To determine the influences of maternal diet and nutrition during pregnancy on the blood lead level of neonates, we conducted a study of mother–infant pairs from lower socioeconomic circumstances living in Albany County, New York. Maternal blood lead (MBPb), anthropometry, and diet were assessed in each trimester. Neonates' blood lead (NBpB) levels were low (geometric mean = 1.58 µg/dL), and none had elevated blood lead. More than 50% of the mothers had intakes below the recommended dietary allowances for zinc, calcium, iron, vitamin D, and kilocalories. As expected, MBPb was strong and positively related to NBpB. Among the anthropometric measures of maternal nutritional status, variables measuring gain in weight and arm circumference were negatively related to NBpB. In multivariable models reflecting different analytic strategies and including MBPb, anthropology, and sociodemographic characteristics, dietary intakes of iron and vitamin D were negatively related to NBpB. The effect of zinc varied substantially depending on model covariates. Effects of dietary constituents are difficult to distinguish, given the intercorrelated nature of nutrients in the diet. Nevertheless, the influences of maternal anthropometric variables, iron, and vitamin D on neonatal lead levels are clear in our analyses.

Key words: anthropometry, calcium, children, diet, iron, lead, neonates, nutrition, zinc.

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Measurement of blood lead. Maternal blood was drawn in each trimester during a regularly scheduled visit to the prenatal clinic and at delivery by a trained phlebotomist using a lead-free venous blood collection kit. The infant’s cord blood (3 cc) was collected in the delivery room in most cases (90%). When cord blood could not be collected, venous blood (3 cc) was drawn in the neonatal nursery within the first 3 days (except in one case, drawn on day 8). All blood lead measurements were performed by the Wadsworth Center’s Lead Poisoning/Trace Elements Laboratory, the New York State Department of Health’s reference laboratory for the test. The analytic method for blood lead determination was electrothermal atomization atomic absorption spectrometry with Zeeman background correction; it has been fully validated and described in the literature (Parsons and Slavin 1993).

Measurement of maternal diet and nutrition. During each prenatal interview, maternal diet for the month leading up to the interview was assessed using a modified version of the National Cancer Institute Food Questionnaire. The modifications allowed for reporting actual amounts consumed rather than small, medium, or large portions, and for specifying ethnic or foreign foods not included in the food list. A program was written to compute the 30-day intake of 37 macronutrients, vitamins, and minerals.

Maternal nutritional status with regard to serum Vitamin D (1,25-OH Vitamin D) was assessed in the second and third trimesters and was analyzed by Metpath Labs, Inc. (Teterboro, NJ). Maternal nutritional status also was assessed at each interview by anthropometric measures including weight, midupper arm circumference, and triceps skinfold thickness. Height and biaxicondylar breadth of the humerus were measured once at the first prenatal visit. The latter measurement is an index of skeletal frame size (Frisancho and Flegel 1983). All measurements were made by one of the authors (L.M.S.) and nurses or graduate research assistants trained by that author using standard, published protocols (Cameron 1986; Lohman et al. 1988). Retraining sessions were performed at approximately 6-month intervals. Prepregnancy weight was obtained from the medical chart based on subject recall.

The sample. Of the 317 eligible women, 71 terminated their pregnancies, discontinued participation, moved, or transferred care to another facility. In addition, blood from 26 newborns was not drawn at delivery for no medical reason, or was clotted and unanalyzable. These losses to the study left 220 newborns with a measured blood lead level at the time of delivery; thus, 220 is the maximum number used for analyses of relationships among mothers’ and newborns’ lead levels. This sample differs slightly from that used in a previous analysis of APILS data (Schell et al. 2000) because the previous analysis required two consecutive maternal blood lead levels during pregnancy. The blood lead levels of the sample mothers do not differ significantly from those excluded (n = 97) during pregnancy or at delivery; excluded mothers had marginally higher second-trimester blood lead levels than included mothers (2.2 µg/dL and 2.0 µg/dL, respectively), though this difference was not statistically significant.

