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Use of Multivitamin/Mineral Prenatal Supplements: Influence on the Outcome of Pregnancy

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The objective of this study was to examine the association of prenatal multivitamin/mineral supplement use during the first and second trimesters of pregnancy by low income, urban women in the Camden Study (1985–1995, n = 1,430) and preterm delivery (<37 completed weeks) and infant low birth weight (<2,500 g). Prenatal supplement use was corroborated by assay of circulating micronutrients at entry to care (no differences) and week 28 gestation (increased concentrations of folate and ferritin for supplement users). Compared with women who entered care during the first or second trimester but did not use prenatal supplements, supplement use starting in the first or second trimester was associated with approximately a twofold reduction in risk of preterm delivery. After controlling for potential confounding variables, risk of very preterm delivery (<33 weeks' gestation) was reduced more than fourfold for first trimester users and approximately twofold when use dated from the second trimester. Infant low birth weight and very low birth weight (<1,500 g) risks were also reduced. Risk of low birth weight was reduced approximately twofold with supplement use during the first and second trimester. Diminution in risk was greater for very low birth weight infants, amounting to a sevenfold reduction in risk of very low birth weight with first trimester supplementation and a greater than sixfold reduction when supplement use started in the second trimester. Thus, in low income, urban women, use of prenatal multivitamin/mineral supplements may have the potential to diminish infant morbidity and mortality. *Am J Epidemiol* 1997;146:134–41.

birth weight; delivery; diet; pregnancy; prenatal care; vitamins

A substantial proportion of US women of childbearing age consume diets that contain less than recommended amounts of certain micronutrients (e.g., zinc, folate, iron, and calcium), which have been associated with the course and outcome of pregnancy (1). This observation applies to women living far above the poverty level, but particularly to women who are at or below low income levels. For poor women, the proportion with low micronutrient intakes (<70 percent recommended daily allowance) from diet is greater than might be expected: More than 33 percent consume a diet that is low in folate; for calcium the proportion is more than 40 percent, and for iron and zinc, in excess of 50 percent (1). Moreover, vitamin and/or mineral supplements are not routinely used by nonpregnant women. Among women sampled by the National Maternal and Infant Health Survey (2), only 27 percent of white and 18 percent of black women reported some multivitamin use during the 3 months before their pregnancy was recognized.

Over the past decade, as part of the Camden Study of teenage and minority gravidas, we have shown that poor maternal diet is correlated with an increased risk of preterm and very preterm delivery (3–6). A diet chronically low in energy also provides a low intake of micronutrients, which is associated with both an inadequate gestational weight gain and an increased risk of preterm delivery (4, 6). When quantity, and possibly quality, of the maternal diet is marginal, available micronutrients—vitamins and minerals—may not be used effectively to support either the mother (inadequate gestational gain) or the fetus (decreased growth and gestation duration). There is also the possibility that in poor urban areas such as Camden, New Jersey, where both poor micronutrient intakes and poor pregnancy outcomes are widespread, the use of prenatal

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Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; LBW, low birth weight; LMP, last menstrual period; VLBW, very low birth weight.

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multivitamin/mineral supplements might diminish nutrition-associated risks for mother and fetus and reduce the rate of preterm delivery.

MATERIALS AND METHODS

The Camden Study (3–6) examines the effects of maternal nutrition and growth during pregnancy in one of the poorest cities in the continental United States. Gravidas with serious nonobstetric problems (e.g., lupus, chronic hypertension, non-insulin-dependent diabetes mellitus, seizure disorders, malignancies, drug or alcohol abuse) were excluded from this study. Women, stratified by maternal age and parity, include young (<18 years) and more mature (19–29 years) gravidas who were enrolled into the study during 1985–1995.

