World Health Organization

Global Disease Burden of Four Foodborne Chemicals

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World Health Organization

Food safety

Chemical risks

Chemicals can end up in food either intentionally added for a technological purpose (e.g. food additives), or through environmental pollution of the air, water and soil. Chemicals in food are a worldwide health concern and are a leading cause of trade obstacles.

WHO develops scientific risk assessments to define safe exposure levels which form the basis for the development of national and international food safety standards to protect the health of the consumers and ensure fair trade practices.

Poisoned food in shops for THREE WEEKS: Supermarkets clear shelves of cakes and quiches containing contaminated eggs from Germany

By DAVID DERBYSHIRE FOR MAILONLINE
UPDATED: 08:32 EST, 8 January 2011

Food Safety News
Breaking news for everyone's consumption

Dioxin Scare Halts German Egg Sales

By News Desk | January 5, 2011

Melamine

WHO Expert meeting to review toxicological aspects of melamine and cyanuric acid

Held in collaboration with FAO and supported by Health Canada Ottawa, Canada, 1-4 December 2008

NSW GOVERNMENT Food Authority

Follow up survey of cyanogenic glycosides in ready-to-eat cassava chips

UCD DUBLIN

UCD GEARY INSTITUTE DISCUSSION PAPER SERIES

Public Perceptions of the Dioxin Crisis in Irish Pork

June 2009

OPEN ACCESS Freely available online

PLOS | ONE

Urinary and Dietary Analysis of 18,470 Bangladeshis Reveal a Correlation of Rice Consumption with Arsenic Exposure and Toxicity

Stephanie Melkonian[1], Maria Argos[1], Megan N. Hall[2], Yu Chen[4], Faruque Parvez[2], Brandon Pierce[1], Hongyuan Cao[1], Briseis Aschebrook-Kilfoy[1], Alauddin Ahmed[5], Tariqul Islam[5], Vesna Slavcovich[3], Mary Gamble[3], Parvez I. Haris[6], Joseph H. Graziano[2,3], Habibul Ahsan[1,7*]

Global Disease Burden of Four Foodborne Chemicals

Cancer Epidemiology, Biomarkers & Prevention

Research Article

The Global Burden of Disease for Skin, Lung, and Bladder Cancer Caused by Arsenic in Food

Shilpi Oberoi[1], Aaron Barchowsky[1,2], and Felicia Wu[3]

Research Article

Contaminated Turmeric Is a Potential Source of Lead Exposure for Children in Rural Bangladesh

Kelsey Gleason,[1] James P. Shine,[1] Nadia Shobnam,[2] Lisa B. Rokoff,[1]
Hafiza Sultana Suchanda,[3] Md Omar Sharif Ibne Hasan,[3] Golam Mostofa,[3]
Chitra Amarasiriwardena,[4] Quazi Quamruzzaman,[5] Mahmuder Rahman,[3] Molly L. Kile,[5]
David C. Bellinger,[1,6] David C. Christiani,[1] Robert O. Wright,[4] and Maitreyi Mazumdar[1,6]

Global methylmercury exposure from seafood consumption and risk of developmental neurotoxicity: a systematic review

Mary C Sheehan,[a] Thomas A Burke,[b] Ana Navas-Acien,[c] Patrick N Breysse,[c] John McGready[d] & Mary A Fox[b]

Chemical & Toxins Task Force

- Herman Gibb (USA), Chairperson
- Gabriel Adegoke (Nigeria)
- Reza Afshari (Iran)
- Janis Baines (Australia)
- Kalpana Balakrishnan (India)
- David Bellinger (USA)
- Michael Bolger (USA)
- Rolaf van Leeuwen (Netherlands)
- John Pitt (Australia)
- Philippe Verger (France)

Groups of Chemicals & Toxins Considered by the Chemical & Toxins Task Force

- Elemental contaminants (e.g., lead, mercury, cadmium, manganese, arsenic)
- Mycotoxins (e.g., aflatoxins, ochratoxins, fumonisins, trichothocenes)
- Food additives (e.g., sulphites, nitrites/nitrates, benzoic acid)
- Pesticides/residues (e.g., organophosphates, carbamates, DDT, pyrethrins)
- Organic industrial pollutants (e.g., persistent organic pollutants)
- Veterinary drugs/residues (e.g., antibiotics, hormones – but not antimicrobial residues)
- Seafood toxins (e.g., tetrodotoxin, ciguatera, shellfish toxins, DSPs, PSPs, histamines)
- Process contaminants (e.g., acrylamide, PAHs, chloropropanol)
- Allergens (e.g., peanuts)
- Natural toxicants (e.g., cyanide in cassava, aminoglycosides)
- Radionuclides and depleted uranium

