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# Association Between Maternal Multivitamin Use and Preterm Birth in 24 States, Pregnancy Risk Assessment Monitoring System, 2009–2010

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## Abstract

**Objectives—**The study objective was to examine the prevalence of maternal multivitamin use and associations with preterm birth (<37 weeks gestation) in the United States. We additionally examined whether associations differed by race/ethnicity.

**Methods—**Using the Pregnancy Risk Assessment Monitoring System, we analyzed 2009–2010 data among women aged ≥18 years with a singleton live birth who completed questions on multivitamin use 1 month prior to pregnancy (24 states; n = 57,348) or in the last 3 months of pregnancy (3 states, n = 5,095).

**Results—**In the month prior to pregnancy, multivitamin use ≥4 times/week continued to remain low (36.8 %). In the last 3 months of pregnancy, 79.6 % of women reported using multivitamins ≥4 times/week. Adjusting for confounders, multivitamin use 1–3 times/week or ≥4 times/week prior to pregnancy was not associated with preterm birth overall. Though there was no evidence of dose response, any multivitamin use in the last 3 months of pregnancy was associated with a significant reduction in preterm birth among non-Hispanic black women.

**Conclusions—**Multivitamin use during pregnancy may help reduce preterm birth, particularly among populations with the highest burden, though further investigations are warranted.

### Keywords

PRAMS; Pregnancy; Preterm birth; Vitamins

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*Disclaimer* The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

The authors declare that they have no conflict of interest.

## Introduction

In 2014, preterm birth (birth at less than 37 weeks gestation affected an estimated one out of ten infants in the United States (16). Most preterm births (approximately 65–70 %) are spontaneous, often occurring without a known cause (3, 15). Nearly one-third of infant deaths are attributable to preterm birth (6). Surviving preterm infants, particularly the smallest and youngest, have an increased risk of neurodevelopmental disabilities, including cerebral palsy, hearing impairment, and retinopathy of prematurity (11, 20, 23). Furthermore, the societal economic burden associated with preterm birth in the United States in 2005 exceeded $26.2 billion (20).

In the United States, there is a persistent racial disparity in preterm birth rates. In 2014, the preterm birth rate was 13.2 % among non-Hispanic Black (NHB) women compared to 8.9 % among non-Hispanic white (NHW) women. (16). Reasons for racial disparities in preterm birth are likely multifactorial and are not completely understood. Possible explanations have included genetic, psychosocial, and environmental factors (26).

With increasing recognition of the importance of implantation and formation of the placenta for pregnancy outcomes, risk factors for preterm birth have expanded to include the period before, during, and soon after conception (5, 22). Current evidence indicates that maternal nutritional status before and during pregnancy may influence pregnancy outcomes (5, 7, 8, 22, 33). Daily consumption of 400 micrograms of folic acid starting at least 1 month before conception through early pregnancy is estimated to prevent 50–70 % of neural tube defects (9). Iron-deficiency in early pregnancy has been associated with increased risk of preterm birth (25). Research also suggests vitamin D deficiency may be associated with adverse reproductive outcomes, including preeclampsia, gestational diabetes mellitus, preterm birth, or small-for-gestational age (34).

As with preterm birth, racial disparities are also present when comparing the nutritional status of NHB and NHW women of reproductive age. In a previous analysis of Pregnancy Risk Assessment Monitoring System (PRAMS) 2004 data for 26 states, multivitamin use ≥4 times per week 1 month prior to pregnancy was lower among NHB women than among NHW women (13). Additionally, many national population-based studies have reported lower intakes of folic acid as well as lower serum levels of iron and vitamin D among NHB than among NHW women of reproductive age (14, 18, 30).

Research examining the association between multivitamin use and preterm birth is limited by race/ethnicity, locality, and sample size (7, 8, 12, 33). A previous randomized controlled trial in Hungary assessed the effect of periconceptional (a term referring to the time period before and soon after conception) multivitamin supplementation on pregnancy and found no significant differences in the incidence of preterm birth between the supplementation and control groups (12). However, it is possible that results may have been obscured by the fact that the control group was also exposed to some micronutrients. Three observational studies examining multivitamin use and preterm birth indicated that higher pre- or periconceptional multivitamin use was associated with a reduced risk of preterm birth (7, 8, 33), though these studies primarily comprised white women. Studies including a broader range of racial/ethnic

groups offer insight into whether multivitamin use may explain some of the disparities in preterm birth rates.

The purpose of this study was to assess the prevalence of multivitamin use 1 month prior to pregnancy or during the last 3 months of pregnancy, and to examine associations with preterm birth using multistate, population-based data. Additionally, we examined whether associations differed by race/ethnicity.

