Maternal Blood Lead Concentration, Diet During Pregnancy, and Anthropometry Predict Neonatal Blood Lead in a Socioeconomically Disadvantaged Population

Lawrence M. Schell,[1] Melinda Denham,[2] Alice D. Stark,[3] Marta Gomez,[3] Julia Ravenscroft,[2] Patrick J. Parsons,[4] Aida Aydermir,[5] and Renee Samelson[6]

[1]Department of Epidemiology, and [2]Department of Anthropology, University at Albany, State University of New York, Albany, New York, USA; [3]Bureau of Environmental and Occupational Epidemiology, New York State Department of Health, Troy, NY, USA; [4]Lead Poisoning/Trace Elements Laboratory Wadsworth Center, New York State Department of Health, Albany, New York, USA; [5]Department of Biostatistics, University at Albany, State University of New York, Albany, New York, USA; [6]Department of Obstetrics and Gynecology, Albany Medical Center, Albany, NY, USA

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 strongly 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 strageties and including MBPb, anthropometry, 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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The average blood lead concentration among young children in the United States has decreased markedly since 1980 (Brody et al. 1994; Pirkle et al. 1994); but in many inner-city, socioeconomically disadvantaged communities, worrisome numbers of children continue to be diagnosed with elevated lead levels (Brown et al. 2000; Centers for Disease Control and Prevention 2001; LaFlash et al. 2000; Litaker et al. 2000). Lead is related to adverse health effects in children including interference with neurobehavioral development, reduced physical growth, impaired heme synthesis, kidney and liver failure, seizures, and even death (ATSDR 1988).

A child's lead burden begins before birth with lead transferred from maternal circulation and increases rapidly in the first few years of life, as exposure to environmental lead increases (ATSDR 1988; Brody et al. 1994; Pirkle et al. 1994). During pregnancy, lead is liberated from the maternal skeleton (Gulson et al. 1997) and transferred from mother to child *in utero*. It is useful to know the factors that may influence this transfer in order to manipulate them and reduce fetal exposure and its effects. Although many risk factors for lead exposure such as past maternal education or race/ethnicity cannot be altered, maternal diet during pregnancy and nutritional status can be. The goal of this investigation is to determine the influence of these two factors on the concentration of blood lead in the newborn in a socioeconomically disadvantaged population at risk for lead exposure.

Materials and Methods

The Albany Pregnancy Infancy Lead Study (APILS), a prospective, longitudinal study, was initiated to address the question of nutrient–lead interaction and to explore the impact of early lead concentration on infant growth and development (the subject of other reports). The study was conducted in two phases that differed in follow-up protocol and lead concentration measurement methods: phase one from 1986 to 1992 and phase two from 1992 to 1998; both phases have been described elsewhere (Schell et al. 1997, 2000). This report is based on data from the second phase. All procedures for both studies were reviewed and approved by the Institutional Review Boards of the New York State Department of Health, Albany Medical Center and the State University of New York at Albany. Informed consent was obtained before data collection.

Data collection and sample recruitment. The APILS sample was drawn from a socioeconomically disadvantaged population of pregnant women at risk for lead exposure due to poverty, urban residence in old, dilapidated housing, and close proximity to industrial and vehicular emissions. Pregnant women were recruited into the study if they sought prenatal care at either the Albany County Department of Health (ACDH) Clinic or the Albany Medical Center (AMC) Obstetrics Clinic. Once enrolled, a woman was seen for a study visit once during each trimester of her pregnancy. To be eligible for the study, a participant must *a*) have been a resident of Albany county; *b*) have been eligible for the Women, Infants and Children program (WIC; < 185% of poverty level); *c*) have been pregnant < 24 weeks; *d*) have planned to use either the ACDH or AMC clinics for prenatal care for at least two of the three trimesters of pregnancy (depending upon the timing of entry into the study); *e*) have permitted a cord blood sample to be taken; and, *f*) have planned to deliver at AMC and have the child followed at the ACDH or AMC pediatric clinic. Potential participants were excluded if they *a*) already had a child in the study; *b*) were unable to complete interviews in English (indicating insufficient linguistic ability to complete the cognitive performance assessment on maternal IQ tests needed to interpret infant development measures); *c*) were high-risk pregnancies (these were referred by clinic staff to a specialized clinic); or *d*) were pregnancies involving multiple fetuses. Newborns were not excluded on the basis of APGAR score or infant size. The sample used in this study represents all the participants recruited into the study between September 1992 and October 1998, when recruitment was completed.

Address correspondence to L.M. Schell, A&S 237, University at Albany, State University of New York, 1400 Washington Ave. Albany, NY 12222 USA. Telephone: (518) 442-4714. Fax: (518) 442-4563. E-mail: l.schell@albany.edu

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