Info Pack on Interpretation of a Child's Tooth Lead Test Results

Info Pack by Elizabeth O'Brien, Manager, Global Lead Advice & Support Service (GLASS) run by The LEAD Group Inc charity, with kind permission to reprint from the recipient (who was male and born in 1985 in inner Sydney, Australia's most populous city) of this Info Pack emailed on 21 Jan 2021

Today I received your baby tooth lead (Pb) result from the Lidcombe lab of NSW Health Pathology showing the "left lower central incisor baby tooth" you lost in March 1993 when you were aged 8, contained 8.835 mg/kg (milligrams of lead per kg of tooth).

Your four previous tooth lead results ranged from 1.2 to 1.8mg/kg) on teeth (3 molars and a wisdom tooth) lost between 2009 (aged 24 & a half) to 2013 (aged 28).

And, in the article: "The Early Lead Poisoned Child In The Classroom: Symptomatology and Intervention for School Psychologists and School-Based Personnel; A WORD FROM THE EDITOR; Tooth Lead Analysis: Example of a report (May 1994)" at https://lead.org.au/lanv2n3/lanv2n3-10.html - the May 1994 example of a tooth lead result, was also your tooth, lost at age 7. That is:

Example of a Report (May 1994):

Description: Deciduous Crown – Upper left central incisor. Sample mass = 0.1915 g.

Result: 22.2 µg/g (micrograms per gram) or ppm (parts per million) – note that these units are exactly the same as mg/kg so your first tooth lead result can also be written as 22.2 mg/kg.

Thus, during the development of your upper central incisor, you likely had the highest blood lead level of your childhood, resulting in a tooth lead level of 22.2 mg/kg, but today's result shows that the (later developing) lower central incisor had a much-reduced tooth lead level of 8.835 mg/kg and your (much later developing) molar and wisdom teeth results were even lower at 1.2 to 1.8 mg/kg.

If your parents had known that they needed to test blood lead levels between the ages of 1 and 6 years (when your blood lead level was 14 µg/dL or micrograms per decilitre), you wouldn't have needed to test all these teeth but, now that you have these five teeth lead results, they seem to confirm that you probably had a typical blood lead level graph shape rising (from crawling age) to a childhood peak (during top front teeth development) sometime between 12-24 months, then falling again to the pre-crawling level by the time your molars were developing.

