Many of the critical pollutants contaminating the Great Lakes ecosystem are also found in the setting of municipal and industrial waste sites. Hazardous waste sites can emit irritant gases, metals, solvents, pesticides, polyaromatic hydrocarbons and organochlorines and contaminate surrounding air, soil and ground water. The potential health effects from these compounds are a source of concern to residents living in close proximity to these sites.1

This review will focus on nine studies from the recent literature, primarily from North America, examining the health effects associated with living close to a municipal or hazardous waste site. The first four studies unveiled the possibility of associations between exposures from hazardous sites and selected cancers, low birth weight and infants small for gestational age (SGA). In the following five studies, the authors found either a marginal or lack of association between exposure to contaminants and health outcomes, or were reluctant to suggest links due to study limitations. Five of the nine studies involved reproductive health risks. The other four studies explored the relationship between exposure and increases in risk for cancer, renal or respiratory disease, or other health problems.

A quarterly summary of recent findings in the scientific literature on human health effects and environmental pollutants, with an emphasis on pollutants of the Great Lakes ecosystem. Prepared under the direction of the Health Professional Task Force of the International Joint Commission. This newsletter does not represent the official position of the International Joint Commission.

Health Professionals Task Force Secretary: Jim Houston
Health Professionals Task Force Commission: 100 Metcalfe Street
Ottawa, Ontario K1P 5M1
phone (613) 995-0230
fax (613) 995-5333
e-mail houston@ottawa.ijc.org

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Studies by Goldberg and co-workers examined the health effects among residents living near the third largest municipal solid waste site in North America, the Miron Quarry in Montreal, Quebec, which opened in 1958.2 The authors note that the primary emission is of methane. Biogas, a complex mixture of vapors and gases resulting from anaerobic digestion of organic material. Biogas contains primarily methane and CO2, but also various sulfur compounds(H2S, mercaptans) and VOCs. They note that some of the constituents of biogas are embryo- or fetotoxic (eg. benzene, tetrachloroethene, chlorflurocarbons), and that some of the VOC’s, in particular, are known or suspected carcinogens. The authors examined cancer, low birth weight and pre-term birth, among populations living close to the site. The measure of exposure was residence in four “exposure zones”, defined by distance from the site. In the cancer study (1981-1989),2 incident cancer cases were identified from the Quebec Tumour Registry; sex- and age-standardized incidence rates were calculated using Canadian census data to estimate the population at risk. Results: In women, modest excess risks were found for stomach cancer (RR 1.14, 95% CI 1.01-1.15) in the medium exposure group and cancer of the cervix uteri in the medium and high exposure groups (RR 1.23, 95% CI 1.04-1.45 for high exposure group). There were fewer than expected breast cancers. In men, modest excess risk was found for stomach cancer in the high exposure group (RR 1.24, 95% CI 1.06-1.44) and for cancer of the liver and intrahepatic ducts (RR 1.78, 95% CI 1.21-2.64). For lung cancer, modestly elevated RR’s were seen in low, medium and high exposure groups with no dose-response relationship evident; the risk in the high exposure group, using the most closely matched reference group was 1.06 (95% CI 0.98-1.16). One exposure group, adjacent to the site but upwind, had an elevated RR for prostate cancer (RR 1.18, 95% CI 1.02-1.37). The authors note the following limitations to interpreting their results: the use of place of residence at the time of diagnosis as a surrogate for exposure, unknown duration of exposure, and the limited latency for solid tumors (maximal 21 years from onset of exposure to last year of study).

Hazardous Waste Sites and Human Health

A case-control design was used to examine the risk of pre-term birth, low birth weight, very low birth weight, and SGA among residents near the Montreal site of the previous study.1 Singleton births between 1979 and 1989 were identified from provincial birth registration files. These files contain selected maternal factors (age, education, residence at birth, language usually spoken) and birth characteristics (weight, gender, length of gestation), but not maternal smoking, occupational or health status. Unexposed reference zones from other areas of Montreal were chosen to approximate the study population with regard to potential risk factors for prematurity (average household income, proportion of immigrants, and proportion of French as native language). Results: The risk of low birth weight was significantly elevated in the high exposure zone (OR 1.20, 95% CI 1.04-1.39). There were also excess SGA births in the medium and high exposure groups with the OR's suggesting significance or near-significance, respectively. (OR for medium exposure: 1.11, 95% CI 1.08-1.31; OR for high exposure: 1.09, 95% CI 1.00-1.22). No significant increased risk for very low birth weight, or pre-term births was observed. Again, the authors note that the following factors limit the interpretation of these data: residence at the time of birth; the inability to control for several maternal factors known to be associated with prematurity; low birth weight; and absence of information on maternal occupation. They also note that while animal and limited human reproductive toxicity data do provide a basis for biologic plausibility for their observations, the relevant dose-response and outcome measures in animals may have uncertain applicability to humans.

Berrey and Bove (New Jersey Dept. of Health and ATSDR) examined 11,579 births during 5 five-year time periods between 1961 and 1985 in four New Jersey towns closest to the Lapiir Landfill.3 Lipari accepted such hazardous wastes as cleaning solvents, resins, paint and paint thinners, ester press cakes, phenol and amine wastes, metals, and the particularly hazardous bis (2-chloroethyly) ether, until 1971. Inhabitants of VOC’s from the landfill were exposed to a contaminated lake was considered to be the greatest public health threat. The exposure period was presumed to be greatest between 1971 to 1975, just after the site closed and before clean up began. Results: There was increased risk of low birth weight 1.19 (95% CI 1.05-1.34) in the adjacent to the site between 1971 - 1975 (OR 5.12, 95% CI 2.14 - 12.27), the period of presumed greatest exposure. This finding was especially significant because in years both before and after that 4-year period, the average adjusted birth was significantly higher in the adjacent site, suggesting that in general, mothers in the exposed area may have had fewer other risk factors for low birth weight than controls. There was also an increased risk of being born preterm in this exposure group (OR 2.1 95% CI 1.01 - 4.36). The authors concluded that the population living immediately adjacent to the landfill was significantly impacted regarding birth weight in the period of probable greatest exposure.