The sample (n = 220) is described in Table 1. Of the 220 mothers, nearly half identified their ethnicity/race as African-American. The median age of the women at time of enrollment was 22.6 years, and 31% of the women were 19 years of age or younger. Mean ages of women did not differ by ethnicity/race. Of the 220 mothers, 59% had completed high school, but 5% had not begun high school; 18% had one or more years of college. Most women (81%) had never been married or were separated or divorced. Median gravidity was three pregnancies, and median parity was one live birth. Sixty percent of the women reported that they were unemployed at the time of their first study visit. Forty-one percent reported that they had been unemployed during the 6 months preceding their first study visit (i.e., 1–5 months before they became pregnant, depending on when in the pregnancy they entered the study). Of the women who worked, most found employment in service occupations in which the hourly pay scale was near minimum wage.

For the analyses of relationships between maternal lead level during pregnancy and the blood lead level of the neonate, the sample sizes are reduced because of missing maternal blood lead observations. For further analysis of the relationship between dietary items and neonatal lead levels, the sample was restricted to those mother–neonate pairs with neonatal blood lead and dietary data available from interviews in all trimesters (n = 89). In two cases missing prepuberty body mass index (BMI; weight in kilograms/height in square centimeters) was predicted by regressing other maternal anthropometric measurements on prepuberty BMI for the sample of 220 (r² = 0.96). Six additional cases were missing maternal lead levels and these could not be predicted well by multivariate regression, leaving a sample size of 83. These 83 subjects did not differ from excluded subjects (n = 137) in second or third trimester weight; first-, second-, or third-trimester arm circumference or tricip skinfold thickness; maternal age; height; biaxicondylar breadth of the humerus; prepuberty weight or BMI; rate of arm circumference change from the first to second, first to third, or second to the third trimesters; ethnicity/race; education; marital status; first-, second-, and third-trimester intakes of fat, iron, and kilocalories; first- and second-trimester intakes of zinc, protein, vitamin D, and calcium; maternal lead level at birth; or newborn blood lead concentration. Excluded subjects had a lower first-trimester weight than did the 83 included subjects. Maternal intakes of zinc, protein, vitamin D, and calcium in the third trimester were significantly higher among excluded mother–infant pairs.

Data analysis methods. Blood lead concentrations were log transformed due to non-normal distributions. We first determined the relationships between newborn lead level and maternal factors (sociodemographic variables, biochemical measures of nutritional status, and maternal anthropometry) through bivariate analysis. Before testing, we noted that years of education are closely related to age in the subsample of women < 19 years of age (r = 0.67, p < 0.001, n = 46). We constructed an education index (EI) of age-appropriate education that is independent of age (r = 0.06, p = 0.397, n = 220) but closely related to maternal education (r = 0.96, p < 0.001, n = 220). For persons < 19, EI = years of education + 6/age, and expresses the degree to which they are below or ahead of the age-appropriate year of schooling up to the completion of high school. For persons ≥ 19 years of age, presumably old enough to have completed high school, EI = years of education + 6/18 (18 is the age by which a person should have completed high school, allowing for one
In this sample, averaging intakes considerably reduced the variance of dietary intake measures. The variance of the averaged intakes of calcium, iron, fat, kilocalories, vitamin D, and zinc was, on average, only 58% of the individual trimester values.

**Results**

Blood lead concentrations in this sample are low (Table 2). None of the newborns and only one mother had a blood lead concentration > 10 µg/dL in any single test. The effect of ethnicity/race is evident: African-American mothers and newborns have significantly higher blood lead concentrations than white mothers and newborns, except in the second trimester.