To examine the influence of supplement use before pregnancy (preconception) as well as early in pregnancy in cases of preterm and very preterm delivery, data were restricted to women who entered prenatal care during the first and second trimesters and who had singleton pregnancies. Prenatal vitamins were routinely prescribed for all women in this study at the time of the first prenatal visit. Although a range of supplements was available, the product usually prescribed contained vitamins, minerals, and trace elements including folic acid (1 mg), zinc (25 mg), calcium (200 mg), and iron (65 mg). Information on use was obtained by interview at entry to prenatal care and at 28 and 36 weeks' gestation with restriction to data obtained by week 28 for this analysis. Dietary intakes were estimated with 24-hour recalls obtained at entry and at 28 and 36 weeks' gestation; the average of the entry and 28-week recalls is used herein.

Blood was assayed for certain micronutrients and iron status (ferritin, serum and red cell folate, and zinc) at entry to care and 28 weeks' gestation (each sample was obtained ± 2 weeks). Circulating concentrations of ferritin and folate were assayed by radioimmunoassay using kits produced by Micromedics (Horsham, Pennsylvania). Samples for zinc, drawn into blue-topped vacutainers for trace element analysis, were wet-ashed with 16M nitric acid (2 ml, Ultres Grade, J. T. Baker Co., Phillipsburgh, New Jersey), concentrated by evaporation, and diluted with distilled, deionized water containing 1 percent HNO_3. The concentration of zinc was determined by flame atomic absorption spectrophotometry.

Socioeconomic, demographic, and lifestyle data as well as anthropometry were obtained by interview during pregnancy and after birth (4–6 weeks). Information on current and past pregnancy outcomes, complications, and infant abnormalities was abstracted from the prenatal records, delivery record, delivery log books, and infant's chart.

Poor pregnancy outcomes are defined as follows: Infant low birth weight (LBW) (<2,500 g) was also subdivided into the very low birth weight (VLBW) (<1,500 g) category and preterm delivery (<37 completed weeks), which was based on two estimates of gestation used in parallel. Preterm delivery from the last menstrual period (LMP) was based on gestation from the gravida's last normal menstrual period. The obstetric estimate was based on the LMP, confirmed or modified by ultrasound. When cross-classified, 79.8 percent of the infants who were preterm from the obstetric estimate were also preterm from the LMP estimate; 92.8 percent of infants not preterm by the obstetric estimate were also not preterm by the LMP estimate. Preterm deliveries were subdivided further into those delivered very preterm (<33 completed weeks).

Small for gestational age was defined as below the 10th percentile for standards of birth weight for gestational age (7). Two estimates of small for gestational age were computed from the two gestational age estimates and used in parallel. Adequacy of gestational weight gain for the whole of pregnancy was defined to within 2 completed weeks of delivery using published criteria that adjust for gestation duration (8). Body mass index was computed as preconceptional weight for height^2 (kg/m^2).

One key confirmatory test of reported prenatal vitamin use was to determine whether the categories of prenatal vitamin use actually reflected differences in nutritional status, as indexed by circulating levels (serum ferritin, plasma zinc, serum folate, red cell folate) of the usual nutrients contained in prenatal multivitamins. However, because there were a number of missing samples at entry to care or 28 weeks' gestation, the effects of prenatal vitamin use on nutritional status were estimated using a multiple imputation procedure (9–11) instead of a complete-subject analysis. Using the multiple imputation procedure, missing values for the individual blood assays were replaced in separate imputations by 10 random values (11), which consisted of the predicted value from the regression plus a random prediction error term (9). Ten data sets containing these imputed values were analyzed separately as if they were complete, and the resultant regression coefficients combined using the multiple imputation methods of Little and Rubin (9, equations 12.17–12.22). In total, we imputed values for 98 missing serum ferritin values at entry to care, 41 plasma zinc, 100 serum folate, and 101 red cell folate. At 28 weeks' gestation, we imputed values for 174 missing serum ferritin values, 157 plasma zinc, 163 serum folate, and 169 red cell folate.