Kharrazi and co-workers examined a population of 25,216 live births and fetal deaths to mothers living within three miles of the BKK hazardous waste site located in West Covina, Calif., 18 miles east of Los Angeles. The site had been subject to numerous complaints from residents, including odors, surface water runoff, dust releases, and hazardous waste spills from trucks going to the landfill. Earlier studies had shown an increase in early neonatal deaths and low birth weights for those living near the site. In this study, potential for exposure was assessed as high, medium, low, or intermittent, based on the number of historical odor complaints. Births in these areas were compared with those in a control area that had no such odor complaints. Data on birth weight, fetal, neonatal and infant mortality were obtained from vital records. Results: After adjusting for potential confounders, the authors found an average difference of -59 grams in birth weight among infants born to 226 mothers in the high odor complaints zone, and a -1.8 day gestational age for infants in the target population compared with mothers in the reference area (p < 0.05). The highest odor area also corresponded to high exposure estimates by other measures (environmental sampling, topography and meteorology). When using distance from the site as a measure of exposure, the authors found much less dramatic differences in birth weight and gestational weight than with the odor complaint measure. The authors concluded that the observed health effect was modest, but may have been underestimated due to misclassification inherent in the exposure determination.

The following studies, though not suggesting associations, are still of interest. The researchers reveal the difficulties they have in methodology, particularly in establishing accurate measures of exposure to contaminants from hazardous waste sites. Marshall and Gensburg (New York Department of Health) examined whether pregnant women who gave birth to babies with birth defects (Continued on page 2)
of the CNS and the MUS system were more likely to have been exposed to hazardous waste than mothers with children without such outcomes. The study population included all single births during 1983 to 1986 in 18 New York counties, excluding New York City, Long Island, and 36 sparsely populated outer counties. The authors studied 473 babies born with CNS defects and 3,304 babies born with MUS defects. They compared them with 12,000 randomly selected controls. The potential for exposure for self-reporting of all four respiratory symptoms, adjusted for health effects of nearby residents compared with controls. For example, respiratory allergy (OR 3.3, 95% CI 1.4 - 7.8); hay fever or other non-asthma respiratory allergy (OR 2.4, 95% CI 1.3 - 4.4); and eczema or other skin problem (OR 1.9, 95% CI 1.04 - 3.5). However, the authors noted drawbacks to simply using a surrogate exposure measurements. The studies reported on the risk of end-stage renal disease and living near a hazardous waste site. The study included 216 pairs matched by age, race and sex living in 20 New York State counties. They excluded cases of diabetes, polycystic ovarian disease, congenital nephritis, metal and mercury, and cases due to malignancy, anabolic abuse, or infections. Results: A non-significant elevated OR was seen for the disease for those ever having lived within a 1-mile radius of a hazardous waste site (1.40, 95% CI 0.92 - 2.1). Elevated OR’s were also found for other confounders (painting pictures, making pottery, education, income, lead poisoning, ever having smoked, kidney disease in female child). The authors noted that the study is the first to examine the link between end-stage renal disease and hazardous waste, but because of limitations including small sample size (shown in the wide CIs), further investigation is needed. In summary, these reports suggest associations between exposure to hazardous waste sites and low birth weight, SGA, and shortened gestation. The reports demonstrated the potential for exposure during these early pregnancies and associations. Primary among these difficulties is the absence of personal exposure data. Approaches to exposure assessment used in these studies included distance from site, odor complaints, and environmental monitoring data. Several authors noted drawbacks to simply using a uniform distance from the site as a measure of exposure. The approach used was in studies at the request of concerned community members. In some cases, small sample size, when studying particular outcomes, was an obstacle. The availability of more extensive environmental data, and the development of biomarkers of exposure to relevant pollutants would help overcome these limitations. References:

Miller and McGeehin (ATSDR) analyzed health questionnaires completed by 473 residents about four miles from the National Priority List Superfund site near Houston, Texas. The study was a follow up to a 1989 citizen's survey that had unveiled concerns about elevated risk of respiratory illness and birth defects among residents living near the two facilities – the Brio Refining Company and the Dixie Oil Processors -- both open from 1957 until 1982. VOC’s had contaminated groundwater under both sites; metals contaminated the Dixie site. Community wells were not contaminated. There was also exposure to low levels of VOCs from site emissions. The study participants (who must have lived in their homes at least one year prior to survey) were recruited through two geographically matched populations of 360 residents. Results: The authors found differences in the self reported health effects of nearby residents compared with controls. For example, the OR’s for the reporting of all four of these symptoms as maternal residence at three months before and after exposure as maternal residence at three months before and after conception instead of at the time of birth. Mothers were studied who lived either in a census tract with a hazardous waste site or within one mile of a site. Results: The authors found no increased risk of OR’s, kidney defects, or oral cleft defects in newborns of mothers living near hazardous waste sites. In contrast to Marshall et al., the authors determined the time of exposure as maternal residence at three months before and after conception instead of at the time of birth. The reports demonstrate the methodologic difficulties of examining these potential associations. Primary among these difficulties is the absence of personal exposure data. The approach used was in studies at the request of concerned community members. In some cases, small sample size, when studying particular outcomes, was an obstacle. The availability of more extensive environmental data, and the development of biomarkers of exposure to relevant pollutants would help overcome these limitations.