## Methods

We used data from the 2009–2010 PRAMS for this analysis. PRAMS is a population-based surveillance system that was established in 1987 by the Centers for Disease Control and Prevention (CDC) to monitor reductions in infant mortality and low birth weight in the United States. PRAMS provides information on maternal experiences and behaviors before, during, and after pregnancy (10). Each year, states participating in PRAMS sample information from between 1,300 and 3,400 women who have had a recent live birth, using data from each state's birth files. PRAMS' method of data collection includes a mailed survey and, in the case of nonresponse after repeated mailing attempts, a telephone survey. Questionnaire mailing packets and telephone surveys include all required elements of informed consent. PRAMS data are linked to birth certificate data and weighted to adjust for the sampling design, noncoverage, and nonresponse. Further details about the PRAMS methodology have been published elsewhere (27). The PRAMS project was approved by the CDC Institutional Review Board.

We included in the analysis states with response rates of ≥65 % that included the PRAMS questions related to multivitamin use for the years 2009–2010. Maternal multivitamin use 1 month prior to pregnancy was evaluated by the 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?" The 24 states that included this question were Alaska, Arkansas, Colorado, Delaware, Georgia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Washington, West Virginia, and Wyoming (n = 68,426). Maternal multivitamin use during pregnancy was based on the response to the question, "During the last 3 months of your most recent pregnancy, how many times a week did you take a multivitamin, a prenatal vitamin, or a folic acid vitamin?" The 3 states that included this question were Arkansas, Georgia, and Ohio (n = 7,486).

The analysis was limited to women ≥18 years with a singleton live birth (multivitamin use 1 month prior to pregnancy, 24 states, n = 63,561; multivitamin use in the last 3 months of pregnancy, 3 states, n = 6,762). To investigate a possible dose–response relationship between multivitamin use and preterm birth, multivitamin use was categorized as 0, 1–3, or ≥4 days/week. The classification of multivitamin use ≥4 days/week has been used in previous PRAMS publications (13, 28). Preterm birth was defined as birth at <37 weeks gestation, and early preterm birth as birth at <34 weeks gestation; the information was based on the clinical estimate of gestational age at birth as indicated on the birth certificate.

Covariates included in the analysis have been shown to be associated with maternal multivitamin use and preterm birth. Covariates from birth certificate data included maternal education (<12 years, 12 years, or >12 years), marital status (yes/no), parity (0, 1, ≥ 2 previous live births), age, and race/ethnicity. As a result of smaller sample sizes among certain racial/ethnic groups, we examined characteristics by race/ethnicity and combined groups according to similar patterns. For multivitamin use 1 month prior to pregnancy, race/ethnicity was categorized as NHW, NHB, Hispanic, American Indian/Alaska Native/Hawaiian, Asian, or other, and age was categorized as 18–19, 20–24, 25–29, 30–34, 35–39, or ≥40 years. For multivitamin use in the last 3 months of pregnancy, race/ethnicity included only NHW, NHB, and Hispanic, and age was categorized as 18–19, 20–24, 25–29, or ≥30 years because of smaller sample sizes in other categories.

Covariates from the PRAMS questionnaire included Medicaid recipient (yes/no), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) recipient (yes/no), and smoking status during pregnancy. Women who reported smoking in the 3 months prior to pregnancy and in the last 3 months of pregnancy on the PRAMS questionnaire were categorized as smokers. Women who reported smoking 3 months before pregnancy but not in the last 3 months of pregnancy were categorized as quitters. Women who reported no smoking at both time points were categorized as nonsmokers. Prepregnancy body mass index (<18.5, 18.5–24.9, 25–29.9, and ≥30), was calculated from maternal weight and height as reported on the PRAMS questionnaire. Prepregnancy body mass index was coded as missing for extreme values (n = 120) based on data distributions for maternal height (<4’0” or >6’6”) and prepregnancy weight (<75 pounds or >500 pounds).

Records with missing data for multivitamin use, preterm birth, or covariates were excluded (multivitamin use 1 month prior to pregnancy, 24 states, n = 6,107; multivitamin use in the last 3 months of pregnancy, 3 states, n = 843). Comparing predictor and outcome variables, women included in the study sample were similar to those excluded (data not shown). The final study sample for the analysis of multivitamin use prior to pregnancy included 57,348 women and the final sample for the analysis of multivitamin use the in the last 3 months of pregnancy included 5,905 women.

We used SAS-callable SUDAAN version 9.3 (Research Triangle Institute, Research Triangle Park, North Carolina) to account for PRAMS’ complex sampling design. Chi-squared tests were used to examine bivariate associations between maternal or infant characteristics and multivitamin use. We estimated unadjusted and adjusted odds ratios (OR) and 95 % confidence intervals (CI) for the association between multivitamin use and preterm birth using logistic regression. Because women with certain medical or pregnancy conditions may be more likely to have a preterm birth and receive preventive interventions, we also conducted a sensitivity analysis excluding women with diabetes mellitus, hypertension and, among women with a previous live birth, those with a history of previous preterm birth or low birth weight. We evaluated effect modification by race/ethnicity by including an interaction term between race/ethnicity and multivitamin use in the model. *P* values were considered significant at <0.05 for main effects and <0.15 for interactions.