Confounding was assessed by comparing crude and adjusted odds ratios. Using multiple logistic regression, separate models were fitted for each outcome containing the independent variable(s), maternal age, parity, and potential confounding variables along with interaction terms using forward inclusion and backward deletion (12). Adjusted odds ratios (AORs) and their 95 percent confidence intervals (CIs) were computed from the logistic regression coefficients and their corresponding covariance matrix. Multiple linear regression was used when the dependent variable was continuous.

RESULTS

Characteristics of women who entered care and did or did not take prenatal vitamin/mineral supplements are shown in table 1. Factors associated with prenatal supplement use included increased primiparity, early nausea of pregnancy, earlier entry to care, and, for first trimester supplement users, increased reliance on Medicaid funding for prenatal care. A greater percentage of women using supplements, particularly those whose use dated from the first trimester, had characteristics sometimes related to poor pregnancy outcome: bleeding early in pregnancy and hemorrhage (>500 ml of blood loss) during the immediate puerperium. During the course of their pregnancy, prenatal supplement users were, in general, less likely to experience a poor prognostic indicator, inadequate weight gain for gestation. There was little difference in age, ethnicity, smoking, drinking, or other important risk factors potentially associated with the outcome of pregnancy. A history of supplement use before pregnancy was significantly more common when multivi-

TABLE 1. Characteristics associated with prenatal multivitamin/mineral supplement use, Camden, New Jersey, 1985–1995

	Prenatal supplement users									Prenatal supplement nonusers		
	1st trimester			2nd trimester			Total users					
	No.	%	Mean ± SE†	No.	%	Mean ± SE	No.	%	Mean ± SE	No.	%	Mean ± SE
Age	418		18.0 ± 0.17	730		18.1 ± 0.13	1,148		18.0 ± 0.10	282		18.1 ± 0.21
Preconceptional BMI† (kg/m²)	418		24.0 ± 0.24	730		23.0 ± 0.18	1,148		23.4 ± 0.14	282		23.4 ± 0.29
Average intake of entry week 28 (kcal/day)	418		2,470 ± 54.9	730		2,449 ± 37.1	1,148		2,456 ± 25.9	282		2,342 ± 52.2
Gestation at entry (weeks)												
≤13	418	100					418	36.4		282	29.4**	
14–26				730	100		730	63.6		282	70.6	
Medicaid	418	89.2		730	83.5		1,148	85.6		282	85.8*	
Multiparas	418	25.6		730	31.9		1,148	29.6		282	38.3**	
Black	418	52.6		730	58.6		1,148	56.4		282	58.9	
Inadequate weight gain for gestation	418	20.1		730	23.2		1,148	22.0		282	28.7*	
Cigarettes/day	418			730			1,148			282		
None		77.3			77.5			77.4			72.0	
1–9		17.7			15.8			16.5			19.5	
10–19		3.3			4.7			4.2			5.0	
≥20		1.7			2.0			1.9			3.6	
Drinks/day	418			730			1,148			282		
None		78.4			76.4			77.2			75.2	
≤1		21.3			23.0			22.4			24.5	
>1		0.2			0.6			0.4			0.4	
1st trimester	418			730			1,148			282		
Bleeding		21.0			15.2			17.3			17.0*	
Nausea		77.9			68.4			71.9			64.9***	
Postpartum hemorrhage	401			712			1,113			268		
Blood loss >500 ml		13.0			8.0			9.8			10.4*	
Prior spontaneous abortion	417	9.4		730	9.5		1,147	9.4		282	9.9	
Prior low birth weight	107	10.3		233	15.9		340	14.1		108	14.8‡	
Prior preterm delivery	107	11.2		233	13.7		340	12.9		108	12.0‡	
Preconceptional supplement use	418	17.9		730	19.3		1,148	18.8		282	11.7*	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ for 1st and 2nd trimester prenatal supplement users vs. nonusers.
† SE, standard error; BMI, body mass index.
‡ Multiparas.

tamins were taken during the index pregnancy (table 1). In total, 17.4 percent of pregnant women from Camden reported use of multivitamin/mineral supplements before they knew they were pregnant. Preconceptional supplement users were more likely ($p < 0.05$) to have a reproductive history suggesting increased risk, principally prior spontaneous abortion (13.7 percent of preconceptional users vs. 8.4 percent of nonusers). In addition, similar to prenatal supplement use during the first trimester, preconceptional supplement use also was associated with bleeding early in the index pregnancy (21.3 percent of preconceptional users vs. 16.4 percent of nonusers).

