New York State Department of Health
Center for Environmental Health

Address-Specific Review of Birth Outcomes, 1978-2005

Modock Road Springs Study Area
Town of Victor, Ontario County
New York

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Prepared by:
New York State Department of Health
Center for Environmental Health
Troy, New York

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Background

In response to a request by area residents and public officials, the New York State Department of Health (NYS DOH) agreed to conduct a review of cancer and birth outcomes among residents of an area near the Modock Road Springs in the Town of Victor. This review looks at levels of health outcomes among the population of a specific geographic area and provides residents with information about numbers of outcomes in their area compared with expected numbers based on statewide data. This type of review cannot link cause (exposure) and effect (health outcome) and cannot prove that an individual's health problem was caused by an environmental exposure. A report on the review of cancer among residents of the area was released in 2009 (NYS DOH, 2009). The current report describes the review of birth outcomes among babies born to people living in the study area near the Modock Road Springs in the Town of Victor (see attached map).

The neighborhood within the study area is located above a mile-long area of groundwater contaminated with industrial solvents. Results of an environmental investigation of drinking water and soil vapor intrusion sampling conducted by the NYS Department of Environmental Conservation, in conjunction with the NYS DOH Center for Environmental Health, showed the presence of two completed pathways of human exposure to contaminants in the groundwater in the study area. These pathways included ingestion of contaminated drinking water from private wells and the inhalation of contaminants that had entered homes through soil vapor intrusion. According to the data from the environmental investigation, a limited number of residences were impacted by these completed exposure pathways.

Groundwater Contamination Within the Study Area

Contamination of the groundwater discharging at the Modock Road Springs in the Town of Victor was first discovered in 1990. Three industrial solvents were identified in the groundwater: trichloroethylene (TCE, or trichloroethene); 1,1,1-trichloroethane (1,1,1-TCA); and 1,1-dichloroethene (1,1-DCE).

Following the discovery of contamination, subsequent sampling showed that a mile-long area of contaminated groundwater extended southward from the springs to the DLS Sand & Gravel property, the suspected source of the contamination. About 70 homes are located above the contaminated groundwater, in an area of mixed suburban and rural development. Sampling of private drinking water wells has been conducted in this area since 1990, and a comprehensive environmental investigation, involving both the sampling of private drinking water wells and the air inside and beneath homes for soil vapor intrusion, began in 2007.

Volatile Organic Compound (VOC) Exposure and Potential Health Risks

The amount of scientific research that has been conducted on the chemicals associated with the Modock Springs Road area groundwater contamination varies considerably. Specifically, a large amount of research has been published about the health effects of exposure to trichloroethene (TCE) compared to the relatively small number of scientific studies available regarding 1,1,1-trichloroethane (1,1,1-TCA) and 1,1-dichloroethene (1,1-DCE). The results of this research are briefly summarized below.

Trichloroethene (TCE). In humans, long-term exposure in the workplace to high levels of TCE in air is linked to effects on the central nervous system and irritation of the mucous membranes. Some studies of people exposed to high levels of TCE in workplace air or in drinking water show an association between exposure to TCE and increased risks for certain types of cancer, including cancers of the kidney, liver, esophagus, and non-Hodgkin's lymphoma. Other studies suggest an association between workplace TCE exposure and reproductive effects (alterations in sperm counts) in men. Studies of women exposed to mixtures of chlorinated solvents (including TCE) in drinking water during pregnancy also suggest TCE may increase the risk of birth defects (e.g., neural tube defects, oral cleft defects, and congenital heart defects) and/or childhood leukemia (ATSDR, 1997). In each of the drinking water studies, however, there are uncertainties about how much contaminated water the women drank during pregnancy and about how much TCE was in the water the women drank while pregnant. In addition, we do not know if the health effects observed in the studies of human exposure to TCE in workplace air and in drinking water are due to TCE or other factors, including exposure to other chemicals, smoking, alcohol consumption, and lifestyle choices. Since these potential confounding factors were not well controlled, and because there were uncertainties about actual exposures, the studies in humans suggest, but do not prove, that exposure to TCE can cause cancer, developmental effects, and reproductive effects in humans.