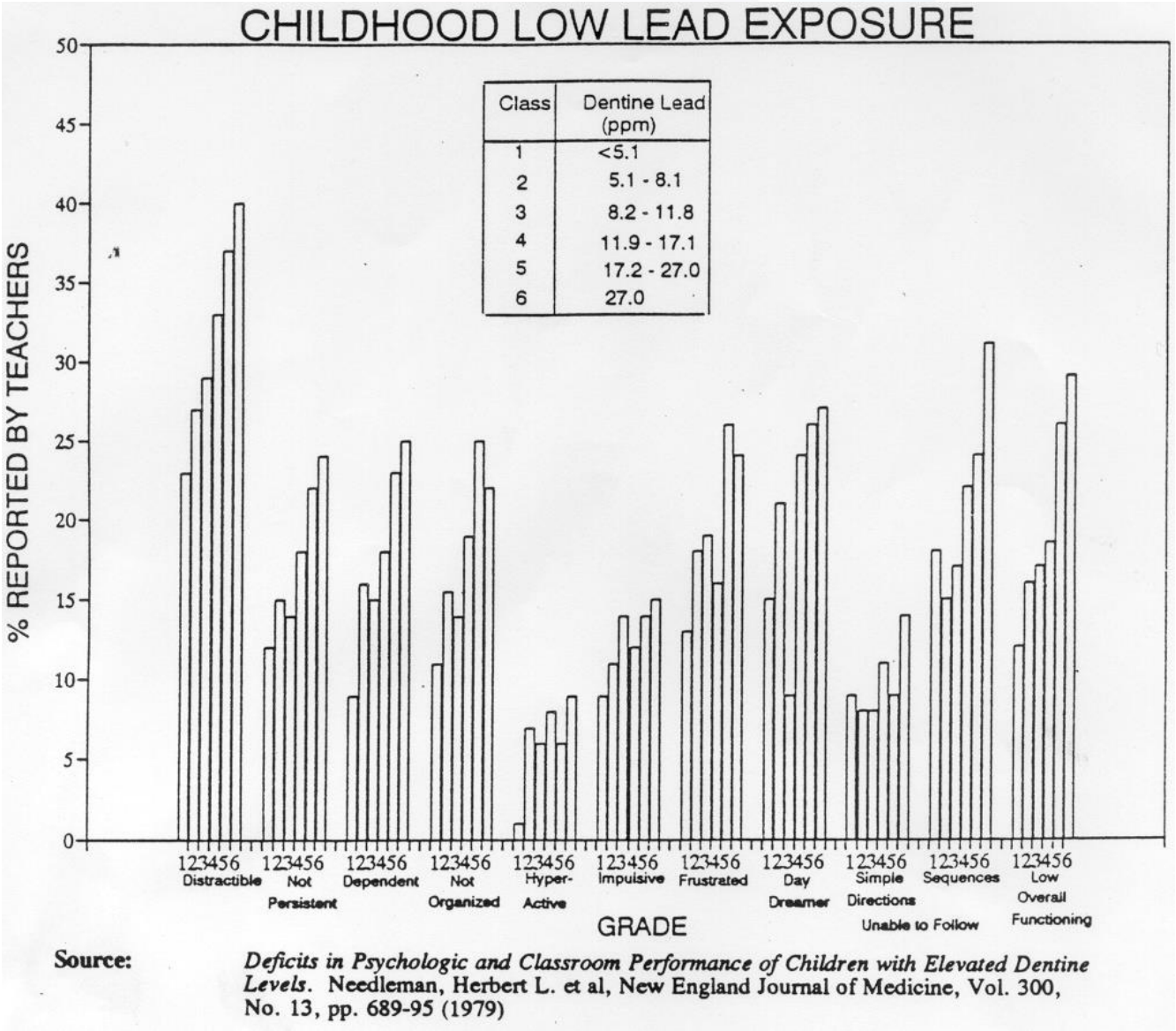
General comments on interpreting tooth lead results:

When interpreting tooth lead results, it's important to know how old the children were when they lost the teeth that you have tested for lead and preferably also, the age at which they developed the particular teeth tested. That will make a difference to the conclusions you can draw from the results. If the tested teeth for two children were developed at approximately the same age, then it can become clear whether one child has had more lead exposure than

the other, at that age. If two tested teeth from one child were developed at different ages, then it can become clear that the child experienced more or less lead exposure at the times of the development of those two teeth.

You can compare your children's (or your own baby) tooth lead results to the findings for other children from three studies in which petrol lead was likely to be the major source of the lead found in the children's teeth.

They're reported at https://www.lead.org.au/lanv2n3/lanv2n3-10.html - that is:



A. "Deficits in Psychologic and Classroom Performance of Children with Elevated Dentine Levels" by Needleman, Herbert et al (1979) in which the graph labelled "CHILDHOOD LOW LEAD EXPOSURE" gives results on a range of US children's learning behaviours, as reported by their teachers, for the different tooth lead level ranges: 1. less than 5.1 ppm [parts per million, which is exactly equivalent to < 5.1 µg/g (less than 5.1 micrograms per gram) which is exactly equivalent to < 5.1 mg/kg (milligrams per kilogram)]; up to 6. greater than 27 ppm [>

27 µg/g or > 27 mg/kg].

According to the *Obituary for Herbert Leroy Needleman* in the Lancet in 2017, at https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32245-6/fulltext :

"He [Dr Herbert Needleman] came up with the idea of looking at lead in children's shed teeth", says Bernard Goldstein, a friend of Needleman's ... "No one had thought of that before." Needleman set about collecting deciduous teeth from dental practices in suburban and inner-city areas [of Philadelphia, PA]. The latter turned out to have five times as much lead as the former. The differences were so pronounced that, as Needleman described, "I could guess the kids' race and where they lived. If [the lead concentration] was over 20 ppm, it was a black kid from the inner city. If it was under 5, it was a white kid from Northeast Philadelphia."