The strongest predictors of newborn blood lead concentration are maternal blood lead concentration in the first, second, and third trimesters and at delivery, as well as the change in maternal blood lead levels from the second trimester to delivery (Table 3). When the sample is restricted to mother–infant pairs with data on blood lead levels in every trimester and at delivery ($n = 79$), the correlation coefficients are similar to or greater than those presented in Table 3 (data not shown). The correlation between mother’s blood lead concentrations and the newborn’s is similar in the African-American and white subsamples in every trimester but the first, where sample sizes also are the smallest. Infant blood lead levels are slightly, though significantly, lower than their mother’s among both African-American and white subsamples. The transfer of blood lead is similar between the two subsamples when the higher level of blood lead in African-American mothers is taken into account. The difference between mother’s and child’s blood lead level expressed as percent of the mother’s is 19% for whites and 25% for African Americans (a nonsignificant difference).

**Effects of maternal nutrition/anthropometric characteristics on newborn blood lead concentration.** Several anthropometric measures of maternal nutritional status are related to newborn lead level. Greater rates of gain in maternal weight and arm circumference during the pregnancy are associated with lower blood lead concentration in the newborn (Table 4). Weaker, positive associations exist between blood lead concentrations in the newborn and several other measures of maternal size: prepregnancy BMI, prepregnancy weight, second-trimester arm circumference, and triceps skinfold thickness (Table 4). The correlations among these variables for the white and African-American subsamples are similar in direction and most are similar in magnitude to the correlations for individual trimester values.

| Maternal lead | Total sample | Whites | African Americans |
|---------------|--------------|--------|--------------------|
| Trimester 1   | r            | p-Value | No. |
|               | 0.66         | < 0.001 | 94  |
| At delivery   | r            | p-Value | No. |
|               | 0.81         | < 0.001 | 211 |
| Change: second trimester to delivery | r | p-Value | No. |
|               | 0.37         | < 0.001 | 201 |

| Newborn lead level at birth | Total sample | Whites | African Americans |
|-----------------------------|--------------|--------|--------------------|
| Trimester 1                 | r            | p-Value | No. |
|                           | 0.53         | < 0.001 | 209 |
| At delivery                | r            | p-Value | No. |
|                           | 0.77         | < 0.001 | 211 |
| Change: second trimester to delivery | r | p-Value | No. |
|                           | 0.32         | < 0.001 | 201 |

| Table 2. Geometric mean (GM) of maternal blood lead measurements during pregnancy and infant’s blood lead measurement at birth. |
|-----------------------------------------------------------------------------------------------------------------------------------|
| Lead (µg/dL) | No. | GM ± SD | Maximum | GM ± SD | Maximum | GM ± SD | Maximum | Race/ethnicity t-test (p-value) |
|-------------|-----|---------|---------|---------|---------|---------|---------|-----------------------------|
| Trimester 1  | 94  | 1.9 ± 1.68 | 12.9    | 1.6 ± 1.25 | 3.8     | 2.2 ± 1.61 | 7.5     | −3.06 (0.003)               |
| Trimester 2  | 209 | 1.8 ± 1.63 | 10.4    | 1.6 ± 1.65 | 7.6     | 1.8 ± 1.62 | 6.6     | −1.92 (0.056)               |
| Trimester 3  | 198 | 1.8 ± 1.65 | 9.4     | 1.5 ± 1.73 | 3.8     | 2.0 ± 1.54 | 7.5     | −3.86 (<0.001)             |
| Delivery (mother) | 211 | 2.2 ± 1.72 | 11.2    | 1.8 ± 1.72 | 5.6     | 2.5 ± 1.67 | 8.8     | −4.13 (<0.001)             |
| Delivery (infant) | 220 | 1.6 ± 1.78 | 6.9     | 1.3 ± 1.75 | 4.0     | 1.8 ± 1.79 | 6.5     | −3.10 (0.002)               |

*Not log transformed. #Test comparing lead levels in white and African-American subsamples."
the sample as a whole, except for the effect of second-trimester triceps skinfold and the EI in the white subsample. The two anthropometric measures of skeletal size, maternal height, and biepicondylar breadth of the humerus are unrelated to newborn blood lead level. Other maternal anthropometric measures are unrelated to newborn lead level (data not shown): arm circumferences and triceps skinfolds in the first and third trimesters; maternal weight in the first, second, and third trimesters; rate of change in maternal triceps skinfold across all trimesters; rate of change in maternal weight and arm circumference from the first to second trimester.