Hazards were Ranked on:

- Severity of potential health effects
- Prevalence of exposure
- Availability of data to make burden estimates

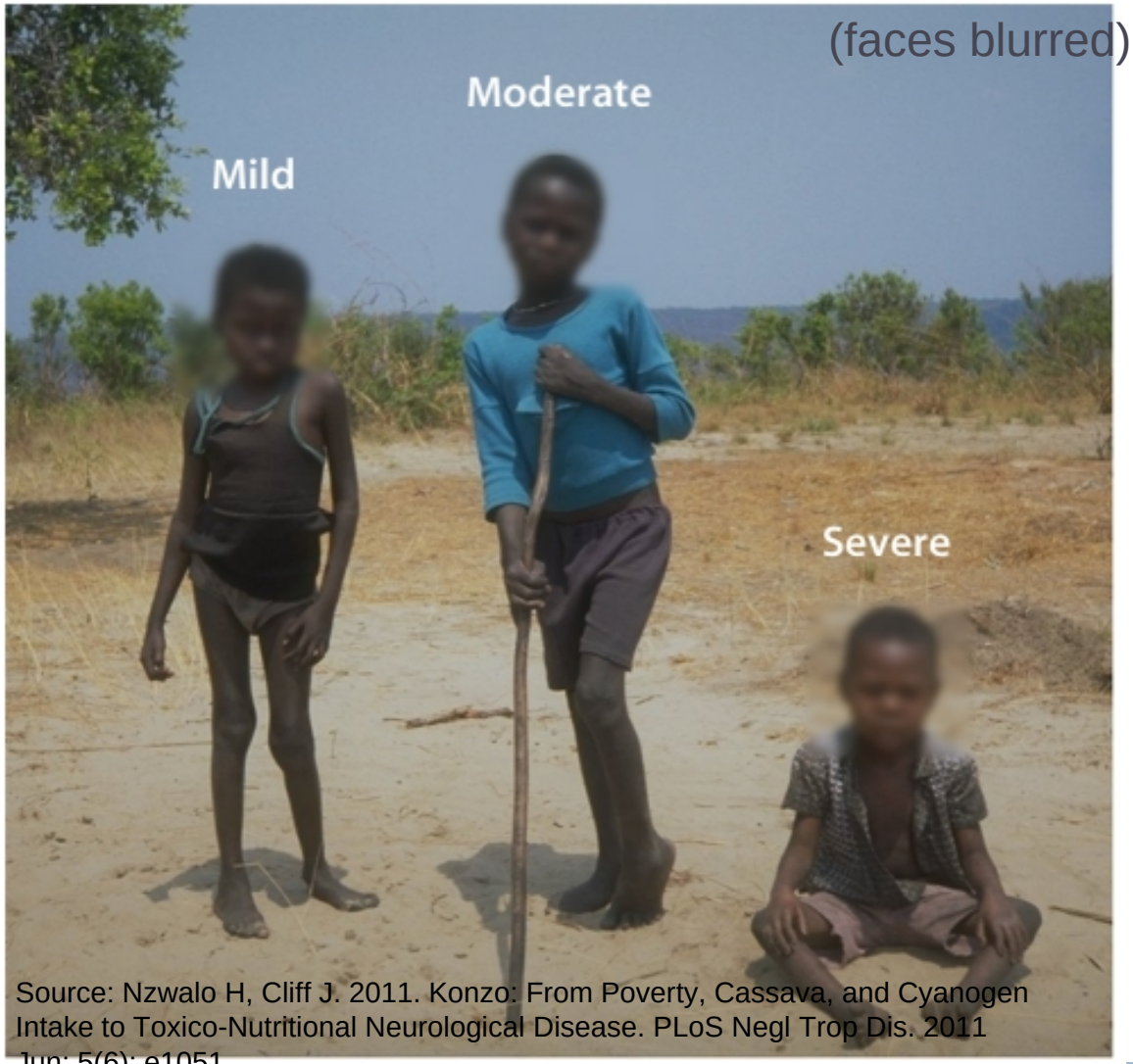
Hazards Selected and the Scientists Commissioned to Work on the Hazard

