Seasonal Incidence of Lead Poisoning in Children in St. Louis*

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Lead poisoning in children offers interesting problems in prevention as well as in education of the public.

THE KNOWLEDGE that children suffer from lead poisoning is not a recent development. Still, of England, in his textbook on pediatrics published in London in 1917, devoted four pages to this subject.[1] Blackfan[2] in the United States in 1917, gave a classical account of the disease as it is manifested in children. The Australians have made thorough studies on the occurrence of poisoning in children, their investigations extending back to their first recorded case in 1892. They emphasized the significance of ingested lead and of pica.[3]

More recently it was observed that the incidence of lead poisoning in children was apparently influenced by the season of the year. Shelling and Hooper,[4] in 1936, commented in general as follows: "The number of cases of acute lead poisoning admitted to our clinic is greatest during the summer months, when the sun's rays emit a greater abundance of ultraviolet rays than in any other season of the year." A similar observation was made by Rappaport and Rubin[5] in 1941. They report, "almost all the cases occur during the late spring and summer months."

A study made by the Baltimore City Health Department, extending over two decades, demonstrated clearly that there is a seasonal pattern in the occurrence of this disease. It was evident from that study that "more cases were reported in July and August than in any other months."[6]

Exposure to Lead

Lead compounds enter the body by three routes: (1) via the gastrointestinal tract; (2) via the lungs; and (3) through the skin.

In children the main route of entry is the gastrointestinal tract, but some cases have been caused by the inhalation of lead fumes, or the absorption through the skin of lead compounds.

The problem of lead poisoning in children from ingested lead is inseparable from the disorder known as pica. This is defined as a craving for unnatural articles of food, a depraved appetite. It is considered by some to be an exaggeration of the habit in young infants of attempting to place everything within reach into their mouths.

In children who suffer from pica, the sense of wholesomeness is lacking, and they crave sand, dirt, gravel, cinders, wall plaster, paper, paint and other substances. Although a child with pica craves many different types of things, it is very fortunate that most of these things are chemically inert and, although they occasionally lead to minor ailments, they do not cause any serious disturbance in the health of the child.

There is, however, one type of poisoning which these pica children may acquire, and that is lead poisoning. This may easily be overlooked, because the average physician has never had his attention called to the fact, and also because the clinical picture of lead poisoning in children is usually very different from that of poisoning in adults.[7 8]

Some children affected with pica have a morbid craving to gnaw painted objects, such as window sills, furniture, crib railings, porch railings and other articles around the home within their reach. A child lives in a lead world.

Colored chalks have also been incriminated, both at home and at school. Chalks of certain colors, namely, yellow, orange, and green, frequently contain large amounts of

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lead chromate. Nibbling on these chalks can be a potent source of lead.[9]

Since it has never been demonstrated that pica, when it exists, has seasonal variations, the answer to this hot weather increase in lead poisoning in children must be found elsewhere. The most satisfactory explanation of this seasonal pattern of increased incidence of this disease is probably as follows: (1) lead compounds must be present in the gastrointestinal tract, and (2) the body surface must be exposed to the vitamin D activating properties of ultraviolet rays, which increases the absorption of ingested lead from the gastrointestinal tract. A constantly increased absorption of lead would produce a higher concentration of lead in the body fluids, with a resultant increase in damage to the vital tissues. The sensitization by sunlight, of the increased amounts of porphyrin known to be present in persons with increased lead absorption, may also contribute to this seasonal incidence.[5]

Findings

The Laboratory Section of the St. Louis Health Division first offered chemical analytical service for the determination of lead in biological materials in 1946. The dithizone method of analysis, mixed color photometric technic, is used.

This service was made available without charge to all hospitals, clinics, and physicians in the City of St. Louis. A few years after this service had been established, it was apparent that there was a great increase in the number of samples of blood and urine submitted to the chemical laboratory for lead determination during the summer months. Approximately 90 per cent of the warm weather samples were obtained from infants and children. Therefore, starting in November, 1950, a study of the monthly incidence of lead poisoning cases in children was begun. The diagnosis, in every case, was made by the physician in charge of the case, who submitted the material for lead determination. The case was recorded as occurring in the month the diagnosis was made. Figure 1 illustrates our experience. The total number of cases, by months, are plotted together with the mean total sunshine hours and minutes per month. Mean monthly temperatures are recorded under the monthly legend.