## Results

### Multivitamin use 1 month prior to pregnancy (24 states)

Maternal characteristics are shown in Table 1. Overall, only 36.8 % of women reported using multivitamins ≥4 times per week (data not shown). Multivitamin use ≥4 times per week was higher among Asian and NHW women, as well as among women who were older, more educated, married, and nonsmoking. Multivitamin use ≥4 times per week was also higher among women who reported they were not Medicaid or Women, Infants, and Children (WIC) program recipients. Preterm birth (<37 weeks gestation) was highest among women who reported using no multivitamins 1 month prior to pregnancy (8.6 %) compared to those who reported multivitamin use 1–3 times per week (7.4 %) or ≥4 times per week (7.8 %) (Fig. 1). Patterns were similar for early preterm birth (<34 weeks gestation).

The association between multivitamin use 1 month prior to pregnancy and preterm birth was not modified by race/ethnicity ($p$ for interaction = 0.17). We found a significant decrease in the unadjusted odds of both preterm birth and early preterm birth for women who reported multivitamin use ≥4 times per week (Table 2). However, these associations were weakened and no longer statistically significant after adjustment for covariates. Associations were similar after performing a sensitivity analysis excluding women with diabetes mellitus, hypertension, previous preterm birth, or low birthweight (data not shown).

### Multivitamin use in the last 3 months of pregnancy (3 states)

Maternal characteristics are shown in Table 3. Overall, 79.6 % of women reported using multivitamins ≥4 times per week (data not shown). Multivitamin use ≥4 times per week in the last 3 months of pregnancy was higher among women who were older, more educated, married, and nonsmoking (Table 3). Multivitamin use ≥4 times per week was also higher among women who reported they did not receive Medicaid or Women, Infants, and Children benefits. Preterm birth was highest among women who reported using no multivitamins in the last 3 months of pregnancy (11.5 %) compared with those who reported multivitamin use 1–3 times per week (8.5 %) or ≥4 times per week (8.9 %) (Fig. 2). Patterns were similar for early preterm birth.

Race/ethnicity modified the association between multivitamin use in the last 3 months of pregnancy and preterm birth ($P$ for interaction = 0.09), thus results are presented stratified. In the last 3 months of pregnancy, multivitamin use was not associated with preterm birth or early preterm birth among NHW or Hispanic women (Table 4). Among NHB women, vitamin use in the last 3 months of pregnancy was associated with a significant reduction in early preterm birth, but there was no evidence of a dose-response relationship. Categorizing multivitamin use in the last 3 months of pregnancy as none versus any (≥1 times per week), any multivitamin use was associated with a significant reduction in both preterm [adjusted OR 0.51, 95% CI (0.28–0.91)] and early preterm birth [adjusted OR 0.40, 95% CI (0.20–0.80)] among NHB women. All associations were similar after performing a sensitivity analysis excluding women with diabetes mellitus, hypertension, previous preterm birth or low birthweight (data not shown).

## Discussion

Overall, 36.8% of women reported using multivitamins ≥4 times per week 1 month prior to pregnancy (24 states). Reported multivitamin use 1 month prior to pregnancy was lower among American Indian/Alaska Native/Hawaiian, NHB, Hispanic, and Other women than among NWH and Asian women. In the last 3 months of pregnancy (3 states), 79.6 % of women reported multivitamin use ≥4 times per week, and use was similar across racial/ethnic groups. The results of this analysis do not support an association between maternal multivitamin use in the month prior to pregnancy and preterm birth. Although there was no evidence of dose response, any multivitamin use in the last 3 months of pregnancy was associated with reduced odds of preterm birth among NHB women.

We observed a similar prevalence of any multivitamin use in the last 3 months of pregnancy (90.8 %) for 3 states compared with data from the 1999–2006 National Health and Nutrition Examination Survey, which found 89.2 % of women in the third trimester reported using a folic acid-containing supplement in the last thirty days (4). In addition, our findings confirm that multivitamin use among nonpregnant women of reproductive age remains relatively low. The prevalence of any multivitamin use 1 month prior to pregnancy in our study (45.3 %) was similar to a 2004 analysis of Behavioral Risk Factor Surveillance System data (47.0 %) of nonpregnant women of reproductive age (29). Moreover, our data indicating 36.8 % of women report vitamin use ≥4 times per week 1 month prior to pregnancy was consistent with a 2004 PRAMS report (35.1 %) (13).

