Available online at www.sciencedirect.com
SCIENCE DIRECT®
Int. J. Hyg. Environ.-Health 209 (2006) 57–64
International Journal of Hygiene and Environmental Health
www.elsevier.de/ijheh

Wilms' tumor and exposures to residential and occupational hazardous chemicals

James Tsai*, Wendy E. Kaye, Frank J. Bove

Centers for Disease Control and Prevention (CDC), Agency for Toxic Substances and Disease Registry (ATSDR), 1600 Clifton Road, Mailstop-E86, Atlanta, GA 30333, USA

Received 24 June 2005; received in revised form 12 August 2005; accepted 2 September 2005

Abstract

This case-control study examines the association between residential and occupational exposures to hazardous chemicals and the risk of Wilms' tumor. The study included 303 cases recruited from six state cancer registries, who were diagnosed between January 1, 1992 and December 31, 1995. A total of 575 controls selected through random digit dialing were frequency matched to the cases. A standard questionnaire was administered to participants during a telephone interview. Parental residential addresses and locations of US Environmental Protection Agency National Priority List (NPL) sites were geocoded and analyzed, along with occupational exposure information. There were no cases of Wilms' tumor found in individuals living within one-half mile distance of a hazardous waste site. However, elevated odds ratios were found for using hairdressing chemicals, motor oil, paint, paint stripper, and pesticides during the pregnancy term and during the 2-year period prior to birth. The findings do not support the hypothesis that Wilms' tumor is associated with residing near an NPL site.

Keywords: Wilms' tumor; Nephroblastoma; Childhood kidney cancer; Proximity; Distance; Hazardous chemicals; Geographic information system; Occupational exposure; Environmental exposure; Risk factors

Introduction

Wilms' tumor is the most common malignancy of renal origin in children (Parkin et al., 1988). It accounts for 8% of all childhood cancers and affects one in every 10,000 children before their 15th year (Pritchard-Jones and Hastie, 1990; Breslow and Beckwith, 1982). The peak incidence for Wilms' tumor occurs between 2 and 4 years of age; most cases are diagnosed before 5 years of age (Breslow and Beckwith, 1982). Cases found in males tend to be diagnosed a few months earlier (Breslow et al., 1993). The incidence of Wilms' tumor is higher among African Americans, but lower among Asians. Wilms' tumor can be unilateral, bilateral, unicentric, or multicentric (Breslow et al., 1993). It may combine with several other congenital malformations such as sporadic aniridia, microcephaly, mental retardation, hemihypertrophy, spina bifida, or Down syndrome (Breslow et al., 1993; Danglot-Banck et al., 2002). Familial cases, which comprise about 1% of all Wilms' tumor cases, also have been observed (Cochran and Froggatt, 1967; D'Angio et al., 1976). Wilms' tumor cases have been linked to parental ages (Olson et al., 1993), aniridia and other

*Corresponding author. Tel.: +1 404 498 3951; fax: +1 404 498 3040.
E-mail address: jxt9@cdc.gov (J. Tsai).

1438-4639/$ - see front matter © 2005 Elsevier GmbH. All rights reserved.
doi:10.1016/j.ijheh.2005.09.003

congenital malformations with specific chromosomal deletion (D'Angio et al., 1976). Children with both sporadic aniridia and chromosome deletion (11p13) have a 33% chance of developing Wilms' tumor (Franceke et al., 1979).