Effects of maternal dietary intakes on newborn blood lead concentration. Among women with nutrient intake data for each trimester ($n = 83$), mean dietary intakes were significantly lower than the recommended dietary allowances (RDAs) for iron and vitamin D, significantly higher than the RDA for protein, and not significantly different from the RDAs for total caloric intake, calcium, and zinc (Table 5). More than 50% of women were below the RDA for zinc, calcium, iron, vitamin D, and kilocalories.

The first multivariable model, controlling for all other nutrients, shows significant negative relationships between neonatal blood lead and maternal intakes of iron and calcium, but not zinc, protein, or fat (Table 6). When vitamin D is substituted for calcium in the model, the results are similar [vitamin D: $\beta$ coefficient $= -0.013$ (SE $= 0.007$, $t = -1.98$, $p = 0.051$)]. The second multivariable model in which kilocalories are controlled and other nutrient is entered into the model produces very similar results (Table 7) in terms of direction of effect and magnitude ($\beta$ coefficients) for the effects of iron, vitamin D, and calcium except that zinc is a predictor of neonatal lead level in this analysis.

Serum ferritin, serum vitamin D, and the use of supplements were not significant covariates in either multivariable model (data not shown), nor were they significant in bivariate analyses used for model construction.

To estimate the impact of changes in maternal intake of significant micronutrients, we calculated change in newborn lead with changes in maternal intake of iron, calcium, and vitamin D, from one standard deviation below the mean intake to one standard deviation above it, using the model and sample described in Table 6. Among these nutrients, maternal iron intake has the largest impact on newborn lead. A two–standard-deviation decrease in iron (from 30.2 to 11.8 mg) is associated with a 0.51 µg/dL increase in newborn lead (29% of the mean of newborn lead, 1.72 µg/dL, $n = 83$). A two–standard-deviation reduction in calcium (from 1,778 to 583 mg) is associated with an increase of 0.26 µg/dL in newborn lead (15% of the mean of newborn lead), whereas a two–standard-deviation reduction in maternal vitamin D intake, from 10.5 to 2.4 mg, is associated with a 0.18 µg/dL increase in newborn lead, 10% of the mean of newborn lead.

Discussion

Although many of the variables that affect lead levels are difficult to change, maternal diet is potentially modifiable, especially during pregnancy when there may be a supportive environment for maternal and fetal health. However, determining dietary effects of specific nutrients is complicated by covariance among nutrients and wide variation in dietary intake due to intraindividual fluctuation and measurement error. The effect of the latter is apparent in our sample. For any nutrient, the variance of individual trimester intakes is close to twice the variance of the average of the three trimester intakes. The effect of averaging intakes is clear in the APILS sample: Individual nutrient intakes in any trimester are unrelated to newborn lead level in the sample with incomplete dietary data but also in the subsample of 83 mothers with complete dietary data used in our analysis. However, when the intakes across all trimesters are averaged and variances reduced, we observe the relationships reported here.

We employed two analytic approaches to deal with covariance among nutrients, and the results are consistent in both direction and magnitude. After adjustment for control variables (including maternal lead levels), higher maternal iron, calcium, and vitamin D intakes are related to lower newborn lead levels. Evidence for an impact of maternal zinc intake is equivocal. The effect of zinc intake may be absent in the analysis that includes other nutrients as covariates because of its high correlation with protein intake ($r = 0.89$, $p < 0.001$). The near universal use of dietary supplements in the sample used for the analysis of diet (78 of 83 mothers) suggests that the effects of dietary iron, calcium, and vitamin D seen here were not biased by differential supplement use. The lack of variability in supplement use also indicates that the absence of its statistical significance in either multivariable model is not a true test of its biologic effect.