The low level of preconception multivitamin use is somewhat disconcerting given that a significant portion of women of reproductive age do not meet recommended intakes for important nutrients such as iron, vitamin D, and folate through diet alone (1, 2, 31). Nutritional status is important both before pregnancy for the normal development of the embryo and in early pregnancy, as nutritional requirements increase to sustain fetal growth and maternal metabolism and tissue development (19, 21). Increased amounts of iron are required during pregnancy to produce more blood and support the growth of the fetal-placental unit, while folic acid has been shown to decrease the risk of neural tube defects (9, 24). Research also suggests that vitamin D may play an anti-inflammatory role during pregnancy (35).

Our results are different from previous research on pre- and periconceptional multivitamin use comprised primarily of NHW women (7, 8, 33). Our findings may be explained by different underlying risks in the various study populations. The etiology of preterm birth is multifactorial and the pathways leading to it are complex and poorly understood. Further investigation into the relationship between multivitamin use and preterm birth is necessary to understand these differences. While we did observe an association between NHB women and preterm birth for any vitamin use, additional research among other racial/ethnic groups is warranted.

This study has a number of potential limitations attributed to the PRAMS retrospective, cross-sectional study design. PRAMS data are self-reported and most participants are surveyed 2–3 months following delivery; thus, there may be social desirability and recall

bias. In a comparison of self-report data versus an electronic monitoring system among low-income pregnant women, it was shown that self-reported use of prenatal multivitamin/mineral supplements was overestimated by 8.4 % (17). Also, PRAMS asks women whether they took a multivitamin, a prenatal vitamin, or a folic acid vitamin; thus, we could not determine whether just one or a combination of micronutrients was responsible for the observed association. Furthermore, multivitamin use during pregnancy is assessed during the last 3 months of pregnancy; thus, timing of multivitamin use may differ between those with term or preterm births.

The small sample size (3 states) for the study of multivitamin use in the last 3 months of pregnancy may have prevented us from finding an association between multivitamin use and preterm birth among NHW and Hispanic women. Additionally, PRAMS does not distinguish between medically indicated and spontaneous preterm births, which have different risk factors and may have limited our ability to detect an association if nutritional status was linked only to the development of certain conditions. Lastly, findings are only generalizable to the states included in the analyses.

Our study has several strengths. To our knowledge, this is the first study that assesses the relationship between multivitamin use and preterm birth during pregnancy by race/ethnicity using a multistate data source at the population level. PRAMS uses standardized methods for data collection, which allows for a multistate analysis. PRAMS also collects a wide range of data, and as a result, this analysis could control for a number of covariates.

In conclusion, as only a third of women with a recent live birth reported using multivitamins ≥4 times per week in the month prior to pregnancy, the results of our study indicate that public health efforts need to be directed toward increasing the prevalence of multivitamin use among women of reproductive age, including culturally tailored programs targeted to women with lower reported multivitamin use, such as NHB women. Several health organizations and initiatives recommend vitamin supplementation among women of reproductive age because birth defects can occur very early in pregnancy (3–4 weeks after conception) (9, 32). Although nearly 80 % of women reported using multivitamins ≥4 times per week in the last 3 months of pregnancy, our results suggest that NHB women who do not use multivitamins during pregnancy may have increased odds of preterm birth. Further investigations are warranted to understand whether increasing the proportion of women who use multivitamins during pregnancy may be an important strategy for reducing preterm birth, particularly among those with the highest burden.

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## Abbreviations

| | |
|---|---|
| **CDC** | Centers for Disease Control and Prevention |
| **CI** | confidence interval |
| **NHB** | non-Hispanic black |
| **NHW** | non-Hispanic white |
| **OR** | odds ratio |
| **PRAMS** | Pregnancy Risk Assessment Monitoring System |

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## Significance

Current evidence indicates maternal nutritional status before and during pregnancy may influence pregnancy outcomes. To our knowledge, this is the first study that assesses the relationship between multivitamin use and preterm birth during pregnancy by race/ethnicity using multistate, population-based data. Although there was no evidence of dose response, any multivitamin use in the last three months of pregnancy was associated with reduced odds of preterm birth among non-Hispanic black women.

