



Environmental hazards and child growth. Nuclear techniques to monitor mycotoxin exposure.

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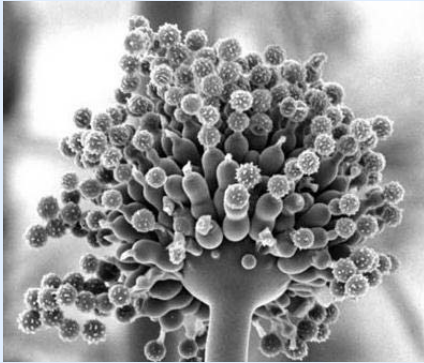
**Nuclear Techniques
in Human Health**

Prevention, Diagnosis, Treatment



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Mycotoxin exposure occurs via contaminated food



Mycotoxins produced by certain fungi growing on food crops

Aflatoxins and fumonisin are two common mycotoxins



Aflatoxin and fumonisin can occur on maize

Aflatoxin (but not fumonisin) increases with storage



Aflatoxin occurs on peanuts

Aflatoxin has both health and economic impacts

About 500 million of the poorest people in sub-Saharan Africa and South-east Asia are exposed to aflatoxin

Aflatoxin can cause death from acute liver poisoning, with notable outbreaks in Kenya in 2004 and Tanzania in 2016

Aflatoxin exposure has been estimate to contribute to 28% of primary liver cancer incidence

It has been estimated that aflatoxin may be responsible for up to \$1.68 billion annual economic losses in maize production in the USA alone



How can we measure individual exposure to aflatoxin or fumonisin?



Biological markers integrate dose, absorption & metabolism

Biomarkers of exposure may be:

- **diet varies little between individuals**
- **contamination is heterogeneous within a given batch of a food commodity.**



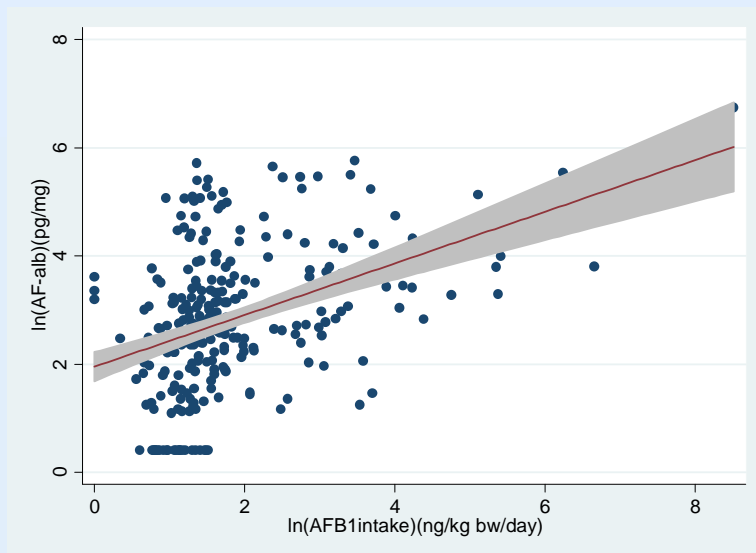
Compound or its metabolites in blood or urine



DNA or protein adducts in target or non-target tissue (white blood cells/albumin/haemoglobin)