The St. Louis experience may be summarized as follows:

In those months when the total sunshine hours are the greatest, the number of lead poisoning cases in childhood are the greatest; and in those months, wherein the total sunshine hours are the least, the number of lead poisoning cases in children are the fewest.

The relationship of temperature to the seasonal pattern of this disease is probably indirect. During the warmest months, less clothing is worn, and more out-of-door play is indulged in, with the result that an increased area of skin is exposed to the action of ultraviolet rays.

During four years, 246 cases of lead poisoning occurred in children. Fifty-six per cent of these cases occurred in the months of June, July, August, and September, the months in St. Louis with the greatest amount of sunshine. Seventy-eight per cent of these

FIG. 1

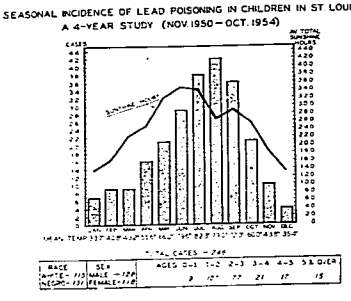
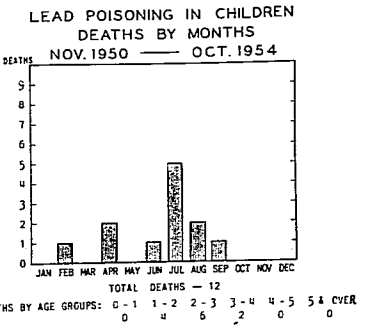


FIG. 2



cases occurred among children in the second and third year of life.

There were 12 deaths from lead poisoning in children during this four-year study. The case fatality rate was 4.9 per cent. Seventy-two per cent of the deaths occurred during June, July, August and September. Eighty-three per cent of the deaths occurred during the second and third year of life. There were no deaths during the first year of life, or after age four. There were no significant differences in the case fatality rates between the sexes, or between white and Negro children. Figure 2 shows our mortality experience.

We are certain that none of these cases were caused by the inhalation of lead fumes from the burning of discarded auto storage battery cases for fuel. Since 1948 we have had the support of an ordinance which requires that discarded battery cases be disposed of so as to be rendered "permanently inaccessible to the public." This ordinance is rigorously enforced.

With three exceptions all of these childhood cases of lead poisoning were hospitalized. All deaths occurred in a hospital.

From a public health viewpoint all measures directed towards the prevention of lead poisoning in children have as their basic strategy the idea of making lead compounds inaccessible to children. The tendency has been to rely on legislation. In France, since 1917, regulations have prohibited the use of lead pigments in paints used for toys, children's furniture, or on interior work. The Province of Ontario, Canada, since 1932, has required that all lead-containing paints supplied to makers of toys and children's furniture be so labeled. In Baltimore under the ordinance concerned with the hygiene of housing there is a regulation which reads as follows: "Interior painting. No paint shall be used for interior painting of any dwelling, or dwelling unit, or any part thereof, unless the paint is free from any lead pigment." Also in Baltimore in properties where lead poisoning in children has occurred, landlords have been required to remove lead paint from surfaces where there is flaking or where a child has chewed.[6]

Prevention through education is best carried on in the newspapers, in pediatric clinics, and in well baby conferences, or by visiting nurses, who should acquaint parents, especially those whose children exhibit pica tendencies, of the dangers of lead poisoning. The dangers arising from the repainting of old toys and furniture with paints of unknown composition should also be made clear to parents.

Summary

(1) Cases of lead poisoning in children, with fatalities, have occurred in St. Louis. The ingestion of material containing lead compounds is the cause.

(2) The incidence of lead poisoning in children in St. Louis is highest in the summer season, when the total actual sunshine hours are the greatest.

(3) The problem of pica is inextricably mixed with these cases of childhood plumbism.

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Discussion (Abstract)

Mr. C. M. Copley, Jr., St. Louis, Mo. My discussion of Dr. Lewis' paper will be concerned with the activities of public health agencies in regard to lead poisoning in children.

The first requirement for any program by a local health agency is to provide diagnostic laboratory services to the medical profession and hospitals. Such a service is not a simple matter since the difficult analytical technic requires a competent chemist if reliable results are to be obtained. Special sample kits must be made up and readily available (blood lead kits) with instructions to insure uncontaminated samples. St. Louis began providing "Blood Lead Service" in 1946.