Hazard	Commissioned Scientist
Aflatoxin	Dr. Felicia Wu (Michigan State University, USA)
Peanut allergen	Dr. Janine Ezendam (National Institute for Public Health and the Environment, Netherlands)
Cyanide in cassava	Dr. Julie Cliff (Eduardo Mondlane University, Mozambique)
Dioxin	Dr. Marco Zeilmaker (National Institute for Public Health and the Environment, Netherlands)
Arsenic	Drs. Aaron Barchowsky and Shilpi Oberoi (University of Pittsburgh, USA)
Cadmium	Dr. Janet Zang (Food and Drug Administration, USA)
Lead	Dr. Clark Carrington (Food and Drug Administration, USA)
Methyl Mercury	Dr. David Bellinger (Boston Children's Hospital, Harvard Medical School, USA)

Cyanide in Cassava

- Important staple for over 800 million people in approximately 80 countries
- Cassava tubers contain varying quantities of cyanogenic glucosides to protect the tuber against attack by animals and insects
- High dietary cyanide processing occurs when high cyanogenic cassava and insufficient processing are combined
- Worldwide reports of acute poisoning exist, but Dr. Cliff, the Commissioned Scientist, believed that the data were inadequate to make burden estimates
- The data are sufficient, however, to make estimates of *konzo*
  - Associated with consumption of bitter cassava and low protein intake
  - Disease of extreme poverty
  - Case definition:
    - Visible symmetrically spastic abnormality of gait while walking or running
    - History of abrupt onset (less than one week), irreversible
    - Bilaterally exaggerated knee and/or ankle jerks without signs of disease in the spine
  - Case-fatality is estimated to be 21%
  - Estimate was made for six countries in Africa:
    - Cameroon, Central African Republic, Democratic Republic of Congo, Mozambique, United Republic of Tanzania, Angola

Different Degrees of Severity of konzo in Children from Democratic Republic of Congo



Source: Nzwalo H, Cliff J. 2011. Konzo: From Poverty, Cassava, and Cyanogen Intake to Toxico-Nutritional Neurological Disease. PLoS Negl Trop Dis. 2011 Jun; 5(6): e1051.

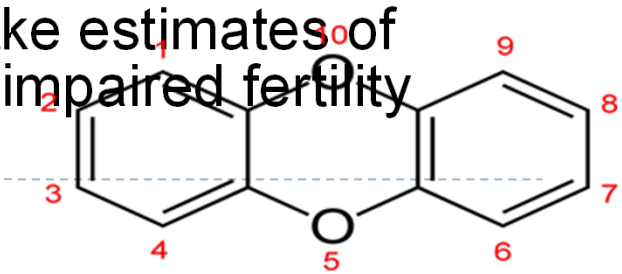
Peanut Allergy

Source: www.wikipedia.org

- Occurs early in life (< 5 years) and believed to be lifelong
- Peanut ingestion → duration of symptoms is short (< 2 days)
- Symptoms vary from mild to severe and can be fatal – prevalence of anaphylaxis: 4.7-9%
- Disease is assumed to be lifelong
- Prevalence confirmed with oral challenges: 0.5-1.5%
- Limited data on mortality rate of peanut-induced anaphylaxis but the majority of studies found similar rates ranging from 0.00125 to 0.017 per 100,000 person-years
- Estimates were made only for high income countries
- Gender distribution assumed to be equal
- Because of the short duration of the allergic response, the contribution of the actual disease to the Burden of Disease is not substantial but the impact on Quality of Life can be significant

Dioxin

- More than 90% of dioxin exposure is through the food supply, mainly meat and dairy products, fish and shellfish
- The dioxin body burden rather than daily exposure is the dose metric for the assessment of dioxin
- Many national authorities monitor dioxin in the food supply and breast milk
- Fifty countries have reported dioxin concentrations in breast milk
- The most sensitive non-cancer endpoints for dioxin are prenatal and postnatal hypothyroidy and prenatally induced sperm production
- Estimates of dose response were done using benchmark dose
- Human data were used to make estimates of hypothyroidy resulting from prenatal exposure
- Animal toxicology studies were used to make estimates of hypothyroidy from postnatal exposure and impaired fertility from prenatal exposure



