Main and Interaction Effects of Metallic Toxins on Classroom Behavior

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This study investigated the relationships of metal levels and metal combinations to children's classroom behavior. Hair-metal concentrations of lead, arsenic, mercury, cadmium, and aluminum were determined in 80 randomly selected elementary-age children, who were also rated by their classroom teacher on the Walker Problem Behavior Identification Checklist (WPBIC). Parents were interviewed to control for confounding variables that may have affected behavioral development. Regression analysis indicated that the set of metals was significantly related to increased scores on four of the five WPBIC subscales and on the total scale, with lead being a major contributor to four of the six dependent measures. Metal combinations were significantly related to increased scores on the WPBIC subscales measuring acting-out, disturbed peer relations, and immaturity, and on the total scale. A continuing reexamination of metal poisoning concentrations is needed because metal levels and metal combinations previously thought harmless may be associated with nonadaptive classroom behavior.

It is well established that children exposed to high doses of lead are subject to behavioral deficits resulting from damage to the central nervous system. A source of considerable debate, however, is whether low doses of lead are an etiologic agent in behavioral disorders (Rutter, 1980). Although limited by methodological errors, previous studies have linked low lead levels with...
hyperactivity and attention deficits (David, Clark, & Voeller, 1972; David, Hoffman, & Sverd, 1976; Wiener, 1970), school failure due to learning and behavioral problems (de la Burde & Choate, 1975), negative ratings by teachers on classroom behavior (Needleman et al., 1979), and mental disorders (Albert et al., 1974). Among the methodological errors of earlier studies has been the inadequate identification and handling of confounding genetic, perinatal, and socioeconomic variables affecting development. Additionally, previous studies have failed to account for the influence of other toxic metals on lead-dose behavioral response measures. Although largely unexplored, low levels of arsenic, cadmium, and aluminum have been recently linked to childhood behavioral decrements (Marlowe, Errera, Ballowe, & Jacobs, 1983; Phil & Parkes, 1977), and some investigators have hypothesized that metal-metal combinations may have an interactive effect, thereby increasing the total toxicity of the child's system.

The purpose of this study was to deal with these design issues while measuring the relationships between lead and other individual metal levels and metal combinations and teachers' ratings of children on the Walker Problem Behavior Identification Checklist (Walker, 1976). It was hypothesized that as children's individual metal levels and metal combinations increased, their scores on the problem behavior rating scale would increase.

METHOD

Subjects

The 80 subjects were randomly drawn from grades 1 through 6 at three elementary schools in the rural southeastern region of Wyoming: University School, a teacher training laboratory school of the University of Wyoming, Laramie, and two public schools in Cheyenne.

Control of Confounding Variables

Parents of subjects were interviewed via questionnaire or telephone in order to identify and control for the following confounding variables effecting behavioral development: mother and father's age at subject's birth, history of immunizations against childhood diseases, number of hospital admissions since birth, history of pica, presence of father in the home, and mother and father's occupation and level of educational attainment. In addition, each child's school record was reviewed to determine whether there was a known or highly probable medical reason for a behavioral deficit, e.g., neurological distur-