The Public Health Agency must also notify the medical profession through children's hospitals and medical societies that the analytical service is available and information as to when use of the service is indicated.

Baltimore has done a great deal since 1935 in preventive medicine in this field. Its approach has

been to investigate all diagnosed cases and to require correction of scaling and chewed paint where poisoning has occurred. Landlords are required to remove flaking paint found by sanitarians, nurses, and other personnel during routine inspections, particularly in enforcing their code on the "Hygiene of Housing." This code prohibits interior painting with paints containing lead pigments.

St. Louis has acted so far only to legislate against burning battery cases after large outbreaks and a number of deaths had occurred from this source. This legislation assures the disposal of battery cases in permanently inaccessible dumps as in deep quarries or sanitary landfills. The results with this legislation have been spectacular since this source of poisoning can be readily controlled by searching out salvage operations and making battery cases inaccessible to the people who might burn them.

In the case of chewing of lead paint legislation is not nearly so effective. Inspections of slum dwellings are few in a large city like St. Louis which has about 65,000 slum dwelling units. The public demand for enforcement of housing laws never seems to be great enough to result in sufficient appropriations to do an adequate job in the face of the financial difficulty of most older large cities. Elimination of our slums is many years away.

Investigation of known lead poisoning cases and corrections ordered thereafter may prevent recurrence but is not preventive of new cases.

Legislation to prohibit future use of lead pigments inside houses and on toys and children's furniture undoubtedly helps to some extent and as time passes will have more effect.

Education of parents through literature, clinics, new releases, radio and television to watch for "pica" and lead poisoning may be very helpful. Dr. Williams, Health Commissioner of Baltimore, has evidence that the many educational activities undertaken in that city have helped. He states in his article in the March, 1952 "Public Health Reports" that: "It is not unusual now for a mother to take a child to a physician and to volunteer information on pica and suggest that the child may be suffering from lead poisoning."

In the long run, legislation coupled with education and with the gradual elimination of our large city slum housing problem should further reduce cases of lead poisoning in children.

Dr. Donald L. Thurston, St. Louis, Mo. I am a pediatrician and concerned with the problem of these children hospitalized with lead poisoning. Since arriving in St. Louis in 1946 the diagnosis of lead poisoning has increased tremendously, as you will notice by the graph. I think this is due to the information that has been disseminated to the physicians by those of us who are interested in lead poisoning. However, that in itself is insufficient to solve this problem of lead poisoning.

Baltimore thought it had the Utopian approach, but if you check its figures, you will find the incidence of lead poisoning is not decreasing, even in Baltimore.

Chicago recently awoke to the fact that it had the problem of lead poisoning. A review of statistics from that city shows very little to no occurrence of lead poisoning occurring, yet, when case histories were reviewed, the incidence was great.

I do not know what we are going to do about lead poisoning. Pica in a child is the first sign of danger. Paint in a house cannot be controlled by legislation because I can go to the local paint stores, get lead paint and smear it all over my house if I want to.

Therefore, we cannot reduce the exposure to lead by legislation, other than with the control of battery cases. This rapid type of lead poisoning has been controlled by public health programs.

I am interested in the treatment and the prevention of lead poisoning and here the pica problem is important. Some have felt that pica is a psychological disturbance. Children chew and will continue to do so; they will practice on the most available thing. In one case of lead poisoning no lead or teeth marks could be found in the house. But the bannisters in grandmother's house next door was chewed from the bottom to the top.

The problem is difficult and I believe the public health approach should be to make physicians in the community cognizant of the possibility of lead poisoning. That will reflect itself in a marked increase in the incidence of lead poisoning, and by education we may hope to eradicate it.

Concerning the future of children with lead poisoning, one feature should be stressed. A child with mild lead poisoning, in terms of no stomach symptoms, can show in the future evidence of damage to the brain. We have followed these children for 5 to 10 years, and we have no child who does not show brain damage, even though the only evidence of lead poisoning were x-ray changes in the ends of long bones.

Lead poisoning is a very serious illness, and presents a twofold problem, one to emphasize the need for early diagnosis and treatment, and the other the matter of prevention. If someone has an excellent idea on how to prevent it, I am sure we all will try to promote the program.