In animal studies, exposure to high levels of TCE caused adverse effects on the central nervous system, liver, and kidneys. Lifetime exposure to high levels of TCE has caused cancer in laboratory animals. When pregnant animals were exposed by ingestion to large amounts of TCE, adverse effects on the normal development of the offspring were observed (ATSDR 1997). In most, but not all of these studies, the high amounts of the chemicals also caused adverse health effects on the parent animals. In one set of studies, effects on fetal heart development were observed in the offspring of rats exposed to TCE in drinking water before and during pregnancy (Dawson, 1993; Johnson, 1998; Johnson, 2003).

1,1,1-Trichloroethane (1,1,1-TCA). Exposure to high levels of 1,1,1-TCA can cause adverse effects on the nervous system, liver, and cardiovascular system (ATSDR, 2006). These effects have also been observed in laboratory animals exposed to high levels of 1,1,1-TCA. Available toxicological data are inadequate to assess the carcinogenic potential of 1,1,1-TCA (US EPA IRIS, 2004). Available information from human and animal studies does not provide strong evidence that 1,1,1-TCA causes birth defects (ATSDR, 2006).

1,1-Dichloroethene (1,1-DCE). US EPA has determined that 1,1-dichloroethene exhibits "suggestive evidence of carcinogenicity" in inhalation studies in animals (kidney tumors only in male mice, but not female mice or male and female rats), but not sufficient evidence to assess human carcinogenic potential. In addition, US EPA determined that the data for 1,1-dichloroethene "are inadequate for an assessment of human carcinogenic potential by the oral route" Moreover, US EPA noted that "the epidemiological results on the carcinogenicity of 1,1-DCE are too limited to draw useful conclusions" (US EPA IRIS, 2004). IARC has determined that 1,1-DCE is "not classifiable as to its carcinogenicity to humans." Humans exposed to high levels of 1,1-DCE have had adverse effects on the nervous system and liver. 1,1-Dichloroethene damages the liver, kidney, lungs, heart, and nervous system of laboratory animals exposed to high levels of this chemical during pregnancy. Whether of not these effects occur in humans is not known (ATSDR, 1994).

Methods

Study Design

This study used an address-specific review to determine if birth outcomes in the Modock Road Springs study area are occurring at different rates compared to NYS, excluding New York City. Other non-cancer health outcomes (e.g., autoimmune diseases) were not examined because data on those outcomes is not routinely collected by NYS DOH. The NYS Congenital Malformations Registry was used to identify children born with congenital malformations to parents living within the study area during the specified time period. Similarly, NYS birth certificates were used to evaluate other birth outcomes, including measures of low birth weight, among infants born to parents living in the study area. When the observed number of any birth outcome is fewer than six, the exact number is not presented in order to protect confidentiality.

Study Area & Timeframe

The study area is located over the contaminated groundwater. This includes all addresses on Hunters Run, Surrey Lane, Trotwood Lane, Natures Way, and Zephyr Heights. The study area also includes addresses on the south side of Modock Road, and both sides of Dryer Road in the area of the groundwater contamination (see map).

The timeframe selected for this study began in 1978. Although it is not known exactly when any exposures to site-related chemicals may have begun, contamination of the nearby Modock Road Springs was identified in 1990. The study includes all births among residents during 1978 through 2005.

Sources of Data

Birth outcomes. NYS DOH used birth certificate data for 1978-2005 (28 years) to determine if the study area had an increased number or unusual patterns of adverse birth outcomes. The beginning date for the time period, 1978, is the first year electronic birth certificates are available for the state. At the time of the analysis, 2005 was the most recent year for which electronic

birth certificates were available. Only singleton births (one baby) were included in this study because multiple births (e.g., twins, triplets) have a much higher risk of some adverse birth outcomes. NYS DOH identified all singleton births to mothers living in the study area by locating the mother's address from the birth certificate on a map. The birth certificate data include the infant's birth weight, gestational age, and gender. In addition, information is available on the mother's age, race, ethnicity, years of education, the number of previous births (parity), and the week of pregnancy when she had her first prenatal visit.

