

## Sour Finding on Popular Sweetener

### Increased Cancer Incidence Associated with Low-Dose Aspartame Intake

More than 20 years have elapsed since aspartame was approved by regulatory agencies as an artificial sweetener. But scientists draw conclusions on carcinogenicity based on the evidence available at the time, and new research out of the European Ramazzini Foundation of Oncology and Environmental Sciences bolsters recent calls for reconsideration of regulations governing aspartame's widespread use in order to better protect public health, particularly that of children [*EHP* 114:379–385; Soffritti et al.].

The researchers added aspartame to the standard diet of Sprague-Dawley rats, using dosages designed to simulate a wide range of human intakes. Each rat was observed from 8 weeks of age until death. This is in contrast with earlier studies that typically sacrificed animals between 104 and 110 weeks of age, corresponding to about two-thirds of a rat's lifespan (in humans, approximately 80% of cancer diagnoses are made in the last third of life, after age 55). Deceased animals were examined for microscopic changes in various organs and tissues, enabling a comprehensive assessment of aspartame's carcinogenic potential. A total of 1,800 rodents were included, far more than in previous studies.

Aspartame-fed females showed significant evidence of lymphomas/leukemias and of carcinomas of the renal pelvis and ureter. The effect on the renal pelvis was much more evident when carcinomas were combined with atypical preneoplastic lesions. The researchers also observed an insignificant increase in incidence of malignant schwannomas of the peripheral nerves in males, as well as hyperplasia of the olfactory epithelium in males and females. Lesions of the kidney and olfactory epithelium are extremely rare in this strain of rats and therefore merit special attention.

The carcinogenic effects were evident at daily doses as low as 400 parts per million, equivalent to an assumed daily human intake of 20 milligrams per kilogram body weight (mg/kg). This dosage is much less than the acceptable daily intake for humans, with current limits set at 50 mg/kg in the United States and 40 mg/kg in Europe. Surveys of aspartame intake in the United States and Europe from 1984 to 1992 showed that consumers typically consumed 2–3 mg/kg daily, with small children and women of child-bearing age consuming slightly more, at 2–5 mg/kg daily.

The public health implications of these findings may be substantial, since aspartame is used in about 6,000 products, and more than 200 million people regularly consume aspartame through foods, beverages, drugs (such as chewable vitamins), and hygiene products (such as toothpaste). Because the study did not take into account *in utero* and perinatal exposures, the authors point to this as a salient direction for future research, given that children and pregnant and breastfeeding women are among the major consumers of aspartame. —M. Nathaniel Mead

## The Cancer Differential

### Minorities in Racially Segregated Urban Areas at Higher Risk than Whites

Nearly 80% of the U.S. population lives in metropolitan areas. With continued growth of urban centers has come increased study of the connection between the built environment, social inequality, and the health and well-being of inhabitants of these large cities. A number of factors related to neighborhood location and other area-level variables such as access to nutritious foods and health care can affect human health. Now a research team points to another health consideration, demonstrating that minority populations living in highly segregated metropolitan areas in the United States have higher estimated lifetime cancer risks from air toxics than whites [*EHP* 114:386–393; Morello-Frosch et al.].

The team analyzed more than 45,000 census tracts in 309 U.S. metropolitan areas for level of segregation. The metropolitan areas were classified as low-to-moderately segregated, highly segregated, or extremely segregated, based on the proportion of people who would have to move to achieve an even racial balance in every neighborhood of the city. They also used census data to divide racial and ethnic groups into six categories: Hispanics of any race, non-Hispanic whites, non-Hispanic blacks, non-Hispanic Asians and Pacific Islanders, non-Hispanic American Indians and Alaska Natives, and non-Hispanic persons of other race.

Then the team used federal air toxics data for 1996 to derive cancer risk estimates. Cancer risks were determined using inhalation unit risk estimates for each known, likely, or potential human carcinogen measured in the tracts' air. Inhalation unit risk estimates consider the individual lifetime excess risk resulting from chronic



**Stirring debate.** New rodent data on aspartame, an artificial sweetener used in a variety of consumer goods, suggest the chemical's potential cancer effects deserve more study.

lifetime exposure to one unit of pollutant concentration.

