.2	22	7.3	24	4.8	33	11.8	14	7.2
Other	738	59.2	438	38.1	55	4.9	89	6.2	175	13.5	53	4.4
None	293	63.6	197	46.3	61	11.7	23	3.7	55	8.4	26	7.5
WIC During Pregnancy ^{a,b,e}												
No	573	57.2	332	35.2	49	5.0	77	6.4	149	15.2	43	5.0

Characteristic	Reason 1 - Not planning pregnancy		Reason 2 - Didn't think needed		Reason 3 - Too expensive		Reason 4 - Side effects		Reason 5 - Other		Reason 6 - No reason	
	n	Row %	n	Row %	n	Row %	n	Row %	n	Row %	n	Row %
Yes	698	63.6	437	45.1	91	7.9	59	4.2	117	9.5	57	6.1
Stressful Event Before Pregnancy ^{a,c}												
No	254	54.6	179	41.5	10	2.9	27	3.6	71	11.4	30	8.3
Yes	1010	62.3	586	41.2	131	7.7	106	5.3	193	11.8	72	5.3
Need Factors												
Chronic Conditions ^{c,d}												
No	675	59.6	444	41.0	61	5.1	57	3.6	147	11.1	64	6.4
Yes	591	62.2	326	40.5	79	9.2	75	6.7	118	12.5	38	5.1
Smoking pregnancy ^a												
No	883	58.1	562	41.3	90	5.7	100	5.1	207	12.4	84	6.5
Yes	385	66.4	208	40.4	52	9.1	35	5.1	60	10.6	18	4.4
Previous Live Birth ^{c,d}												
No	485	62.3	307	43.9	40	4.7	42	3.2	95	12.4	30	4.4
Yes	791	60.1	466	38.9	103	8.4	95	6.5	171	11.6	70	6.3
Pregnancy Intention ^{a,b,d,e}												
Unintended	892	76.0	368	36.4	78	6.9	49	4.0	102	8.7	55	6.1
Intended	350	36.9	394	48.4	62	7.0	81	6.5	157	16.6	45	5.4

a, b, c, d, e and f signify $p < 0.05$ for reasons 1, 2, 3, 4, 5 and 6, respectively; P-values from F statistic

Table 3
Daily Folic Acid Use By Maternal Characteristics and PCC Receipt

Characteristic (n = 4077)	Adjusted Odds Ratio
Folic Acid PCC	
No	1.00
Yes	3.17 (2.48-4.06) ***
Predisposing Factors	
Age (years)	
<30	1.00
30	1.65 (1.29-2.12) ***
Race/Ethnicity	
White, Non-Hispanic	1.00
Black, Non-Hispanic	0.80 (0.59-1.09)
Asian, Non-Hispanic	0.53 (0.35-0.81) **
Hispanic	1.06 (0.70-1.61)
Education	
12 grades	1.00
>12 grades	1.00 (0.73-1.37)
Marital Status	
Married	1.00
Other	0.72 (0.53-0.98) *
Enabling Factors	
Insurance	
Medicaid	1.00
Other	0.66 (0.41-1.04)
None	0.64 (0.39-1.05)
Stressful Event Prepregnancy	
No	1.00
Yes	0.73 (0.58-0.93) *
WIC During Pregnancy	
No	1.00
Yes	0.69 (0.48-1.00) *
Need Factors	
Chronic Conditions	
No	1.00
Yes	0.90 (0.71-1.14)
Smoking Prepregnancy	
No	1.00
Yes	0.57 (0.41-0.80) **
Previous Live Birth	
No	1.00

Characteristic (n = 4077)	Adjusted Odds Ratio
Yes	0.76 (0.60-0.96) *
Pregnancy Intention	
Unintended	1.00
Intended	1.83 (1.41-2.38) ***

*
p<0.05,

**
p<0.01,

p<0.001

Table 4
Associations between Reasons for Folic Acid Non-Use and Maternal Characteristics and PCC Receipt