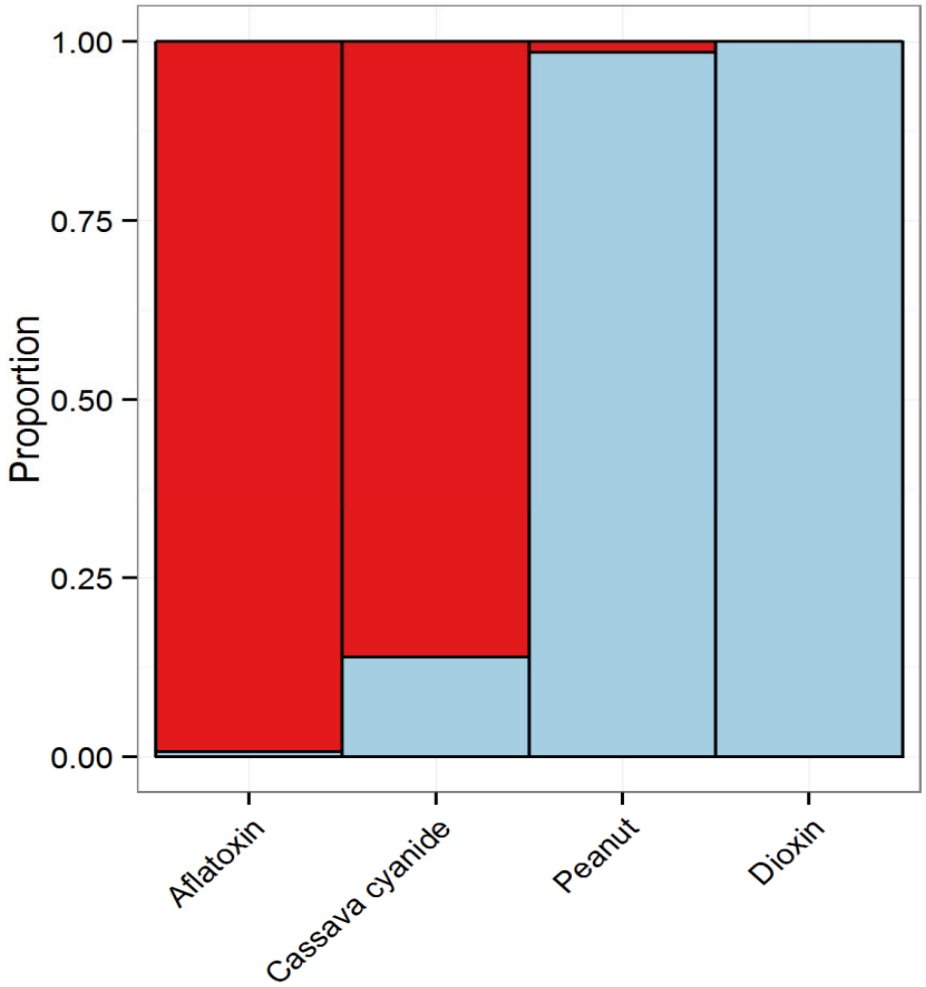
Aflatoxin

- Aflatoxins are secondary metabolites of the fungi *Aspergillus flavus* and *Aspergillus parasiticus* and less frequently other *Aspergillus* species such as *A. nomius*
- These species are prevalent in food crops – particularly maize, peanuts (groundnuts), oilseeds, and tree nuts in tropical and subtropical regions worldwide
- All aflatoxin exposure results from food consumption
- Aflatoxin increases the risk of hepatocellular carcinoma, a disease with a high case-fatality

Median Number of Foodborne Illnesses, Deaths, and Disability Adjusted Life Years (DALYs) with 95% Uncertainty Intervals, 2010

Chemical	Foodborne Illnesses (95% UI)	Foodborne Deaths (95% UI)	Foodborne DALYs (95% UI)
Aflatoxin	21,757 (8,967-56,776)	19,455 (7,954-51,324)	636,869 (267,142-1,617,081)
Cyanide in cassava	1,066 (105-3,016)	227 (22-669)	18,203 (1,769-53,170)
Dioxin	193,447 (155,963-1,085,675)	0 (0-0)	240,056 (192,608-1,399,562)
Peanut Allergens	107,167 (6,262-210,093)	28 (2-56)	99,717 (5,827-195,489)
TOTAL	338,611 (185,705-1,238,725)	19,736 (8,210-51,700)	1,012,362 (562,087-2,822,481)