Anthropometric measures of maternal nutritional status have a very strong and consistent effect on neonatal lead level: Measures of soft tissue size are positively related to higher newborn lead, whereas measures of gain (e.g., arm circumference during the later half of pregnancy) are related to lower newborn lead concentration. Because heavier women are unlikely to gain as much weight and arm circumference as smaller ones, gain becomes an especially

### Table 4. Bivariate correlations (Pearson correlation coefficients) of newborn blood lead concentration at birth to maternal characteristics.

| Maternal variable       | No. | All ethnicities/races | White | Black |
|-------------------------|-----|-----------------------|-------|-------|
|                         |     | $r$ (p-value)         | $r$ (p-value) | $r$ (p-value) |
| Age                     | 220 | 0.28 (< 0.001)        | 0.25 (0.038)  | 0.33 (0.001)  |
| EI                      | 220 | -0.20 (0.033)         | 0.26 (0.038)  | -0.07 (0.522) |
| Arm circumference: 2nd trimester | 216 | 0.16 (0.023)         | 0.22 (0.077)  | 0.20 (0.043)  |
| Triceps skinfold: 2nd trimester | 216 | 0.15 (0.033)        | 0.03 (0.781)  | 0.24 (0.014)  |
| Prepregnancy weight     | 213 | 0.16 (0.021)         | 0.19 (0.121)  | 0.16 (0.104)  |
| Prepregnancy BMI         | 213 | 0.19 (0.007)         | 0.18 (0.147)  | 0.21 (0.039)  |
| Maternal weight rate of change: trimesters 1–3 | 94 | -0.31 (0.002) | -0.32 (0.006) | -0.19 (0.210) |
| Maternal weight rate of change: trimesters 1–3 | 206 | -0.32 (< 0.001) | -0.24 (0.066) | -0.38 (< 0.001) |
| Maternal arm circ rate of change: trimesters 1–3 | 94 | -0.21 (0.045) | -0.22 (0.213) | -0.22 (0.151) |
| Maternal arm circ rate of change: trimesters 2–3 | 206 | -0.32 (< 0.001) | -0.46 (< 0.001) | -0.27 (0.007) |

*Arm circumference.*

### Table 5. Average nutritional intakes of women across three trimesters of pregnancy ($n = 83$), compared with the 1989 recommended dietary allowances.

| Nutrients       | Mean ± SD | Minimum | Maximum | No. | Percent | RDA |
|-----------------|-----------|---------|---------|-----|---------|-----|
| Calcium (mg)    | 1180.7 ± 597.29 | 267.3 | 2817.0 | 50 | 60 | 1,200 |
| Vitamin D (mg)  | 6.4 ± 4.02 | 0.5  | 21.9  | 69 | 83 | 10  |
| Iron (mg)       | 21.0 ± 9.18 | 6.7  | 55.6  | 69 | 83 | 30  |
| Zinc (mg)       | 13.7 ± 6.09 | 3.6  | 34.8  | 57 | 69 | 15  |
| Protein (g)     | 93.8 ± 44.45 | 23.9 | 272.0 | 16 | 19 | 60  |
| Calories (kcal) | 2675.5 ± 1081.47 | 917.9 | 6394.1 | 45 | 54 | 2,500 |
| Fat (g)         | 98.6 ± 43.70 | 22.0 | 246.6 |     |       |     |
important and modifiable characteristic among smaller women. The relationship of maternal size to neonatal lead level mirrors the positive relationship of maternal caloric intake to neonatal lead level seen in our dietary analysis. The anthropometric measures of skeletal frame size (height and biepicondylar breadth) are not related to neonatal lead levels, suggesting that the size of the skeletal mass as a compartment for lead storage does not affect the transmission of lead from mother to fetus.