Biomarkers to measure exposure

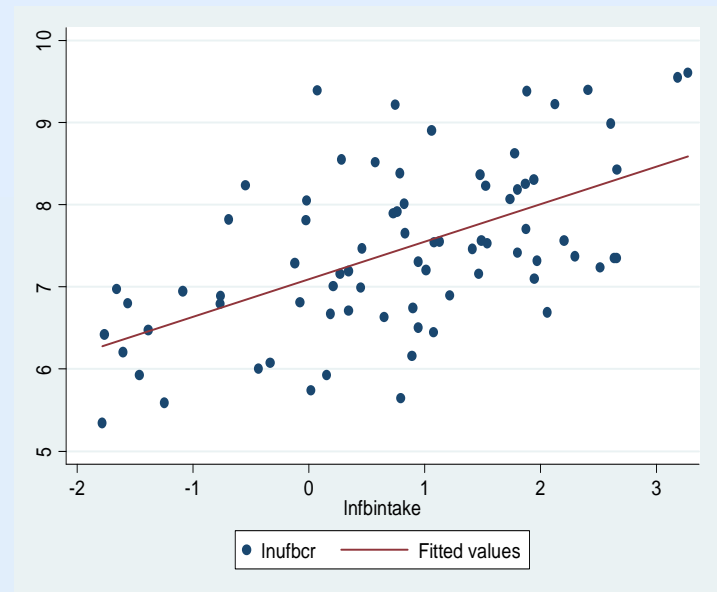
Aflatoxin albumin adducts in blood (ELISA)



AF-alb versus dietary aflatoxin intake

Routledge et al (2014) *Biomarkers* **19**, 430-435

Urinary fumonisin B1 (stable isotope dilution assay by LC/MS)

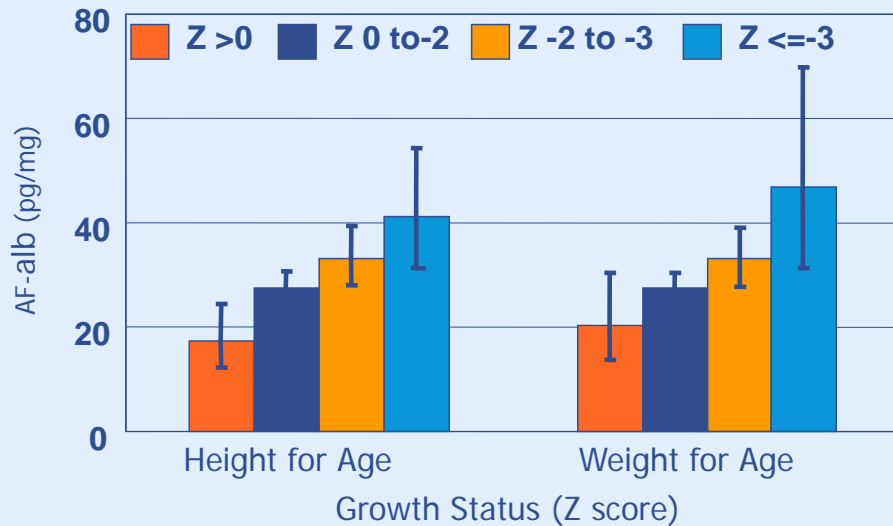


Urinary FB1 versus dietary intake

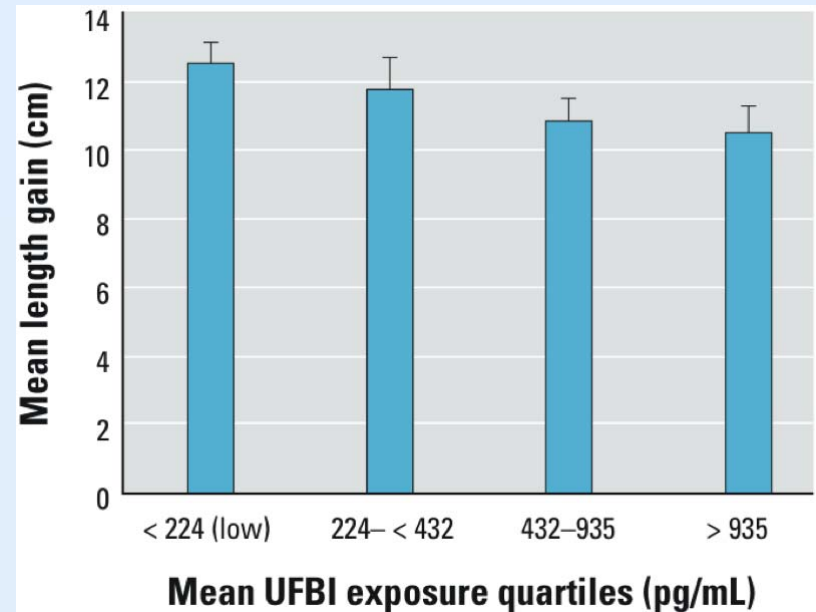
Shirima et al (2013) *Mol. Nutr. Food Res.* **57**, 1874-1871