Birth outcomes are divided into four groups: birth weight, prematurity, growth restriction, and male to female ratio. The birth weight outcomes are: low birth weight (LBW) (<2500 g), and two subsets: moderately LBW (≥1500g and <2500g), and very LBW (<1500g). Birth records with missing birth weight or birth weight outside a reasonable range (<100g or >8000g) were excluded from the analysis. The prematurity outcomes are: pre-term births (<37 weeks gestation) and two subsets: moderately pre-term births (≥32 and <37 weeks gestation), and very pre-term births (<32 weeks gestation). Birth records missing gestational age or with gestational ages outside the reasonable range (<20 weeks or >44 weeks) were excluded from the analysis. Two measures of growth restriction were studied: small for gestational age (SGA) births and term LBW. SGA is defined as a birth weight below the 10th percentile of the NYS (excluding NYC) birth weight distribution of singleton births by gestational week, gender, and five-year time period (1978-1982, 1983-1987, 1988-1992, 1993-1997, 1998-2002) (Alexander, 1996). Term LBW was defined as ≥37 weeks gestation and birth weight <2500g.

Birth defects. Records of birth defects for singleton births for 1983-2005 (23 years) were obtained from the NYS DOH Congenital Malformations Registry (CMR). The beginning date for the time period, 1983, is the first year electronic CMR data are available for the state. At the time of the analysis, 2005 was the most recent year for which electronic CMR data were available. By locating the mother's address from the birth defect records, we identified specific infants born with birth defects during the 23-year period. The birth defects were reviewed to look for unusual patterns in the number and types of defects, with specific attention to the defects associated in the literature with VOC exposures. These defects include neural tube defects, cardiac defects, cleft lip and cleft palate, and choanal atresia.

Results & Discussion

The address-specific review of birth outcomes allowed for the identification and analysis of all births among residents of the study area. A total of 25 singleton births were identified among residents of the study area during the time period of the study. No congenital malformations were identified among those children. Fewer than six low birth weight births were identified among the study population. As previously mentioned, when the observed number of any birth outcome is fewer than six, the exact number is not presented in order to protect confidentiality. Based on the numbers and patterns of the health outcomes reviewed, the current study did not show low birth weight births, small for gestational age births, or pre-term births occurring at different rates compared to NYS, excluding New York City. Similarly, rates of congenital malformations were not occurring at different rates compared to NYS, excluding New York City.

Limitations

In drawing conclusions from this review there are several limitations that need to be addressed. First is the problem of interpreting findings when the number of cases is very small. For example, when a population is very small, the expected number of cases may be a fraction of a case (such as 0.25 cases). If only one case is observed, the excess may appear extraordinarily high (in this hypothetical example, four times higher than expected); if no cases are observed, then it would appear that there was a deficit. Therefore, when the number of observed and expected cases are very small, the study's conclusions can change greatly based on the addition or subtraction of one or two cases and the results of statistical tests must be interpreted with caution.

This type of review also does not take into account personal information that may be related to the health outcomes, such as medical history, dietary and lifestyle choices (e.g., smoking and drinking), and occupational exposures to other chemicals. In addition, exposure misclassification is a limitation of this type of review and can occur because of incomplete knowledge about actual exposure and migration in and out of the study area. Although drinking water and soil vapor sampling was conducted in the study area, there is no way to know if every individual in the study area was exposed or to what extent each individual may have been exposed (including the duration of the exposure, the amount of time residents spent in the home each day). Because the residence of the mother at the time of the birth was taken from the birth certificate, mothers who lived in the study area during their pregnancy but moved out of the study area before giving birth could not be included in the review. Conversely, mothers who moved into the study area shortly before their child's birth were included in the review even though most of the pregnancy occurred outside of the study area.

Conclusions

This review found that the numbers and patterns of adverse birth outcomes diagnosed in children born to residents of the Modock Road Springs study area does not appear unusual (i.e., the outcomes did not occur at different rates compared to NYS, excluding New York City). Conclusions from this review are limited, however, due to the small population in the exposed area and the small numbers of outcomes.

Contact information for questions or comments:
James Bowers, M.P.H.
NYS DOH, Center for Environmental Health
Bureau of Environmental & Occupational Epidemiology
Community Exposure Research Section
Flanigan Square, 547 River Street
Troy, New York 12180-2216
518-402-7950
beoe@health.state.ny.us

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