Our analysis of maternal diet provides new information on nutrient–lead interactions because it pertains to the transfer of lead from mother to fetus whereas most published research examines relationships of dietary intake and lead levels in either adults or children. In the APILS sample, higher maternal intakes of iron are associated with lower neonatal lead levels, a finding consistent with results from both experimental animal studies (Barton et al. 1978; Crowe and Morgan 1996; Hamilton 1978; Hashmi et al. 1989a, 1989b; Klauder and Petering 1975; Mahaffey-Six and Goyer 1972; Ragan 1977; Shukla et al. 1990; Singh et al. 1991; Suzuki and Yoshida 1979) and human studies (Cheng et al. 1998; Hammad et al. 1996; Mahaffey and Amnest 1986; Markowitz et al. 1990; Szold 1974; Watson et al. 1980, 1986; Wright et al. 1999; Yip et al. 1981; Yip and Dallman 1994) that have shown negative associations between iron intake or iron status and blood lead levels. Despite this negative relationship between maternal dietary iron and infant lead levels, we found no significant association between mother’s iron stores (serum ferritin) and newborn’s blood lead levels in bivariate or multivariate analysis (data not shown), mirroring the results of Milman and colleagues (1988). Because 83% of dietary iron intakes in our sample were less than the RDA for pregnant women, our findings refer most closely to gravidae with suboptimal iron intakes.

Maternal dietary calcium and neonatal blood lead are inversely related in the APILS sample. These findings are consistent with results from carefully conducted cross-sectional studies finding higher calcium intakes related to lower lead levels (Cifuentes et al. 2000; Farias et al. 1996; Goyer 1997; Han et al. 2000; Hernandez-Avila et al. 1996; Hertz-Picciotto et al. 2000; Koistial et al. 1991; Mahaffey et al. 1986; Miller et al. 1990). In a longitudinal study of mother–neonate lead levels in Mexico (Rothenberg et al. 1996), greater maternal milk consumption during pregnancy was associated with lower neonatal lead. Thus, calcium intake appears to be related to lead both at low maternal lead levels, as in the APILS sample, and at higher levels, as in the Mexican sample. Whether the effect of calcium is present across the range of calcium intake or is confined to mothers with intakes lower than the RDA could not be resolved here because the small size of the APILS sample precluded testing effects in subsamples below or above the RDA for calcium. Hertz-Picciotto and colleagues (2000) found an effect of calcium above the RDA, but other studies have not investigated this or have not found it.

The similar effects of maternal dietary calcium and vitamin D on neonatal lead levels that we observe in the APILS sample are reasonable, given the coincidence of sources of both nutrients in maternal diets (reflected in the high correlation between them). Our results also are consistent with the finding that adjustment for vitamin D levels removes the effect of calcium on blood lead of a sample of mature men (Cheng et al. 1998).

Our results show that calories are positively related to lead level. Insofar as diet serves as a major vehicle for the ingestion of lead in the United States, our finding is consistent with calories’ being an indicator of dietary quantity. This finding also agrees with several other studies with multivariable analyses that take other nutrients into account (Hammad et al. 1996; Lucas et al. 1996) although it does not agree with all (Mahaffey et al. 1986; Mooy et al. 1975).

Our findings that maternal lead levels during pregnancy are strongly related to neonatal lead level are consonant with previously published studies (Amiati et al. 1999; Angell and Lavery 1982; Campagna et al. 1999; Carbone et al. 1998; Chang et al. 2001; Dietrich et al. 1987; Graziano et al. 1990; Lauwers et al. 1978; McMichael et al. 1988; Nashashibi et al. 1999; Navarrete-Espinosa et al. 2000). The correlation in the APILS sample between maternal and neonatal lead levels at parturition is well within the published range from 0.36 (Amiati et al. 1999) to 0.92 (Graziano et al. 1990). The strong relationship between maternal lead levels and ethnicity/race in the APILS sample is consistent with the distribution of lead levels in the United States. Further, this relationship is reflected in the multivariate analyses where ethnicity/race is not significantly related to neonatal lead when maternal lead levels also are in the model. This reflects the difference in lead levels by maternal ethnicity/race. The large impact of maternal blood lead levels points to the need for interventions before pregnancy to reduce lead transmission from mother to offspring.