The researchers found a persistent relationship between increasing levels of racial/ethnic segregation and increased estimated cancer risk associated with ambient air toxics. Hispanics in extremely segregated areas were the most affected, with a 6.4-fold increased lifetime cancer risk compared to Hispanics in low-to-moderately segregated areas. Non-Hispanic American Indians and Alaska Natives in highly segregated areas were the least affected, with a 1.39-fold increased risk over their counterparts in low-to-moderately segregated areas. The influence of racial segregation on cancer risk appeared independent of the effect of poverty across racial categories. The most significant contributors to cancer risk were mobile sources such as on-road vehicles, airplanes, and trains, with diesel emissions an overwhelming source of pollution.

The authors note that these results are consistent with findings from a previous national study that analyzed the relationship between black/white residential segregation and ambient air toxic exposure in U.S. metropolitan areas. They believe this study to be the first examination of environmental health disparities to use a generalized multiethnic segregation measure. They assert that future research on this issue that incorporates new and better models of exposure should include segregation as a key factor in analysis.  
—Tanya Tillett

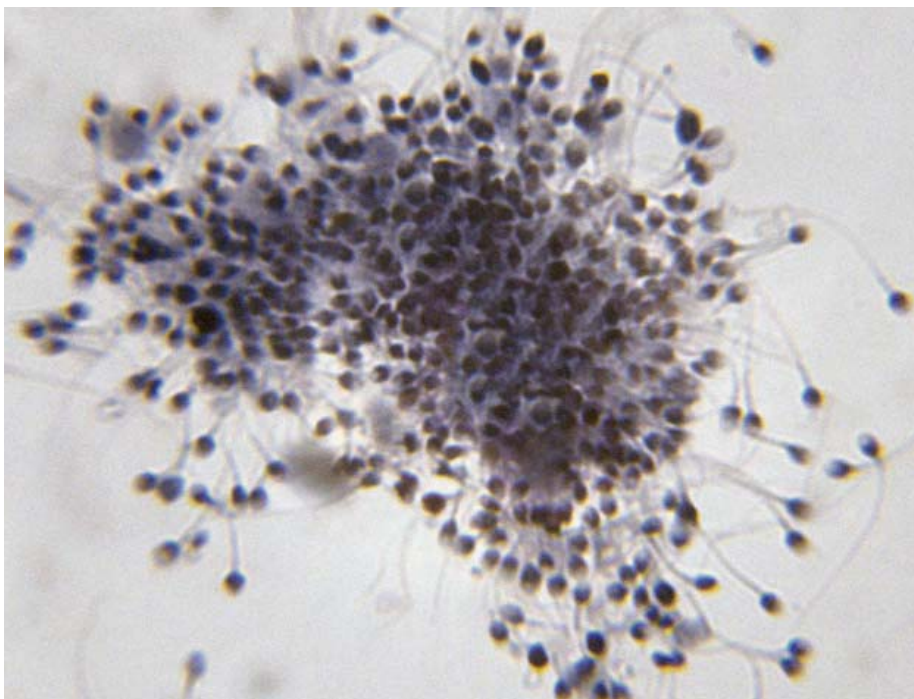
## Sperm Alert

### Semen Quality Decline Linked to Ozone Pollution

Some recent studies examining the effect of environmental hazards on fertility claim that sperm counts are declining in certain industrialized countries. Although the validity of these findings is uncertain, most researchers agree that if there is in fact a decline in semen quality, it's probably linked to geographic location. Now a team of California researchers has examined how exposure to specific air pollutants—ozone, nitrogen dioxide, carbon monoxide, and particulate matter smaller than 10 micrograms in diameter (PM<sub>10</sub>)—affects semen quality and reports a direct connection between ozone exposure and reduced sperm count [*EHP* 114:360–365; Sokol et al.].

It is estimated that at least 2.1 million couples in the United States have difficulty achieving pregnancy, with male infertility responsible for 40–50% of infertility cases. Exposure to environmental toxicants that disrupt sperm production (spermatogenesis) or the function of reproductive hormones or sperm may increase the risk of male infertility.

The investigators analyzed semen samples collected from 48 men who regularly donated to a Los Angeles sperm bank between January 1996 and December 1998. Subjects were healthy, educated males between the ages of 19 and 35 who had



**Gametes and gray skies.** A new study shows significant declines in semen quality associated with exposure to ozone air pollution.

abstained from sex for two to three days before sample collection. Also available were data on each donor's age, date of birth, race, dates of collection, and zip code of residence at the time of first donation.