B. In a study published by H T Delves, Southampton General Hospital, UK

(1982) the range of lead in deciduous crowns collected from a control group of children was 1.0 to 26.9 µg/g, with a mean of 4.7 µg/g.

C. In unpublished research (1990) by Graeme Waller involving a study of 221 deciduous crowns collected from children in the Sydney area the range of lead was: 1.7 to 38.2 µg/g, with a mean of 5.4 µg/g.

An older study in which the major source of lead was also petrol, is:

"Tooth Lead Levels in Birmingham Children" by Mackie et al, (1977) [ABSTRACT ONLY AT http://www.ncbi.nlm.nih.gov/pubmed/889356] which states:

"The mean lead content of deciduous teeth from children living in the city of Birmingham (U.K.) has been shown to be 11.8 ppm dry weight, irrespective of the sex of the donor."

You can also compare your children's results to studies of tooth lead where the major source of the lead was a lead smelter, such as:

"Tooth Lead Levels and IQ in School-Age Children: The Port Pirie Cohort Study" (15/09/1994) by McMichael *et al* at https://academic.oup.com/aje/article-abstract/140/6/489/83420?redirectedFrom=fulltext&login=false [NB the placename in the online Abstract title is wrongly written as "Port Pine"] which states:

"The relation between lead concentration in deciduous central upper incisor teeth and intellectual functioning was examined in 262 children who were followed from birth to age 7 years in the lead smelter town of Port Pirie, South Australia, and its environs....

"The geometric mean concentration of lead in incisors was 8.6 µg/g...

"the decline in IQ points across the tooth lead range from 3 to 22 ppm is 5.1 points. (This range.... encompasses almost exactly 90 percent of the study population)..."

The problem with old studies like the one above, is that it was believed until recently, that low blood lead levels (and therefore presumably low tooth lead levels) caused no IQ loss, and that there was a threshold for IQ loss such as 10 micrograms per decilitre (µg/dL) blood lead level, or 3 ppm for tooth lead.

The whole theory of no IQ loss below 10 µg/dL has been debunked and the latest hypothesis

is that the IQ loss when a child's blood lead level rises from zero to 10 µg/dL, is MORE than the IQ loss in the same child, if the blood lead further rises from 10 to 20 µg/dL. For instance, a child with a blood lead level averaging 10 µg/dL over the first several years of life, has probably already lost up to 7 IQ points, whereas a child averaging 20 µg/dL over the first several years of life has probably lost up to 10 IQ points. Further research may show that the same applies to "low" tooth lead results - the impact of the first rise from say zero to 3 ppm, may be more significant than the impact of a further rise from say 3 ppm to 6 ppm.

IF your children's tooth lead levels are lower than any of the mean results in the 1982 and 1990s studies, we can all celebrate the fact that we were successful in banning lead in petrol in Australia in 2002.

It is quite possible that if there is a difference in the tooth lead results for a younger child and an older child, the decrease could at least partially or wholly be due to this 2002 Australian phase-out date for leaded petrol (or the phase-out year in the country where the children grew up, if that wasn't Australia).

If you had a 19 year old and that child's result was < 5.1 µg/g (the lowest range of the Needleman study subjects results), IF the teeth tested were baby teeth / first teeth, I would venture that the child had probably had more exposure to lead as an infant than other 19 year old children, because, with the amount of lead in petrol having gone down gradually to zero by January 1st 2002, other children aged 19 now (in 2021) would be expected to have demonstrated falling blood lead levels over the first 3 years of their life, and thus lower tooth lead levels compared to 3 year olds born a decade earlier and the decade before that, etc. If the child with a tooth lead result >1 µg/g is struggling at school, it could be as a result of pre-birth exposure to lead, and early-life exposure to lead (both of which are apparent in the tooth lead results if these were baby teeth) but could also be a result of later lead exposure, and/or some other cause/s.