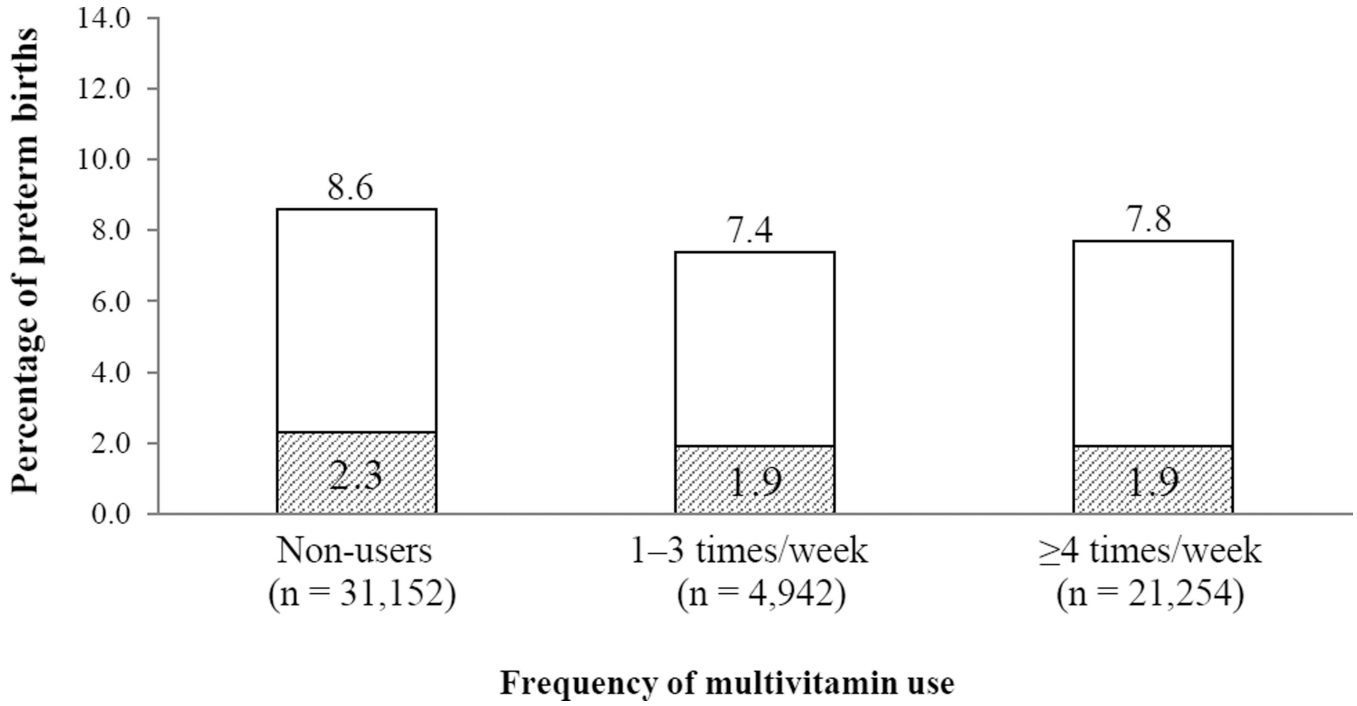


**Figure 1.**

Preterm birth (<37 weeks) by multivitamin use 1 month prior to pregnancy, PRAMS, United States, 24 states, 2009–2010. Hashed lines show the proportion of early preterm births that were delivered <34 weeks. 24 states include Alaska, Arkansas, Colorado, Delaware, Georgia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Washington, West Virginia, and Wyoming. *PRAMS* Pregnancy Risk Assessment Monitoring System. Chi-square *p* value <37 weeks: 0.04. Chi-square *p* value <34 weeks: 0.01.