Managing maternal diets during pregnancy to ensure intakes of calcium, vitamin D, and iron at or above the RDA is warranted by our results. For example, a two-standard-deviation increase in the intake of iron and calcium resulted in a decrease in newborn blood lead level of 0.77 µg/dL or 45% of the mean.

Table 6. Relationship of maternal nutrition, anthropometry, lead levels, and diet to newborn’s blood lead level.

| Terms                      | β coefficient | β SE  | Standardized β | t Value | p Value |
|----------------------------|---------------|-------|----------------|---------|---------|
| Constant                   | −0.473        | 0.269 | 0.07           | −1.76   | 0.083   |
| Age                        | 0.005         | 0.004 | 0.02           | 0.01    | 0.987   |
| Education index            | 0.095         | 0.229 | 0.02           | 0.41    | 0.680   |
| Ethnicity/race (black = 1) | −0.009        | 0.045 | −0.01          | −0.20   | 0.846   |
| Prepregnancy BMI           | 0.008         | 0.005 | 0.13           | 1.63    | 0.109   |
| Triceps skinfold: second trimester | −0.008      | 0.004 | −0.17          | −2.14   | 0.039   |
| Arm circ rate of change: trimester 2–3 | −2.989      | 0.888 | −0.14          | −3.37   | 0.001   |
| Lead at delivery (µg/dL)   | 0.798         | 0.081 | 0.82           | 13.05   | 0.000   |
| Lead at second trimester (µg/dL) | 0.112      | 0.059 | 0.11           | 1.88    | 0.065   |
| Caloric intake (kcal)      | 0.0003        | 0.0001 | 0.63    | 3.65    | 0.001   |
| Iron intake (mg)           | −0.016        | 0.008 | −0.30          | −2.10   | 0.040   |
| Calcium intake (mg)        | −0.0001       | 0.0001 | −0.15         | −2.08   | 0.042   |
| Zinc intake (mg)           | −0.0005       | 0.012 | −0.01          | −0.04   | 0.969   |
| Fats intake (g)            | −0.002        | 0.001 | −0.22          | −1.78   | 0.079   |
| Protein intake (g)         | 0.0002        | 0.002 | 0.13           | 0.897   | 0.367   |

Table 7. Relationship of maternal dietary intakes during pregnancy to newborn’s blood lead level: effects of single dietary variables when added to the core model of control variables.

| Core model plus single nutrient | β coefficient | β SE  | Standardized β | t Value | p Value |
|--------------------------------|---------------|-------|----------------|---------|---------|
| Maternal iron intake (mg)      | −0.014        | 0.005 | −0.26          | −3.06   | 0.003   |
| Maternal zinc intake (mg)      | −0.022        | 0.007 | −0.27          | −3.24   | 0.002   |
| Maternal vitamin D intake (mg) | −0.014        | 0.007 | −0.11          | −2.11   | 0.038   |
| Maternal fats intake (g)       | −0.002        | 0.001 | −0.17          | −1.21   | 0.100   |
| Maternal protein intake (g)    | −0.002        | 0.001 | −0.22          | −1.69   | 0.096   |
| Maternal calcium intake (mg)   | −0.0001       | 0.0001 | −0.12         | −1.73   | 0.088   |

The core model controls for age, education index, ethnicity/race, prepregnancy BMI, second-trimester triceps skinfold, rate of change of arm circumference from the second to third trimester, and mother’s blood lead at delivery and during the second trimester.

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neonatal level. A further opportunity for lowering lead levels by adjusting nutrient intakes may occur during infancy, and a future report from this data set will address this problem.

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