Aflatoxin and fumonisin have been associated with impaired growth in children

These studies in Benin (in 2001) and Tanzania (in 2012) used biomarkers to assess exposure in children



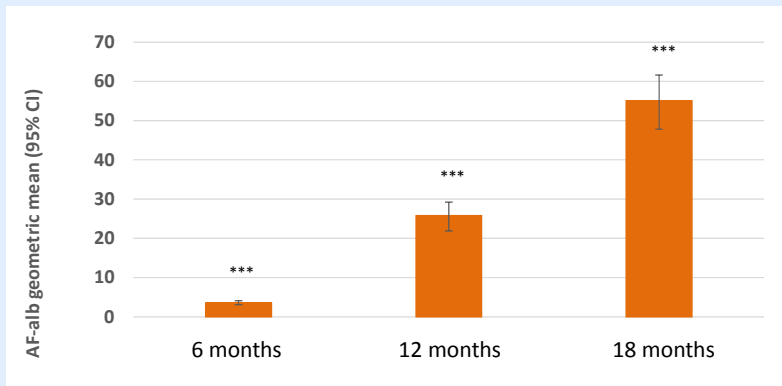
Gong et al (2002) *British Medical Journal* **325**, 20-21



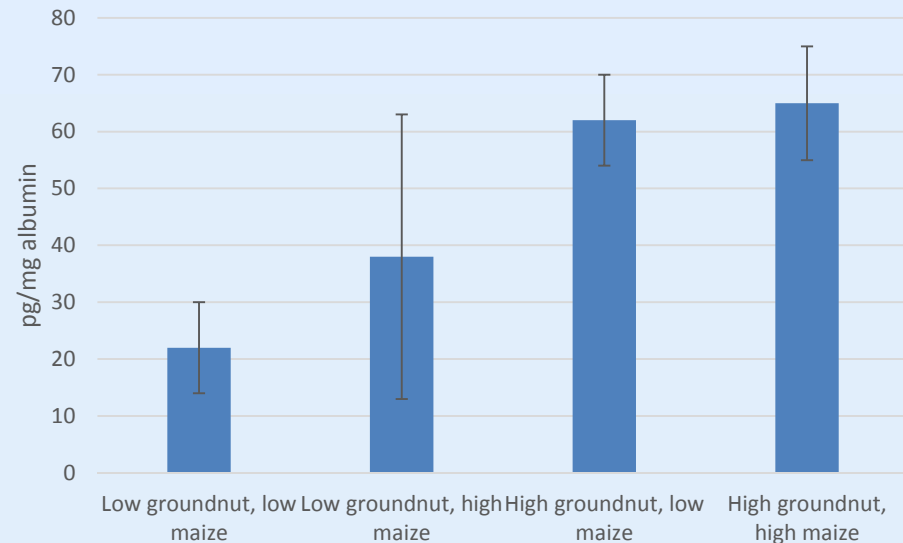
Shirima et al (2015)