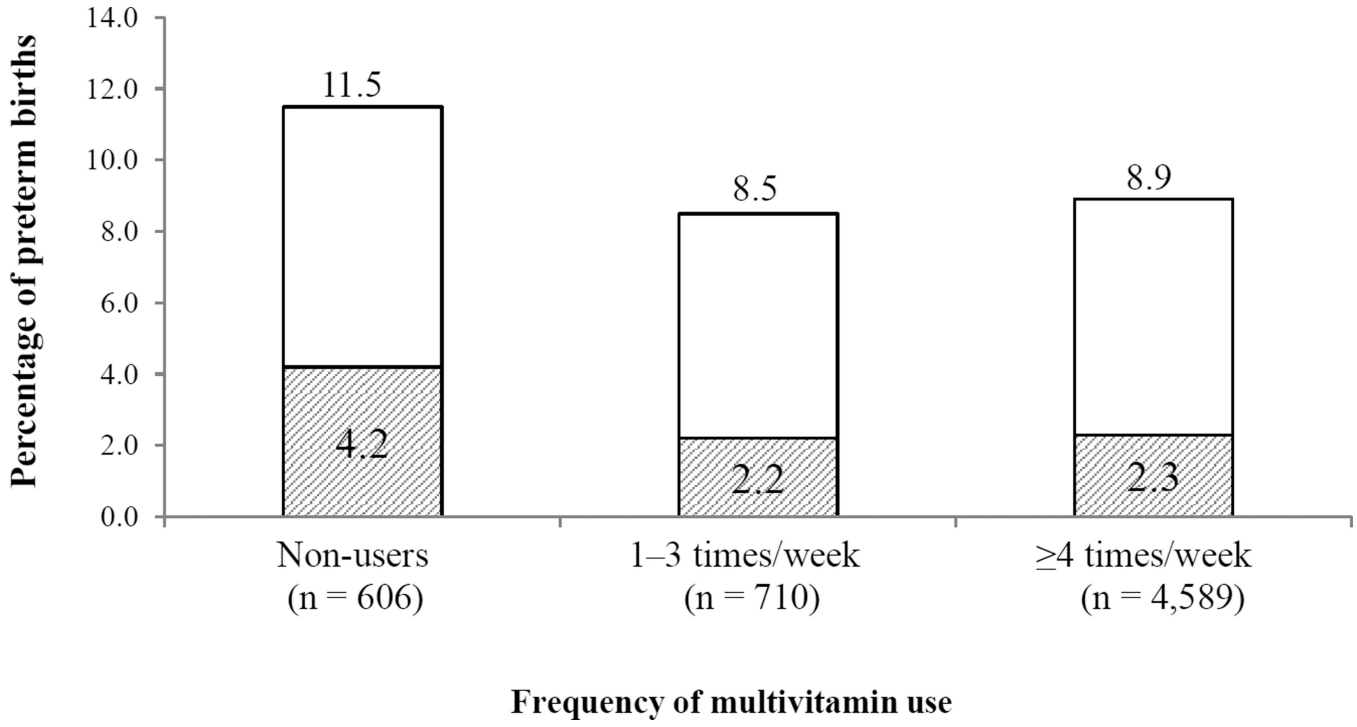


**Figure 2.**

Preterm birth (<37 weeks) by multivitamin use in the last 3 months of pregnancy, PRAMS, United States, 3 States, 2009–2010. Hashed lines show the proportion of early preterm births that were delivered <34 weeks. 3 states include Arkansas, Georgia, and Ohio. *PRAMS* Pregnancy Risk Assessment Monitoring System. Chi-square *p* value for <37 weeks: 0.33. Chi-square *p* value for <34 weeks: 0.14.

**Table 1**

Distribution of maternal characteristics by multivitamin use 1 month prior to pregnancy, PRAMS, United States, 24 states, 2009–2010

| | | Frequency of multivitamin use [a] | | | |
|---|---|---|---|---|---|
| **Maternal characteristics** | **n = 57,348** | **Non-users (%) (n = 31,152)** | **1–3 times/week (%) (n = 4,942)** | **≥4 times/week (%) (n = 21,254)** | ***p* value** |
| Race/ethnicity | | | | | <0.001 |
| Non-Hispanic white | 32,844 | 49.3 | 8.7 | 42.0 | |
| Non-Hispanic black | 7,621 | 66.1 | 9.9 | 24.1 | |
| Hispanic | 7,769 | 64.1 | 7.4 | 28.5 | |
| American Indian/Alaska Native/Hawaiian | 2,842 | 67.2 | 9.4 | 23.4 | |
| Asian race[b] | 4,381 | 47.1 | 8.9 | 44.0 | |
| Other | 1,891 | 61.9 | 6.5 | 31.6 | |
| Maternal age | | | | | <0.001 |
| 18–19 | 3,794 | 80.2 | 4.7 | 15.2 | |
| 20–24 | 13,901 | 72.2 | 7.0 | 20.9 | |
| 25–29 | 17,146 | 53.4 | 8.7 | 37.9 | |
| 30–34 | 13,649 | 41.5 | 10.0 | 48.5 | |
| 35–39 | 7,151 | 38.4 | 10.8 | 50.8 | |
| ≥40 | 1,707 | 40.1 | 7.6 | 52.3 | |
| Education | | | | | <0.001 |
| <12 years | 7,331 | 70.5 | 6.6 | 22.9 | |
| 12 years | 16,065 | 68.7 | 6.8 | 24.5 | |
| >12 years | 33,952 | 44.3 | 9.9 | 45.8 | |
| Married | | | | | <0.001 |
| Yes | 36,102 | 43.5 | 9.5 | 47.0 | |
| No | 21,246 | 73.8 | 7.0 | 19.2 | |
| Medicaid recipient | | | | | <0.001 |
| Yes | 9,147 | 65.4 | 8.1 | 26.5 | |
| No | 48,201 | 53.0 | 8.6 | 38.4 | |
| WIC recipient | | | | | <0.001 |
| Yes | 26,407 | 69.8 | 7.6 | 22.7 | |

