Studies of Morbidity Near a Copper Smelter
by Samuel Milham, Jr.*

Children living near a copper smelter in Tacoma, Washington, have been shown to have increased levels of urinary and hair arsenic. Studies of hearing, blood status and school attendance in exposed and nonexposed children failed to detect any differences in these parameters.

In 1972, children living near a copper smelter in Tacoma, Washington, were shown to have elevated hair and urinary arsenic levels (1). This smelter specializes in processing ores rich in arsenic and is a major producer of arsenic trioxide. In a search for morbidity in children exposed in the community around the smelter, a number of studies were done. These included a search for anemia and hearing loss, since other investigators (2, 3) had reported these abnormalities in children who were exposed to arsenic near coal-fired power plants. Additionally, school absenteeism was examined as a crude index of possible morbidity.

Method

Attendance and enrollment records, and records of hearing screening, were obtained from the Tacoma public schools. Pure tone audiometry was done on 7 children with high average urinary arsenic levels. Blood was drawn from 33 case group and 25 control group children for complete blood counts.

Results

Attendance

Table 1 shows attendance and enrollment at seven Tacoma elementary schools. The Ruston school is less than 100 yd from smelter property, and the other schools are up to 8 miles away.

| School   | Attendance | Enrollment | A/B |
|----------|------------|------------|-----|
| Ruston   | 134        | 141        | 0.95|
| Sherman  | 591        | 637        | 0.93|
| Point Defiance | 451   | 477        | 0.95|
| Truman   | 578        | 605        | 0.96|
| Fern Hill| 650        | 688        | 0.94|
| Larchmont| 342        | 362        | 0.94|
| Oakland  | 189        | 201        | 0.94|

Hearing

Records of pure tone hearing screening for Tacoma elementary schools for the years 1967–1968 showed that of 566 Ruston school children screened, eight (1.4%) failed the testing. This compares quite favorably with a failure prevalence of 5.7% for all schools combined (17,623 children tested). As an added test, six children with elevated urinary arsenic levels (> 0.2 ppm on two or more sample days, normal = < 0.02 ppm) were referred to the school audiologist for pure tone threshold audiometry. One child had a previously known unilateral hearing loss. No high frequency hearing loss was detected in this group of children. One child had a 10 dB loss at 8000 Hz. 5 had 0 dB loss at 8000 Hz.

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Hematology

In May, 1976, blood was drawn from 33 Ruston and 25 Fern Hill school children. Fern Hill school was selected as a control school and is about 8 miles away from the smelter. Urine arsenic levels in Fern Hill school children were normal when tested in 1972.

The age distribution of the children studied is given in Table 2. Table 3 presents the results of the hematology study.

Table 2. Age distribution of children.

| Age  | Ruston | Fern Hill |
|------|--------|-----------|
| 8-9  | 4      | 1         |
| 9-10 | 7      | 2         |
| 10-11| 14     | 7         |
| 11-12| 8      | 12        |
| 12-13| 0      | 3         |
| Total| 33     | 25        |

Table 3. Average Blood Values, Ruston and Fern Hill Schools, Grades 3-5 (May, 1975).

|                    | Ruston   | Fern Hill | Age 6-10 | Age 11-15 |
|--------------------|----------|-----------|----------|-----------|
| Red blood count,   | 4.48     | 4.71      | 4.7      | 4.8       |
| millions/mm³       |          |           |          |           |
| Hemoglobin, g/100 ml | 13.0    | 13.6      | 12.9     | 13.4      |
| Hematocrit, volume of packed RBC/100 ml | 37.2 | 38.8 | 37.5 | 39.0 |
| Mean corpuscular volume, μ³ | 82.4 | 81.8 | 80 | 82 |
| Mean corpuscular hemoglobin, μg | 28.9 | 29.9 | 27 | 28 |
| Mean corpuscular hemoglobin concentration, (%) | 35.3 | 36.7 | 34 | 34 |
| White blood count/mm³ | 5.720 | 6.080 | 8.100 | 8.000 |
| Granulocytes, % | 46.3 | 49.0 | 50 | 51 |
| Lymphocytes, % | 47.6 | 43.6 | 39 | 38 |

*Data of Wintrobe (4).*

The Ruston and Fern Hill blood counts are very similar. The slight difference in counts between the schools could be accounted for on the basis of the Fern Hill children being an average of 9 months older than the Ruston children. Surprisingly, children at both schools had low white counts and an increase in the proportion of lymphocytes. This may be due to an error in counting white blood cells or may be explained by the fact that the blood sampling was done at the time of an Asian influenza outbreak in the community. This is the blood pattern seen in active or convalescent viral infections.

Since the hemoglobin values are similar at the case and control schools and agree well with published normal values for these age groups, it was concluded that arsenic exposure in the Ruston children is not having a demonstrable effect on the blood hemoglobin concentrations. This is in contrast to data from Czechoslovakia (3), which show low hemoglobin in children exposed to arsenic from a power plant.

Summary

Children living near a copper smelter in Tacoma, Washington, are exposed to and excrete elevated levels of arsenic. This study indicates that school attendance, hearing and the hematologic indices in these children are within normal limits and do not seem to be adversely affected by chronic, low dose exposure to arsenic.

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