The researchers also collected air quality data gathered for ten-kilometer grid areas during the same two-year period, and assigned subjects a grid location based on their zip code at the time of first donation. Ozone, nitrogen dioxide, and carbon monoxide were measured daily, and PM<sub>10</sub> was measured once every six days. Then the researchers examined the relationship between each semen sample and the air quality at 0–9, 10–14, and 70–90 days prior to its collection (human spermatogenesis is a 72-day process). They assessed semen volume, sperm concentration, and sperm motility within one hour of collection and compared it against air quality data specific to the donor.

Ozone was the only pollutant associated with changes in sperm quality. The analysis showed an inverse relationship between ozone exposure and sperm density at all points in spermatogenesis. The results remained significant after adjusting for donor age, season, and temperature.

It is known that ozone and its reaction products can cross the blood–gas barrier and enter the bloodstream, and exposure to ozone can cause oxidative stress, which has been shown to disrupt testicular and sperm function. As with smoking, ozone exposure may trigger an inflammatory reaction in the male genital tract or the formation of circulating toxic species. Both events could cause a decline in sperm concentration.

These findings support an earlier study conducted in the Czech Republic by scientists from the U.S. EPA. Young men who were exposed to elevated air pollution were more likely to have altered sperm quality than those who lived in areas with less air pollution. The authors note that the current study controlled well for potential confounders, and the connection between ozone and sperm quality is consistent across several models.

—Tanya Tillett



**Unhealthy home fires.** An assessment of solid fuel use reveals that continued widespread global dependence on such fuels for household needs will impede success in meeting the UN Millennium Development Goals.

## Keeping the Home Fires Burning Cleaner

### Solid Fuel Use, Health, and the Millennium Development Goals

Many people in industrialized nations give little thought to central heating, electric lighting, and flick-of-a-switch cooking. But more than half of the people in the world rely on solid fuels to heat and light their homes and cook their food. After assessing global solid fuel use, researchers estimate that 52% of the world's people burn solid fuels such as wood, coal, peat, and dung [*EHP* 114:373–378; Rehfuess et al.]. Burning these fuels, they say, can profoundly harm the health of the people exposed to them as well as damage regional environments.

The researchers set out to assess household solid fuel use on a country-by-country basis. In this report the researchers describe the impact that increases in worldwide dependence on solid fuels would have on meeting the UN Millennium Development Goals.

These eight goals set in 2000 aim to reduce poverty, hunger, disease, illiteracy, environmental degradation, child mortality, and gender inequality, and improve maternal health.

For 52 wealthier countries (in which per-capita income is more than US\$10,500), the researchers assumed that fewer than 5% of the population depended on household solid fuels. For 147 poorer countries, the researchers melded surveys and modeling where possible. They collected national census or household survey data on solid fuel use—often for cooking only, the fate of most household solid fuel—for 93 countries. For 36 countries that had no such data available, the researchers modeled solid fuel use based on factors such as gross national income and each country's proportion of rural dwellers. Finally, for 18 countries, many of them small island states such as the Cook Islands, the Maldives, and Tuvalu, there were not enough data available to feed the models. These 18 countries were excluded from the study.

Solid fuel use varied widely among the low-income regions, from 77% in sub-Saharan Africa to 16% in Latin America. According to the authors, 3.2 billion people depended on solid fuels as of 2003, not many fewer than the estimated 3.4 billion using such fuels three years earlier. About 75% of these people burned biomass fuels, which can lead to depletion of natural resources when harvested, and which typically are burned in crude stoves or open fires, resulting in incomplete combustion and releasing high levels of greenhouse gases.

Significantly reducing global dependence on solid fuels is necessary if the Millennium Development Goals—in particular reducing child mortality and improving maternal health—are to be met, the researchers explain. Burning solid fuels in cooking rooms, where women and their children typically spend much of their time, fills homes with pollutants such as carbon monoxide, particulate matter, and other carcinogens that penetrate deep into the lungs.

The researchers believe global society must embrace safe alternatives to solid fuels if the Millennium Development Goals are to be achieved, and they point to examples of interventions already in place that have rapidly bettered the lot of solid fuel users. It is essential, they write, that nations work together to make the necessary policy changes and implement technical solutions. —**Scott Fields**



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