| Maternal characteristics | n = 57,348 | Frequency of multivitamin use [a] | | | *p* value |
|---|---|---|---|---|---|
| | | Non-users (%) (n = 31,152) | 1–3 times/week (%) (n = 4,942) | ≥4 times/week (%) (n = 21,254) | |
| No | 30,941 | 42.3 | 9.4 | 48.3 | |
| Maternal smoking status | | | | | <0.001 |
| Nonsmoker | 41,360 | 48.6 | 9.3 | 42.2 | |
| Quitter | 7,491 | 68.1 | 7.3 | 24.6 | |
| Smoker | 8,497 | 79.0 | 5.3 | 15.7 | |
| Prepregnancy body mass index | | | | | <0.001 |
| <18.5 | 2,669 | 63.8 | 8.3 | 27.9 | |
| 18.5–24.9 | 28,501 | 50.3 | 8.6 | 41.2 | |
| 25–29.9 | 13,739 | 56.9 | 8.4 | 34.7 | |
| ≥30 | 12,439 | 60.5 | 8.7 | 30.8 | |
| Previous live births | | | | | <0.001 |
| 0 | 24,248 | 53.3 | 7.1 | 39.6 | |
| 1 | 17,935 | 52.4 | 9.1 | 38.5 | |
| ≥2 | 15,165 | 59.5 | 10.0 | 30.6 | |

*PRAMS* Pregnancy Risk Assessment Monitoring System, *WIC* Special Supplemental Nutrition Program for Women, Infants, and Children.

24 states included Alaska, Arkansas, Colorado, Delaware, Georgia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Washington, West Virginia, and Wyoming.

[a] Unweighted numbers are provided. The percentages were weighted to adjust for survey design, noncoverage, and nonresponse.

[b] Chinese, Japanese, Filipino, other Asian (Asian Indian, Korean, Vietnamese, other Asian, Guamanian, Samoan, and other Pacific Islander).

**Table 2**

Association between multivitamin use 1 month prior to pregnancy and preterm birth, PRAMS, United States, 24 states, 2009–2010

| | Preterm birth | | | | | |
|---|---|---|---|---|---|---|
| **Multivitamin use** | **Unadjusted OR** | **95 % CI** | ***p* value** | **Adjusted OR[a]** | **95 % CI** | ***p* value** |
| | | | *Preterm birth (<37 weeks)* | | | |
| Multivitamin use 1 month prior to pregnancy | | | 0.05 | | | 0.53 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.85 | 0.72, 1.01 | | 0.91 | 0.76, 1.08 | |
| ≥4 vitamins/week | 0.89 | 0.80, 0.99 | | 1.00 | 0.89, 1.13 | |
| | | | *Early preterm birth (<34 weeks)* | | | |
| Multivitamin use 1 month prior to pregnancy | | | 0.01 | | | 0.67 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.81 | 0.64, 1.02 | | 0.92 | 0.73, 1.16 | |
| ≥4 vitamins/week | 0.83 | 0.72, 0.95 | | 1.03 | 0.89,1.18 | |

*CI* confidence interval, *OR* odds ratio, *PRAMS* Pregnancy Risk Assessment Monitoring System.

24 states included Alaska, Arkansas, Colorado, Delaware, Georgia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Washington, West Virginia, and Wyoming.

[a]Adjusted for maternal race/ethnicity, parity, education, age, marital status, Medicaid recipient, Special Supplemental Nutrition Program for Women, Infants, and Children recipient, smoking status, and prepregnancy body mass index.

**Table 3**

Distribution of maternal characteristics by multivitamin use in the last 3 months of pregnancy, PRAMS, United States, 3 states, 2009–2010

| | | Frequency of multivitamin use[a] | | | |
|---|---|---|---|---|---|
| **Maternal characteristics** | **n = 5,905** | **Non-users (%) (n = 606)** | **1–3 times/week (%) (n = 710)** | **≥4 times/week (%) (n = 4,589)** | ***p* value** |
| Race/ethnicity | | | | | 0.31 |
| Non-Hispanic white | 3,669 | 8.7 | 10.5 | 80.8 | |
| Non-Hispanic black | 1,905 | 9.8 | 13.2 | 77.0 | |
| Hispanic | 331 | 12.0 | 10.8 | 77.2 | |
| Maternal age | | | | | <0.001 |
| 18–19 | 559 | 16.4 | 13.9 | 69.7 | |
| 20–24 | 1,783 | 12.1 | 12.8 | 75.0 | |
| 25–29 | 1,779 | 9.6 | 10.3 | 80.1 | |
| ≥30 | 1,784 | 4.6 | 10.0 | 85.4 | |
| Education | | | | | <0.001 |
| <12 years | 859 | 17.5 | 14.7 | 67.9 | |
| 12 years | 2017 | 10.9 | 12.7 | 76.4 | |
| >12 years | 3029 | 6.0 | 9.4 | 84.6 | |
| Married | | | | | <0.001 |
| Yes | 3,121 | 6.6 | 9.6 | 83.8 | |
| No | 2,784 | 12.5 | 13.1 | 74.4 | |
| Medicaid recipient | | | | | <0.001 |
| Yes | 1,184 | 12.2 | 18.5 | 69.3 | |
| No | 4,721 | 8.5 | 9.5 | 82.0 | |
| WIC recipient | | | | | <0.001 |
| Yes | 3,398 | 11.9 | 14.0 | 74.2 | |
| No | 2,507 | 6.5 | 8.3 | 85.2 | |
| Maternal smoking status | | | | | <0.001 |
| Nonsmoker | 4,035 | 7.6 | 9.9 | 82.4 | |
| Quitter | 770 | 8.5 | 12.1 | 79.4 | |
| Smoker | 1,100 | 17.3 | 16.3 | 66.5 | |

