

Skull malformations in lions is a consequence of a combination of environmental and genetic factors

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Foramen magnum of lion (*Panthera leo*) skulls; right: skull of a healthy lion, left: malformed skull. Credit: Dr. Merav Shamir

An international team of researchers led by scientists from the Hebrew University of Jerusalem and the Leibniz Institute for Zoo and Wildlife Research (IZW) Berlin examined the incidence of skull malformations in lions, a problem known to be responsible for causing neurological diseases and increased mortality. Their results suggest that the occurrence is a consequence of a combination of environmental and genetic factors. These findings were published in the scientific journal *PLOS ONE*.

The scientists studied the morphology of 575 lion skulls in museum

collections in North America, Europe, Asia, and Africa and noted the incidence of malformations with respect to the death place of lions – died in the wild or in captivity. The researchers compared the results with skulls of tigers, a similar-sized obligatory carnivorous predator. Whereas tiger skulls of captive origin had a similar incidence of malformations as those of wild origin, large differences occurred between lion skulls from both sources.

Lions have been kept in captivity for centuries and, although they reproduce well, high rates of stillbirths as well as substantial morbidity and mortality of neonates and young lions are reported. Many of these cases were attributed to bone malformations of the skull, including the narrowing of the foramen magnum, the opening at the rear of the skull through which the spinal cord connects to the brain and which can cause associated [neurological diseases](#).

A scientific collaboration between scientists from the Hebrew University of Jerusalem, the IZW Berlin, University of Oxford, the Zoological Center Tel Aviv-Ramat Gan, and the Blue Pearl NYC Veterinary Specialists showed that only 0.4 % of lion skulls from the wild had a narrowing of the foramen magnum whereas the constricted opening of the foramen magnum had a forty-fold higher chance to occur in lion skulls from captivity (15.8 %). Lion skulls from captivity were also wider and had a smaller cranial volume. These findings in lions and their absence in tigers suggest the presence of an interaction of the rearing environment and a heritable predisposition of lions to the pathology. "The morphological changes in many of the lion skulls from captivity suggest that some of these lions possibly died because the hind brain and spinal cord were compressed by abnormal and excessive bone formation in their skulls, resulting in severe neurological abnormalities", says Dr Merav Shamir from the Hebrew University of Jerusalem. "It would be interesting to know whether this is a lion-specific phenomenon. Similar investigations in other big cats would be valuable to answer this

question", added Dr Nobuyuki Yamaguchi from the University of Oxford.

This anomalous skull morphology has been documented in captive [lion](#) skulls dating back as far as the 15th century, and been the subject of many studies since. "And yet", says Dr Joseph Saragusty from the Leibniz Institute for Zoo and Wildlife Research, " the cause of these morphological changes is still not known. The ongoing loss of captive lions to the disease highlights the need for further investigation with a view to reducing its occurrence."

More information: Saragusty J, Shavit-Meyrav A, Yamaguchi N, Nadler R, Bdolah-Abram T, et al. (2014) "Comparative Skull Analysis Suggests Species-Specific Captivity-Related Malformation in Lions (*Panthera leo*)."
PLoS ONE 9(4): e94527. [DOI: 10.1371/journal.pone.0094527](#)

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