PERGAMON

Social Science & Medicine 56 (2003) 1073–1085

SOCIAL SCIENCE & MEDICINE

www.elsevier.com/locate/socscimed

A community-based assessment of learning disabilities using environmental and contextual risk factors

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Abstract

Childhood placement in learning disability (LD) programs in the USA has tripled over the last few decades to 6% of all children enrolled in the public schools today. The revision of educational laws to improve LD testing and reporting guidelines has been credited for these trends. However, some researchers also believe that the increase in LD incidence may be due, in part, to chronic low level exposure to toxicants such as lead, heavy metals, solvents and others chemicals in the physical environment. This study employs the use of geo-statistical methods to explore the potential linkages between these pollution sources and the prevalence rates of LD within an urbanized environment, in the USA. The role of contextual factors such as housing quality, poverty, low parental educational achievement, and other disadvantages are also examined. Using primary data on childhood disabilities for 1997, the LD cases were queried and analyzed to identify the spatial clusters within the community. The neighborhoods within the LD clusters were then compared to other areas in the community on the basis of the environmental and contextual risk factors. The results confirmed that areas of high risk for LD were strongly associated with historically significant sources of lead toxicity and air pollution facilities. Among the socio-economic indicators, the high-risk neighborhoods were characterized by multiple/subdivided housing units, poverty, higher percentage of residents on public assistance and lower adult educational attainment. Taken together, these results suggest the need for a more inclusive multi-disciplinary research on LD that extends beyond the classroom context to the neighborhoods and communities in which these children reside.

Keywords: Learning disabilities; Environmental health; Geo-statistics; USA

1. Introduction

Since the passage of the Individuals with Disabilities Education Act (IDEA) in 1975, followed by subsequent revisions in 1990 and 1997, childhood placement in special education programs has increased considerably, at a pace that is even faster than the rate of public school enrollment. Specifically, between 1977 and 1995, the number of children participating in special education programs increased 47% when compared to a 2% reduction in total enrollment in public schools in the USA (US Department of Education, 1997). Nearly half of the children in these special programs are diagnosed with learning disabilities (MacMillan, Gresham, & Bocian, 1998). The prevalence of learning disability cases has tripled over the last few decades to approximately 6% of all children enrolled in public schools today.

Some researchers have attributed the upward trend in learning disabilities (LD) to changes in assessment methods and eligibility criteria across school districts and state educational agencies (Kidder-Ashley, Deni, & Anderton, 2000). Educational laws that now require better diagnostical measures and mandatory reporting guidelines are credited not only for these placement trends but also for bringing attention to a problem that was previously under-estimated in schools (Hallahan, 1992). This dramatic increase in LD has also prompted

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0277-9536/03/$ - see front matter
PII: S0277-9536(02)00104-1

new questions about the underlying causes with specific concerns about the contributory role of environmental toxicants. Some researchers now believe that the prevalence in learning disabilities may be due, in part, to chronic low level exposure to environmental contaminants such as lead, combustion products, heavy metals, pesticides, solvents and other toxicants (Landrigan et al., 1998, 1999; Preston, Warren, Wooten, Gragg, & Walker, 2001; Schneider & Freeman, 2001).

The purpose of this study is to pursue the potential linkages between environmental pollution and the cognitive and behavioral development of children in a socio-spatial framework. More precisely, this study employs the use of geo-statistical methods to examine the relationships between the sources of environmental toxicants and the prevalence of LD within an urbanized environment. The role of contextual factors such as poor housing quality, poverty, low parental educational achievement and other disadvantages are also examined as mediators in explaining the distribution of the cases within a given community.

The rationale for this study is based on existing literature which documents the potential impact of neurotoxins, such as lead, polychlorinated biphenyls (PCBs) and other chemicals, on childhood development (Needleman, Schell, Bellinger, Leviton, & Allred, 1990; Jacobson, Jacobson, & Humphrey, 1990; Bellinger, Stiles, & Needleman, 1992; Baghurst et al., 1992; Sciarillo, Alexander, & Farrell, 1992; Stiles and Bellinger, 1993; Margai, Walter, Frazier, & Brink, 1997; Preston et al., 2001). However, this study shifts away from the clinical assessment of LD cases to a macroscale level of analysis that focuses on neighborhoods and communities. Several studies conducted in the past were based on an individualized (or so-called case management) approach whereby subjects are monitored closely, over an extended period of time, to document the health and developmental outcomes. In contrast, emphasis in our study is placed on groups of children in different neighborhoods to allow for the identification of potential clusters of high-risk populations, an approach that was initially proposed by Wartenberg (1992). Such an approach is particularly useful for the prediction of LD cases, which has been shown to be more accurate for groups than for individuals within groups (Keogh & Weisner, 1993). The shift away from individual cases to group-based identification is also useful for educational planning, prioritizing and environmental decision-making. An integrative approach that combines LD prevalence with potential risk factors will undoubtedly assist in community intervention strategies whereby high-risk neighborhoods or school districts will be prioritized for LD services and intervention programs. From an environmental health perspective, this approach will also assist in primary prevention efforts that focus on source reduction and hazard abatement activities in communities. Previous studies, for example, have combined geographic information systems (GIS) and statistical methods to identify pediatric health hazards such as lead poisoning, and the results have been used to promote risk reduction and remediation efforts (Shinn, Bing-Canar, Cailas, Peneff, & Binns, 2000) . To date, however, no attempt has been made to extend the use of these tools in characterizing the far-reaching health consequences of these chemicals on children, particularly in terms of LD and other developmental impairments. This study takes a step in that direction by examining the spatial aspects of LD, and then investigating the associative effects of polluting sources and socio-economic characteristics of the neighborhoods in which the children reside. Along these lines, the following questions will be addressed: (1) What is the spatial pattern of occurrence of LD in a given community? (2) Are there any environmental risk factors that contribute significantly to the distribution of these cases? (3) What are the underlying social, economic and ethnic attributes of the high-risk areas? Do these serve as mediating factors or confounders in explaining the existing patterns?

The rest of the paper is divided into four sections. First, a concise background of learning disabilities is provided as a precursor and basis for variable selection in the empirical study. This is followed by discussion of the research design and methodology. In the results section, the spatial distribution of LD cases are presented along with statistical measures that reflect the relative contribution of environmental and socio-economic indicators in explaining the distribution of the health outcomes in the community. The last section summarizes the research findings and provides some suggestions for future investigations.

Learning disabilities research: environmental and contextual risk factors

Part of the complexity in grappling with LD lies in the myriad of definitions that have been utilized in the past by governmental agencies and various advocacy groups and organizations (Macmillan et al., 1998). The most widely used definition, however, was first proposed by the National Joint Committee on Learning Disability (NJCLD). This describes LD as "a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities or social skills" (NJCLD, 1987, p. 1). Some have proposed further that any definition and subsequent classification of LD cases must not only capture these multiple dimensions of the problem but also accommodate data from several disciplines including the physical and