Environ. Health Perspectives **123**, 173-178

Biomarker data can reveal trends of exposure



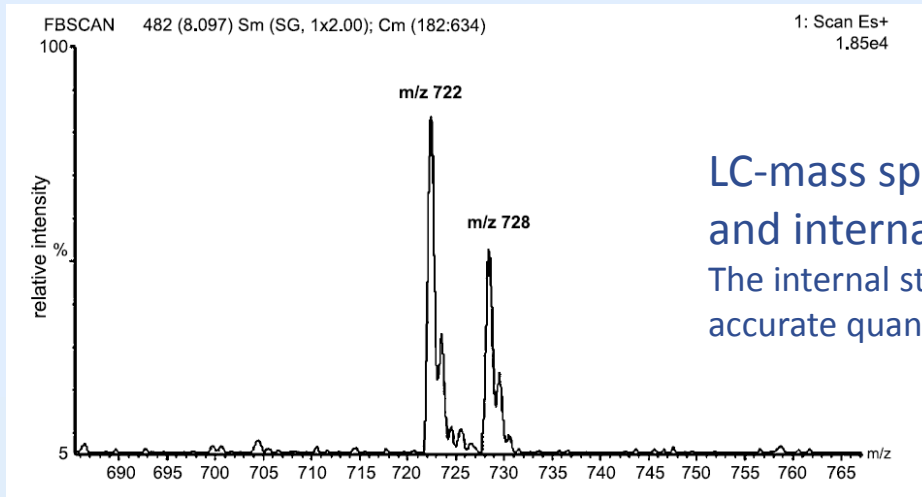
Exposure in Gambian children increases as they are weaned onto family food



Exposure to aflatoxin in Senegal higher in groundnuts versus maize

Stable isotope methods for fumonisin B1....

In Mexico, fumonisin B1 (FB1) intake has been associated with neural tube birth defects



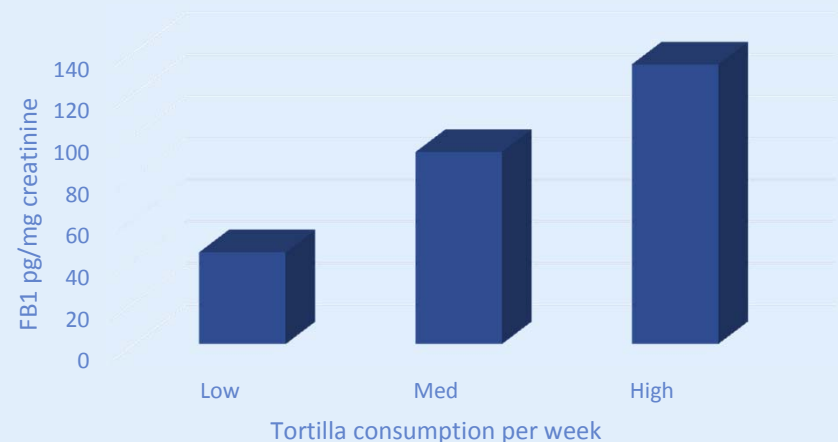
LC-mass spectra of a mixture of FB1 (m/z 722) and internal standard FBd6 (m/z 728)
The internal standard added in fixed amount allowing accurate quantification of FB1



Maize tortillas in Mexico linked to FB1 intake

Gong et al, *Cancer Epidemiological Biomarkers Prevention* 2008;17(3):688-94

FB1 intake by tortilla consumption



Evaluation of intervention effectiveness

Published OnlineFirst January 25, 2011; DOI:10.1158/1055-9965.EPI-10-1002

Cancer
Epidemiology,
Biomarkers
& Prevention

Research Article

Fumonisin B₁ as a Urinary Biomarker of Exposure in a Maize Intervention Study Among South African Subsistence Farmers

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Baseline			Training	Intervention		
Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Consume porridge	Consume porridge	Collect first-void urine	Sorting/washing of maize	Consume porridge	Consume porridge	Collect first-void urine
	Collect first-void urine		Collect sorted/washed maize	Collect first-void urine		

Study protocol: handsorting method to reduce maize fumonisins contamination, evaluating the intervention effectiveness with the urinary FB1 biomarker

Finding: the intervention reduced FB1 intake and urinary FB1 biomarker level

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International Agency for Research on Cancer



Keneba, Gambia, September 2015