Levels of circulating nutrients corroborated self-reports of supplement use during pregnancy (table 2). After control for confounding variables, little difference in ferritin, zinc, or folate could be demonstrated at entry between women who went on to use prenatal supplements and women who entered care during the same time frame but did not use supplements. However, by week 28, there were significant differences in the concentration of many micronutrients. Circulating levels of ferritin (second trimester users), red cell folate, and serum folate all were significantly increased when supplement users were compared with nonusers. Plasma zinc showed no difference either at entry to care or at 28 weeks with respect to prenatal supplement use.

Use of prenatal supplements during the first and second trimesters was associated with approximately a twofold reduction in risk of preterm delivery when calculated either from the LMP or by the obstetric estimates of gestation (table 3). Moreover, the reduction in risk appeared to be greater for deliveries occurring very early in gestation. When examined by trimester when use began and after controlling for maternal nausea, inadequate weight gain for gestation, and other background characteristics potentially associated with early delivery and supplement use, risk of very preterm delivery (LMP estimate) was reduced more than fourfold for first trimester multivitamin users and approximately twofold for those whose use dated from the second trimester, compared with nonusers. Risk reduction was somewhat greater when very preterm delivery was calculated from the obstetric estimate (table 3). In this instance, the risk was reduced again approximately sixfold for first trimester use and about fourfold for the use from the second trimester of pregnancy.

Infant LBW and preterm delivery are significantly correlated ($p < 0.001$) such that approximately 60 percent of LBW infants in Camden were delivered

TABLE 2. Results of a multiple imputation procedure: effects of prenatal multivitamin/mineral supplement use on blood chemistry values, Camden, New Jersey, 1985–1995

Use	Entry to care				28 weeks' gestation			
	Total no.	No. imputed	b*	SE†	Total no.	No. imputed	b*	SE
Serum ferritin (μg/liter)								
1st trimester	415	21	−3.86	4.64	415	28	2.80	2.04
2nd trimester	716	51	0.25	3.90	716	70	6.26‡	1.89
None	273	26			273	76		
Plasma zinc (μg/dl)								
1st trimester	412	6	2.53	2.30	415	24	−1.80	2.19
2nd trimester	715	21	−1.10	1.89	719	59	2.08	2.06
None	272	14			275	74		
Serum folate (μg/liter)								
1st trimester	416	23	1.35	0.96	415	25	4.27‡	1.34
2nd trimester	718	52	1.03	0.79	714	66	5.07‡	1.20
None	274	25			271	72		
Red cell folate (μg/liter)								
1st trimester	413	20	7.40	23.92	414	33	109.26§	37.82
2nd trimester	718	55	25.77	19.76	714	64	85.49§	34.36
None	273	26			271	72		

* Regression coefficients are the combination of results from 10 imputations from models with no prenatal vitamin use as the reference group and including maternal age, parity, black and Puerto Rican ethnicity, bleeding at entry to care, preconceptional vitamin use, and gestation at blood draw as covariates.

† SE, standard error.

‡ Significantly different from no use at $p < 0.01$. For serum ferritin with 2nd trimester vitamin use, $t = 3.31$, df = 20. For serum folate with 1st trimester vitamin use, $t = 3.19$. df = 33; for 2nd trimester use, $t = 4.23$, df = 52.

