

People in biblical Israel 3,000 years ago suffered lead pollution

Industrial zone pollution is nothing new: Analysis of teeth shows 25 times the baseline level of lead in some Iron Age city dwellers in the Levant

Ariel David | Nov. 19, 2020 | 1:50 PM

While human-induced climate change is a modern phenomenon, we turn out to have been poisoning the environment and ourselves for thousands of years. Already 3,000 years ago a significant number of city dwellers across the Levant had elevated levels of lead in their bodies, a new study has shown.

Analysis of teeth found in burials at urban sites across Israel elucidated that almost a third of the sampled individuals had been exposed to the toxic heavy metal during childhood, possibly even while still in the womb, reports a team of Israeli geoscientists and archaeologists.

The contamination was possibly linked to the booming Mediterranean metal trade during the Iron Age and the increasing presence of metallurgical workshops in town centers across the Levant, the researchers reported this month in the *Journal of Archaeological Science*.

To be clear, the levels detected in the biblical-era inhabitants of the Holy Land would not have been high enough to trigger the crippling effects of lead poisoning, explains Prof. Yigal Erel, a geochemist from the Hebrew University in Jerusalem who spearheaded the study. The amounts also pale in comparison to the already known high levels of lead pollution experienced in the Roman Empire and in modern times, Erel tells Haaretz. Still, the study does give us an indication of when and how we and our environment started paying a price for technological advancement, he says.

We are what we eat

The researchers conducted chemical analyses on 41 teeth from 31 individuals who lived between around 1200 B.C.E. to 332 B.C.E. in settlements ranging from Abel Beth Maacah and Megiddo in today's northern Israel to the once mighty Philistine city of Gath in the south. While defining the ethnicity of skeletons can often be tricky, it is safe to assume that the teeth in the study came from the broad mosaic of peoples who inhabited the Levant during the

Iron Age and who appear frequently in the Bible: Philistines, Canaanites, Israelites, Arameans, Phoenicians and others.

In recent years, the use of advanced scientific methods to study teeth, either the enamel or fossilized dental plaque, has provided archaeologists with a wealth of information on the diet, health and migrations of human populations going back to prehistoric times.

Enamel is the hardest and most durable material in the human body, so well-preserved teeth are not an uncommon find in archaeological digs. It also forms throughout early life, starting during gestation and continuing into our second decade, depending on which tooth we are talking about. As it grows, the enamel incorporates substances in our food, water and air, which can give scientists information on where we grew up and what chemicals we were exposed to.

The Bronze Age was cleaner

In the case of this study, the researchers found that nine out of the 31 Levantines they analyzed had higher lead levels than a baseline established by examining the teeth of local Neolithic populations who lived before metallurgy was invented and would have been exposed only to natural background sources of heavy metals.

On average, the contaminated Iron Age people had around 25 times the amount of lead found in the baseline. That may sound onerous but it does compare favorably to the 100-fold increase in Roman times, when water pipes, household utensils, cosmetics and even some foods made with lead were all the rage. It is also much less than the 1,000-fold increase in modern people in the 20th century, before lead-based additives in fuel were phased out, the study notes.

So while they still died young for many other reasons, people in the Iron Age probably did not have to worry too much about lead poisoning, whose symptoms include mental retardation and stunting in the young, general fatigue, mental derangement, bad temper and much more.

It should be noted though that the study only measured lead contamination during childhood and early adulthood, and we don't know if these individuals were subjected to further exposure later on in life, after their teeth had formed.

“The third molars [aka, the wisdom teeth] develop last, so we used as many third molars as possible to catch the oldest possible age that we could say something about,” explains Tzilla Eshel, an archaeologist from the Hebrew University and the University of Haifa who is the top author on the study.

It is also not clear how representative of Iron Age populations the small sample of 31 individuals can be considered, Eshel cautions. But it is still notable that similar contamination is not found in individuals from the previous Copper and Bronze ages, even though, as their very names suggest, people in these periods were already using metals, notes Erel.

“We don’t we see very much pollution in these two periods, but in the Iron Age we start seeing people having some excess levels of lead in their teeth,” he says.

The extra lead would have been absorbed from the air, food and water, but its original source is not entirely clear. One factor in the increase may have been the location of metal workshops during the Iron Age, says Prof. Aren Maeir, an archaeologist from Bar Ilan University who heads the excavation of the Philistine city of Gath, one of the sites from which sample teeth were taken.

“In antiquity, polluting activities were not removed far from a site,” Maeir says. “For example, at Gath, two metal producing areas were right in the center and next to two temples.”

Smelting and casting metals at these workshops may have released lead into the nearby environment. For example, during the Iron Age, most copper used in the Levant came from the Aravah Valley, in the southern deserts of today’s Israel and Jordan. This copper ore is known to be very lead-rich, as opposed to copper from Cyprus, which was the main source for this metal during the Bronze Age, Erel says.

Blame the Phoenicians

Another factor raising Levantine lead levels may have been the increase in metal trading, especially the import of silver. This precious metal is mostly a byproduct of other ore mining and is especially found in association with lead, Eshel explains. So an increase in silver mining was generally accompanied by a flood of extra lead on the market.

“This is why later on the Romans liked lead so much,” Eshel says. “They knew it was polluting but they mined a lot of silver, which left them with an

enormous amount of lead on the side, and once you have a lot of lead, you use it.” Back in the Iron Age, starting in the 10th century B.C.E., there was an increase in the Mediterranean trade of silver and other metals brought in from mines in Spain and Sardinia by Phoenician merchants, she says.

An unwitting contribution of the Phoenicians to this early pollution has also been suggested by a separate study of ice cores from Greenland, published in the journal PNAS in 2018. The Arctic ice sheets contain a record of our planet’s atmosphere and the researchers in that study identified an initial spike of lead in the air during the early Iron Age, which they attributed to the rise of the Phoenician trading empire.

To check whether trade played a role in the contamination of the Levantine people, Erel and colleagues looked at another mineral that is deposited in our teeth by food and water: strontium.

The ratio of strontium isotopes (variants of the same element with a different number of neutrons) varies from place to place. The strontium signal in our teeth can therefore help tell whether people grew up in the same area where they died, or were born elsewhere and migrated.

The people not contaminated by lead seem to have been pretty sedentary, whether they lived inland or on the coast. Conversely, all those who had elevated lead levels showed strontium signatures typical of the coastal environment, even if their bodies were found in inland towns.

In other words, the contaminated individuals seemed to have been particularly mobile, hinting they may have been involved in the metal trade, which was centered on the Levantine coast, Eshel says.

It bears stressing that the sample in this study was small and the number of contaminated individuals even tinier, so it is difficult to draw conclusions based on these figures, qualifies Prof. Erez Ben-Yosef, a Tel Aviv University archaeologist and an expert on ancient metallurgy.

“The correlation between engagement with metal trade and pollution is not really supported,” says Ben-Yosef, who was not involved in the study. “The analytical method itself is robust, and the observation that some people in the Iron Age had some not-toxic levels of lead in their teeth is valid. However, to better understand the ‘so what?’ we need much more data from other periods and regions.”

The recent study is only a first step in uncovering the broader picture of the early history of pollution, Erel and colleagues agree.

“It’s part of a journey of trying to expose the dark side of technological advances, specifically of metallurgy,” Erel says. “We know this from modernity, from the industrial revolution onwards, but it goes much farther back in time: When people mined and worked metals they polluted the environment and they polluted themselves.”