Characteristic	Adjusted Odds Ratio					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Folic Acid-Specific PCC	Not planning pregnancy (n=1881)	Didn't think needed (n=1881)	Too expensive (n=1877)	Side effects (n=1878)	Other (n=1887)	No reason (n=1881)
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.66 (0.40-1.09)	0.47 (0.28-0.78)**	1.13 (0.46-2.77)	1.42 (0.66-3.07)	2.04 (1.17-3.53)*	2.21 (1.00-4.92)
Predisposing Factors						
Age						
<30	1.00	1.00	1.00	1.00	1.00	1.00
30	1.07 (0.77-1.49)	0.68 (0.50-0.94)*	0.81 (0.43-1.51)	0.83 (0.39-1.74)	1.21 (0.78-1.89)	1.28 (0.67-2.45)
Race/Ethnicity						
White, Non-Hispanic	1.00	1.00	1.00	1.00	1.00	1.00
Black, Non-Hispanic	0.65 (0.44-0.95)*	2.09 (1.44-3.04)***	0.26 (0.11-0.63)**	0.64 (0.27-1.53)	0.96 (0.59-1.57)	0.87 (0.42-1.81)
Asian, Non-Hispanic	0.81 (0.43-1.53)	1.81 (1.04-3.14)*	0.46 (0.11-1.88)	0.17 (0.06-0.46)**	0.95 (0.40-2.25)	1.20 (0.37-3.82)
Hispanic	0.94 (0.54-1.63)	2.18 (1.31-3.62)**	0.56 (0.23-1.36)	1.11 (0.46-2.69)	0.54 (0.25-1.16)	1.03 (0.38-2.74)
Education						
12 grades	1.00	1.00	1.00	1.00	1.00	1.00
>12 grades	1.13 (0.77-1.63)	0.88 (0.62-1.24)	1.35 (0.73-2.53)	1.12 (0.56-2.26)	1.09 (0.67-1.77)	1.30 (0.64-2.67)
Marital Status						
Married	1.00	1.00	1.00	1.00	1.00	1.00
Other	1.67 (1.14-2.43)**	0.73 (0.51-1.05)	3.09 (1.42-6.71)**	0.51 (0.23-1.12)	0.74 (0.46-1.18)	2.96 (1.43-6.14)**
Enabling Factors						
Insurance						
Medicaid	1.00	1.00	1.00	1.00	1.00	1.00
Other	1.27 (0.74-2.19)	1.20 (0.74-1.96)	1.27 (0.48-3.32)	1.26 (0.42-3.75)	0.78 (0.38-1.63)	0.49 (0.17-1.37)
None	1.07 (0.61-1.87)	1.30 (0.78-2.18)	3.24 (1.30-8.03)*	0.76 (0.27-2.17)	0.74 (0.33-1.66)	1.21 (0.45-3.26)
WIC During Pregnancy						

Adjusted Odds Ratio						
Characteristic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Not planning pregnancy (n=1881)	1.00	1.00	1.00	1.00	1.00	1.00
No						
Yes	0.90 (0.61-1.35)	1.50 (1.01-2.22)*	1.02 (0.47-2.21)	1.17 (0.49-2.77)	0.85 (0.52-1.39)	0.54 (0.25-1.16)
Stressful Event Prepregnancy						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.95 (0.65-1.41)	1.12 (0.78-1.62)	2.08 (0.81-5.34)	1.91 (0.92-3.96)	1.26 (0.77-2.07)	0.58 (0.28-1.18)
Need Factors						
Chronic Conditions						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.04 (0.75-1.46)	0.98 (0.72-1.33)	1.90 (1.03-3.50)*	1.73 (0.89-3.35)	1.36 (0.87-2.14)	0.84 (0.43-1.63)
Smoking Prepregnancy						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.03 (0.70-1.52)	1.32 (0.92-1.89)	0.83 (0.39-1.78)	0.87 (0.42-1.78)	0.88 (0.52-1.51)	0.56 (0.26-1.21)
Previous Live Birth						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.08 (0.77-1.54)	0.75 (0.54-1.04)	2.77 (1.32-5.79)**	1.77 (0.83-3.78)	0.71 (0.45-1.14)	1.58 (0.77-3.25)
Pregnancy Intention						
Unintended	1.00	1.00	1.00	1.00	1.00	1.00
Intended	0.18 (0.13-0.25)***	2.42 (1.76-3.33)***	1.53 (0.80-2.94)	1.93 (0.99-3.75)	1.98 (1.26-3.10)**	0.77 (0.40-1.48)

* p<0.05,

** p<0.01,

*** p<0.001