§ Significantly different from no use at $p < 0.05$. For red cell folate with 1st trimester vitamin use, $t = 2.89$, df = 18; for 2nd trimester use $t = 2.49$, df = 17.

TABLE 3. Use of prenatal multivitamin/mineral supplements in cases of preterm and very preterm delivery based on last menstrual periods (LMPs) and obstetric estimates, Camden, New Jersey, 1985–1995

Prenatal supplement use	Preterm delivery				Very preterm delivery			
	No.	%	AOR†	95% CI†	No.	%	AOR	95% CI
				LMP estimate				
Yes*	1,131	15.2	0.66	0.47–0.93	1,131	4.7	0.44	0.27–0.72
No	275	22.6	1.00		275	10.9	1.00	
1st trimester‡	415	12.3	0.53	0.35–0.81	415	2.4	0.22	0.10–0.47
2nd trimester	716	16.9	0.71	0.50–1.01	716	6.0	0.54	0.33–0.89
No use	275	22.6	1.00		275	10.9	1.00	
				Obstetric estimate				
Yes*	1,148	11.3	0.55	0.38–0.78	1,148	2.1	0.21	0.11–0.37
No	282	19.2	1.00		282	9.2	1.00	
1st trimester‡	418	11.5	0.56	0.36–0.87	418	1.7	0.16	0.07–0.39
2nd trimester	730	11.2	0.54	0.37–0.79	730	2.3	0.23	0.12–0.44
No use	282	19.2	1.00		282	9.2	1.00	

* Adjusted for age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, gestation at entry, cigarettes/day, preconceptional body mass index, prior preterm delivery, 1st trimester bleeding and nausea, caloric intake, and preconceptional vitamin use. Separate models were fit for supplement use (yes/no) and for trimester when prenatal supplement use started.

† AOR, adjusted odds ratio; CI, confidence interval.

‡ Adjusted for age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, cigarettes/day, preconceptual body mass index, prior preterm delivery, 1st trimester bleeding and nausea, caloric intake, and preconceptional vitamin use. Separate models were fit for supplement use (yes/no) and for trimester when prenatal supplement use started.

preterm (LMP estimate) and 95.4 percent of VLBW infants were delivered very preterm. Infant LBW and VLBW also were influenced by prenatal supplement usage. Risk of infant LBW was reduced approximately twofold with supplement use during the first and/or second trimester (table 4). Diminution in risk was greater for VLBW infants, consistent with the findings on very preterm delivery. For example, after controlling for potential confounding variables and other maternal characteristics, there was approximately a sevenfold reduction in risk of VLBW with first trimester supplementation and a sixfold reduction with supplement use in the second trimester.

The diminution in risk associated with prenatal supplement use during the first and second trimesters appeared to be confined to very preterm delivery and very low birth weight outcomes. Supplement use during the first two trimesters had little influence on risk of small for gestational age births, when estimated either from the LMP or from the obstetric estimate of gestation (table 5).

Finally, preconceptional use of multivitamin/mineral supplement use appeared to have little influence on the outcome of pregnancy among Camden gravidas. When we controlled for potential confounding variables (age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, cigarettes/day, preconceptional body mass index, first trimester bleeding, gestation at entry, caloric intake, and a history of prior spontaneous abortion), the decrease in risk of very preterm delivery (LMP estimate) with preconceptional use was less than twofold (AOR = 0.59); and confidence intervals included unity (95 percent CI 0.29–1.21). For very low birth weight, the adjusted odds ratio was 1.24 (95 percent CI 0.40–3.85).

Effects of preconceptional multivitamin/mineral supplement use and prenatal use were additive. Thus, when supplements were used before pregnancy as well as during the first trimester, risk of very preterm delivery (LMP estimate adjusted for variables given above) was reduced more than sevenfold (AOR = 0.14, 95 percent CI 0.05–0.40). For very low birth weight, the values (AOR = 0.17, 95 percent CI 0.03–0.90) were approximately equivalent to first trimester use alone.