| Maternal characteristics | n = 5,905 | Frequency of multivitamin use[a] | | | *p* value |
|---|---|---|---|---|---|
| | | Non-users (%) (n = 606) | 1–3 times/week (%) (n = 710) | ≥4 times/week (%) (n = 4,589) | |
| Prepregnancy body mass index | | | | | 0.07 |
| <18.5 | 293 | 8.7 | 13.0 | 78.3 | |
| 18.5–24.9 | 2,637 | 7.5 | 10.1 | 82.4 | |
| 25–29.9 | 1,469 | 9.8 | 11.6 | 78.7 | |
| ≥30 | 1,506 | 12.0 | 12.5 | 75.4 | |
| Previous live births | | | | | <0.001 |
| 0 | 2,454 | 6.0 | 7.6 | 86.4 | |
| 1 | 1,802 | 9.4 | 12.7 | 77.9 | |
| ≥2 | 1,649 | 13.4 | 14.5 | 72.1 | |

*PRAMS* Pregnancy Risk Assessment Monitoring System, *WIC* Supplemental Nutrition Program for Women, Infants, and Children.

3 states included Arkansas, Georgia, and Ohio.

[a]Unweighted numbers are provided. The percentages were weighted to adjust for survey design, noncoverage, and nonresponse.

**Table 4**

Association between multivitamin use in the last 3 months of pregnancy and preterm birth, PRAMS, United States, 3 states, 2009–2010

| | Preterm birth | | | | | |
|---|---|---|---|---|---|---|
| **Multivitamin use by race/ethnicity** | **Unadjusted OR** | **95 % CI** | ***p* value** | **Adjusted OR[a]** | **95 % CI** | ***p* value** |
| | | | *Preterm birth (<37 weeks)* | | | |
| Non-Hispanic white | | | 0.59 | | | 0.61 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.72 | 0.38, 1.37 | | 0.80 | 0.42, 1.53 | |
| ≥4 vitamins/week | 0.90 | 0.56, 1.44 | | 1.04 | 0.63, 1.73 | |
| Non-Hispanic black | | | 0.09 | | | 0.08 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.57 | 0.26, 1.21 | | 0.55 | 0.26, 1.14 | |
| ≥4 vitamins/week | 0.50 | 0.27, 0.93 | | 0.50 | 0.28, 0.91 | |
| Hispanic | | | 0.32 | | | 0.88 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 2.06 | 0.51, 8.25 | | 1.46 | 0.22, 9.66 | |
| ≥4 vitamins/week | 2.56 | 0.76, 8.67 | | 1.47 | 0.32, 6.66 | |
| | | | *Preterm birth (<34 weeks)* | | | |
| Non-Hispanic white | | | 0.24 | | | 0.36 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.60 | 0.33, 1.09 | | 0.63 | 0.33, 1.19 | |
| ≥4 vitamins/week | 0.75 | 0.48, 1.17 | | 0.78 | 0.47, 1.28 | |
| Non-Hispanic black | | | 0.06 | | | 0.03 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.40 | 0.15, 1.04 | | 0.43 | 0.17, 1.04 | |
| ≥4 vitamins/week | 0.38 | 0.17, 0.84 | | 0.39 | 0.19, 0.79 | |
| Hispanic | | | 0.66 | | | 0.74 |
| 0 vitamins/week | 1.00 | referent | | 1.00 | referent | |
| 1–3 vitamins/week | 0.66 | 0.08, 5.55 | | 0.84 | 0.07, 9.80 | |
| ≥4 vitamins/week | 1.35 | 0.29, 6.33 | | 1.69 | 0.30, 9.65 | |

*CI* confidence interval, *OR* odds ratio, *PRAMS* Pregnancy Risk Assessment Monitoring System.

3 states included Arkansas, Georgia, and Ohio.

[a] Adjusted for parity, education, age, marital status, Medicaid recipient, Supplemental Nutrition Program for Women, Infants, and Children recipient, smoking status, and prepregnancy body mass index.