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# Artificial turf infill associated with systematic toxicity in an amniote vertebrate

Elvis Genbo Xu, Nicholas Lin, Rachel S. Cheong, Charlotte Ridsdale, Rui Tahara, Trina Y. Du, Dharani Das, Jiping Zhu, Laura Peña Silva, Agil Azimzada, Hans C. E. Larsson, and Nathalie Tufenkji

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Edited by Catherine J. Murphy, University of Illinois at Urbana–Champaign, Urbana, IL, and approved September 30, 2019 (received for review June 8, 2019)

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## Significance

Athletes and children are playing on artificial turfs. However, the health risk associated with exposure to crumb rubber from artificial turfs is unknown for higher vertebrates. Here, we employed chicken embryo as a developing amniote vertebrate model to show that toxic leachate from artificial athletic turf infill impairs the early development of chicken, notably brain and cardiovascular system. This study triggers a scientific discussion as to whether crumb rubber is an appropriate infill material for artificial fields.

## Abstract

Artificial athletic turf containing crumb rubber (CR) from shredded tires is a growing environmental and public health concern. However, the associated health risk is unknown due to the lack of toxicity data for higher vertebrates. We evaluated the toxic effects of CR in a developing amniote vertebrate embryo. CR water leachate was administered to fertilized chicken eggs via different exposure routes, i.e., coating by dropping CR leachate on the eggshell; dipping the eggs into CR leachate; microinjecting CR leachate into the air cell or yolk. After 3 or 7 d of incubation, embryonic morphology, organ development, physiology, and molecular pathways were measured. The results showed that CR leachate injected into the yolk caused mild to severe developmental malformations, reduced growth, and specifically impaired the development of the brain and cardiovascular system, which were associated with gene dysregulation in aryl hydrocarbon receptor, stress-response, and thyroid hormone pathways. The observed systematic effects were probably

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due to a complex mixture of toxic chemicals leaching from CR, such as metals (e.g., Zn, Cr, Pb) and amines (e.g., benzothiazole). This study points to a need to closely examine the potential regulation of the use of CR on playgrounds and artificial fields.

artificial turf   amniote model   tire crumb   embryonic development   environmental health

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## Footnotes

↵<sup>1</sup>To whom correspondence may be addressed. Email: [hans.ce.larsson@mcgill.ca](mailto:hans.ce.larsson@mcgill.ca) or [nathalie.tufenkji@mcgill.ca](mailto:nathalie.tufenkji@mcgill.ca).

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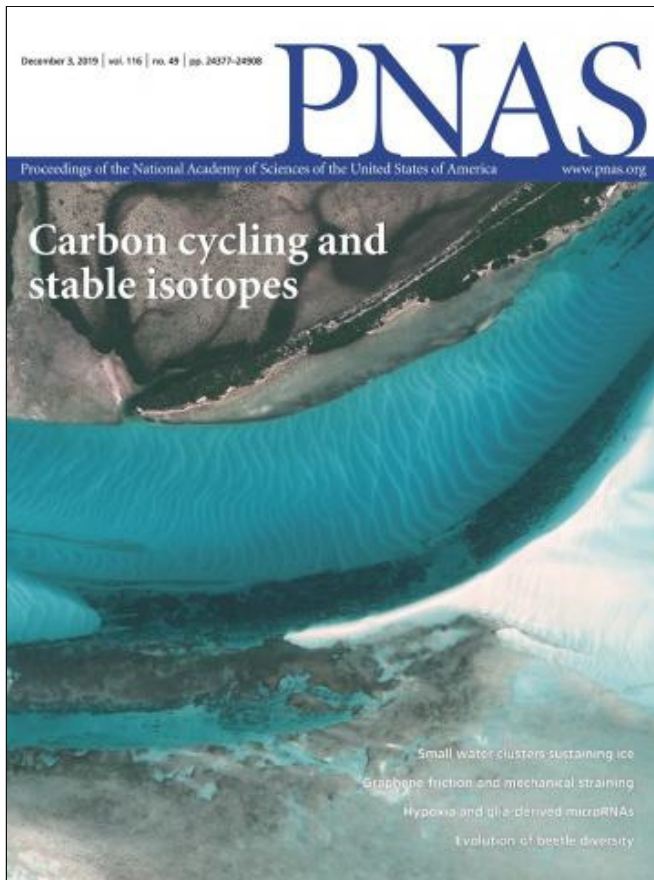
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