DISCUSSION

In 1988, the latest date for which information is available, women in prenatal care reported that they were almost universally advised to use prenatal multivitamin/mineral supplements (2). White pregnant women, married women, and women with more than 12 years of education were considerably more likely to comply (84–87 percent) than gravidas at risk of low micronutrient intake and poor pregnancy outcome, including women eligible for dietary supplementation through the Women, Infants, & Children (WIC) program, black women, teenage girls, and smokers (2).

TABLE 4. Use of prenatal multivitamin/mineral supplements in cases of low birth weight and very low birth weight, Camden, New Jersey, 1985–1995

Prenatal supplement use	No.	%	AOR†	95% CI†
		Low birth weight		
Yes*	1,148	9.8	0.59	0.40–0.87
No	282	16.7	1.00	
1st trimester‡	418	9.8	0.63	0.39–1.00
2nd trimester	730	9.7	0.57	0.38–0.86
No use	282	16.7	1.00	
		Very low birth weight		
Yes*	1,148	0.8	0.15	0.06–0.37
No	282	4.6	1.00	
1st trimester‡	418	0.7	0.14	0.04–0.51
2nd trimester	730	0.8	0.16	0.15–0.44
No use	282	4.6	1.00	

* Adjusted for age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, gestation at entry, cigarettes/day, preconceptional body mass index, prior low birth weight, 1st trimester bleeding and nausea, caloric intake, and preconceptional vitamin use. Separate models were fit for supplement use (yes/no) and for trimester when prenatal supplement use started.

† AOR, adjusted odds ratio; CI, confidence interval.

‡ Adjusted for age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, cigarettes/day, preconceptual body mass index, prior preterm delivery, 1st trimester bleeding and nausea, caloric intake, and preconceptional supplement use. Separate models were fit for supplement use (yes/no) and for trimester when prenatal supplement use started.

Among Camden gravidas, prenatal supplement use starting in the first or the second trimester was associated with a diminished risk of very preterm delivery and VLBW infants. Assays of circulating micronutrients contained in prenatal supplements added credence to self-reports of use during pregnancy. However, among first trimester users, it is likely that increased nausea may have interfered with supplement use, and vaginal bleeding reduced circulating levels, especially for ferritin. Diminution in risk of very preterm delivery was greater with first trimester use (four- to sixfold reduction), compared with a two- to fourfold decrease when use of prenatal supplements began in the second trimester. Risk of VLBW was decreased sevenfold with a first trimester start and sixfold when prenatal supplements were started in the second trimester. No influence of preconceptional supplement use on these outcomes was detectable.

The finding that prenatal supplement use is associated with a decreased risk of poor outcomes among low income, urban women from Camden is consistent with a growing literature on the influence of maternal micronutrient intake on the course and outcome of pregnancy. Recently, use of periconceptional folic acid-containing multivitamin/mineral supplements (400 μg/day) was recommended for all women in their reproductive years because of the reduced risk of recurrent and occurrent neural tube defects found in randomized, double-blind clinical trials (13, 14). Likewise, observational studies have suggested that among pregnant women, low folate intake from diet was associated with an increased risk of neural tube defects (15, 16). Follow-up on the infants from the Hungarian trial (13) also suggested that the preconceptional use of folic acid-containing prenatal supplements was associated with a reduced risk of two additional congenital defects: urinary tract anomalies and cardiovascular defects (17, 18). These relations have since been confirmed by other groups (19, 20). A third association, the reduced risk of orofacial clefts (21), was not found in Hungary (17, 18).

In separate epidemiologic studies, marginal folate intake and lower serum folate concentrations during pregnancy were related to increased risks of preterm delivery and infant low birth weight (6). Small, randomized studies of folic acid supplementation (in combination with iron) also suggested positive effects on gestational weight gain and duration (22).