Past epidemiologic studies suggest the etiological hypotheses of genetic and mutational factors (Miller et al., 1964; Maurer et al., 1979; Franco et al., 1991). A two-stage mutational model proposed by Knudson and Strong (1972) suggests that Wilms' tumor results from two successive mutational events: a germinal mutation either with a subsequent somatic mutation or two somatic mutations. It indicates that Wilms' tumor can present in hereditary or sporadic forms, depending on whether the first mutation is a germinal or somatic event. It is believed that hereditary forms of Wilms' tumor are associated with pre-conception exposures of the germ cells of either parent, while sporadic forms may be associated with exposure to carcinogens during pregnancy (Bunin et al., 1987). As of this study, a number of hypothesized Wilms' tumor risk factors have been investigated. Results from a number of studies linked environmental and occupational exposures, including exposures to lead (Kantor et al., 1979), hydrocarbons (Wilkins and Sinks, 1984a), boron (Wilkins and Sinks, 1984b), radiation (Hicks et al., 1984), pesticides (Sharpe et al., 1995; Kristensen et al., 1996; Fear et al., 1998), and maternal hypertension during pregnancy (Lindblad et al., 1996), with Wilms' tumor risk (Kantor et al., 1979; Lindblad et al., 1996; Olshan et al., 1990; Sanders et al., 1981; Wilkins and Sinks 1984a, b; Bunin et al., 1989). These substances were often found at toxic waste sites, such as those listed on the National Priorities List (NPL) by the United States Environmental Protection Agency (USEPA). The NPL is comprised of sites which contained hazardous substances, pollutants, or contaminants throughout the United States and its territories (EPA, 1992). Proposed sites with uncontrolled hazardous waste were listed upon completion of Hazard Ranking System (HRS) screening and public comments period. HRS used information from initial investigations to assess the relative potential of sites to pose a threat to human health or the environment (EPA, 1992).

The primary objective of this study examines the associations between environmental exposures to contaminants commonly found at NPL sites. A secondary objective evaluates whether self-reported parental occupational exposures are associated with an increased risk of developing Wilms' tumor. The study objectives test the hypotheses that there is no association between (1) the risk of developing Wilms' tumor and the proximity of parental residence to NPL sites during pre-conception or pregnancy, and (2) parental occupational exposure during pre-conception or pregnancy and Wilms' tumor risk.

Materials and methods

Case definition and recruitment

The states of California, Florida, New Jersey, Michigan, North Carolina, and Pennsylvania were selected for the study because there were adequate Wilms' tumor cases and adequate numbers of NPL sites within their borders. After approval by the CDC/ATSDR Institutional Review Board and review and approval by each state health department, these states provided the Agency for Toxic Substances and Disease Registry with data for their reported Wilms' tumor cases. Table 1 lists the NPL sites in each state and the distribution of Wilms' tumor cases. All incidents of Wilms' tumor cases in children through 9 years of age and registered with the six selected states between January 1, 1992, and December 31, 1995, were selected for participation. All cases were microscopically confirmed and the families involved were confirmed as residents of these states at the time of diagnosis. Familial Wilms' tumor cases were excluded, as were cases involving non-resident parents, and non-English speaking parents. There were 483 Wilms' tumor cases meeting the case criteria and, therefore, eligible for participation in the study. Among them, 115 were not locatable or not traceable, and 16 were unavailable for interview. Of the remaining 352 cases, 49 refused participation. Therefore, interviews with 303 Wilms' tumor cases occurred, which resulted in a participation rate of 86%.

Information obtained for each case from the state cancer registries included name, date of birth, birth place (state), sex, race, diagnosis, and parents names, address, and telephone number when available. Parents of eligible cases were first approached by mail with a letter introducing the study and inviting participation. Subsequent telephone contact arranged an interview.

Table 1. Wilms' tumor cases and hazardous waste sites by state

State	Cases	Percent of total cases
California (115 NPL sites[a])	106	35.0
Florida (74 NPL sites[a])	58	19.1
Michigan (87 NPL sites[a])	26	8.6
Pennsylvania (115 NPL sites[a])	58	19.1
North Carolina (27 NPL sites[a])	20	6.6
New Jersey (132 NPL sites[a])	35	11.6
Total	303	100.0

Source: ATSDR's Hazardous Substance Release and Health Effects Database (HAZDAT), January 2001

[a]Total number of National Priority List (NPL) sites in the US = 1581