The Relative Contributions from YLLs and YLDs for Each of Four Chemicals

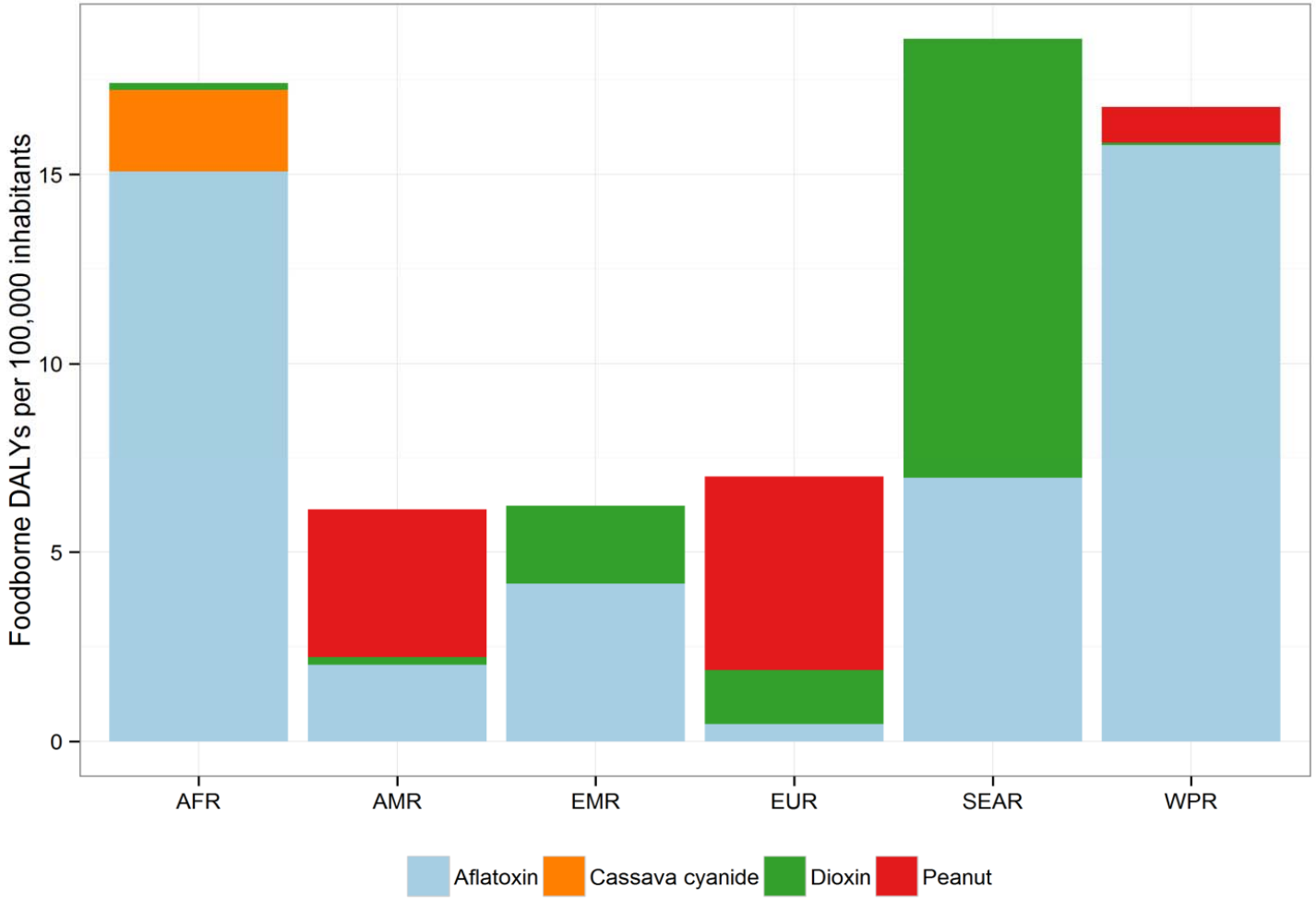


YLL
YLD

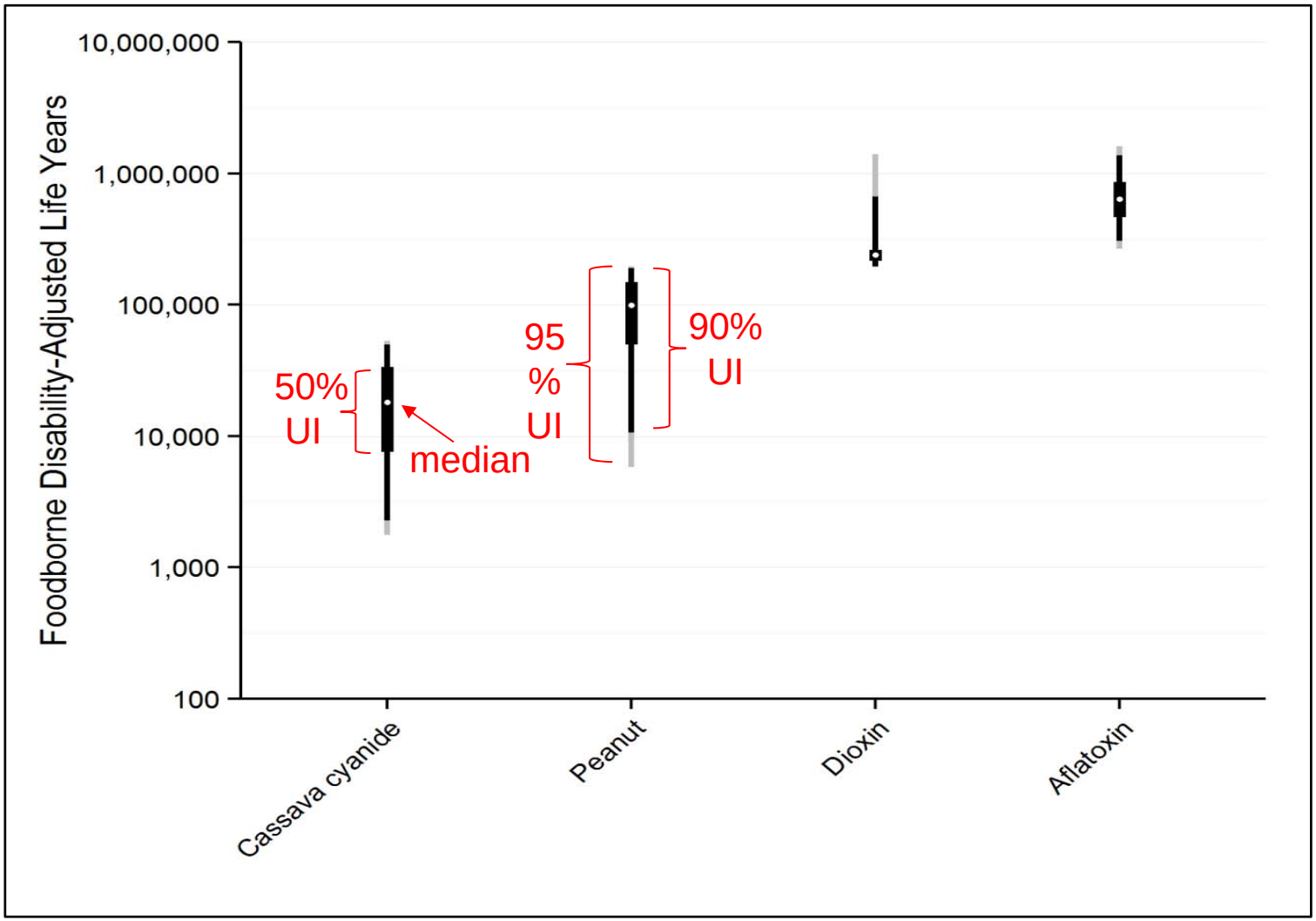
YLL = Years of Life Lost

YLD = Years Lost due to Disability

The Relative Contribution to the DALY Incidence for Four Chemicals by Region



DALYs for Each of Four Chemicals from Contaminated Food Ranked from Lowest to Highest



Summary

- Of the four chemicals assessed Aflatoxin has the greatest impact on deaths and DALYs
- Cyanide in cassava has the second greatest impact on deaths but estimates were made for only 6 countries in Africa
- Dioxin is associated with the greatest number of illnesses of the four chemicals evaluated
- Peanut allergens are associated with the second highest number of illnesses; estimates were only made for high income countries
- Virtually all exposure to these four chemicals is through the food supply
- The results for these four chemicals should be considered the tip of the iceberg regarding the impact of chemicals in food on the burden of disease

Thank you, Arie H. Ha r!!!