Studies of circulating concentrations of zinc (23) or of low zinc intake during pregnancy (4) showed in-

TABLE 5. Use of prenatal multivitamin/mineral supplements in small for gestational age births based on last menstrual periods (LMPs) and obstetric estimates, Camden, New Jersey, 1985–1995

Prenatal supplement use	No.	%	AOR†	95% CI†
		LMP estimate		
Yes*	1,131	9.8	1.43	0.88–2.36
No	275	8.0	1.00	
1st trimester‡	415	9.6	1.49	0.84–2.63
2nd trimester	716	9.9	1.42	0.84–2.38
No use	275	8.0	1.00	
		Obstetric estimate		
Yes*	1,148	7.3	1.07	0.64–1.80
No	282	7.1	1.00	
1st trimester‡	418	7.9	1.22	0.67–2.22
2nd trimester	730	7.0	1.00	0.58–1.73
No use	282	7.1	1.00	

* Adjusted for age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, gestation at entry, cigarettes/day, preconceptional body mass index, prior preterm delivery, 1st trimester bleeding and nausea, caloric intake, and preconceptional supplement use. Separate models were fit for supplement use (yes/no) and for trimester when prenatal supplement use started.

† AOR, adjusted odds ratio; CI, confidence interval.

‡ Adjusted for age, parity, ethnicity, clinic pay status, inadequate weight gain for gestation, cigarettes/day, preconceptional body mass index, prior preterm delivery, 1st trimester bleeding and nausea, caloric intake, and preconceptional supplement use. Separate models were fit for supplement use (yes/no) and for trimester when prenatal supplement use started.

creased risks of infant LBW and preterm delivery with poor maternal zinc status. Clinical trials of zinc supplementation have yielded equivocal results, perhaps because of their focus on populations at risk as opposed to specific individuals at risk. However, screening low income, pregnant women for potential risk (lower plasma zinc) coupled with randomly assigning supplementation with zinc was associated with marginally increased gestation duration ($p = 0.06$) and infant birth weight (24), especially among nonobese gravidas (body mass index < 26).

Likewise, numerous studies have delineated links between maternal anemia or iron deficiency anemia early in pregnancy and increased risk of preterm delivery (5, 25), between calcium and increased risk of preeclampsia (26), and recently between gestational diabetes and nutrients that maintain pancreatic function (e.g., chromium) in the face of the insulin resistance of pregnancy (27).

With the exception of the studies cited above, information on use of supplements during pregnancy is limited (2, 28), and extant studies of the associated pregnancy outcomes are few (e.g., (29, 30)). Since prenatal multivitamin/mineral supplements are almost universally recommended for pregnant women by their providers (2), it would not be ethical to conduct a randomized trial among vulnerable gravidas (minority women from inner cities of the United States). However, the outgrowth of this is an observational study; and observational data, such as those described herein, are prone to unforeseen bias. The outcomes observed may be a consequence of intrinsically lower risk of poor pregnancy outcome among supplement users rather than an effect of multivitamin/mineral supplement use per se.

In Camden, low income gravidas at risk of poor outcome were more likely to be using multivitamin/mineral supplements before and/or during the first trimester of pregnancy. Preconceptional supplement users were more likely to have a history of spontaneous abortion and first trimester bleeding when compared with nonusers. Prenatal users, principally women whose use of multivitamin/mineral supplements dated to the first trimester, had characteristics (early bleeding, postpartum hemorrhage) suggesting that they were at higher rather than lower risk of a poor outcome. Women whose supplement use dated to the second trimester were similar in the demographic and behavioral characteristic measured to women who did not use prenatal supplements. They also demonstrated a reduced risk of very preterm delivery and very low birth weight compared with nonusers. We should be mindful of the fact that very preterm delivery, which often gives rise to very low infant birth weight, is the major cause of infant mortality in the United States and of morbidity and disability among the children who survive (31). In urban areas like Camden, an ounce of prevention may be worth a pound of cure.

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