This is an author produced version of Dietary aflatoxin exposure and impaired growth in young children from Benin and Togo: cross sectional study.

White Rose Research Online URL for this paper:
http://eprints.whiterose.ac.uk/154/

Article:

https://doi.org/10.1136/bmj.325.7354.20
Dietary aflatoxin exposure and impaired growth in young children from Benin and Togo: cross sectional study

Y Y Gong, K Cardwell, A Hounsa, S Egal, P C Turner, A J Hall and C P Wild

BMJ 2002;325:20-21
doi:10.1136/bmj.325.7354.20

Updated information and services can be found at:
http://bmj.com/cgi/content/full/325/7354/20

These include:

References
This article cites 4 articles, 2 of which can be accessed free at:
http://bmj.com/cgi/content/full/325/7354/20#BIBL

3 online articles that cite this article can be accessed at:
http://bmj.com/cgi/content/full/325/7354/20#otherarticles

Rapid responses
One rapid response has been posted to this article, which you can access for free at:
http://bmj.com/cgi/content/full/325/7354/20#responses

You can respond to this article at:
http://bmj.com/cgi/eletter-submit/325/7354/20

Email alerting service
Receive free email alerts when new articles cite this article - sign up in the box at the top right corner of the article

Topic collections
Articles on similar topics can be found in the following collections

- Pharmacology and toxicology (284 articles)
- Medicine in Developing Countries (725 articles)
- Other Pediatrics (1357 articles)

Correction
A correction has been published for this article. The contents of the correction have been appended to the original article in this reprint. The correction is also available online at:
http://bmj.com/cgi/content/full/325/7372/1089/a

Notes

To order reprints of this article go to:
http://bmj.bmjjournals.com/cgi/reprintform

To subscribe to BMJ go to:
http://www.bmjjournals.com/subscriptions
Dietary aflatoxin exposure and impaired growth in young children from Benin and Togo: cross sectional study

Y Y Gong, K Cardwell, A Hounsa, S Egal, P C Turner, A J Hall, C P Wild

Fetal and early childhood environment, including the nutritional status of the pregnant mother and the infant, are considered critical for growth and risk of disease in later life. Many people in developing countries are not only malnourished but also chronically exposed to high levels of toxic fungal metabolites (mycotoxins). One family of mycotoxins, the aflatoxins, are carcinogenic and immunotoxic and cause growth retardation in animals. Aflatoxins contaminate staple foods in West Africa, particularly maize and groundnuts, as a result of hot, humid storage conditions that promote fungal growth. High exposure to aflatoxins occurs throughout childhood in the region, suggesting that growth and development could be critically affected. We assessed exposure to aflatoxins in relation to anthropometric measures in children in Benin and Togo.

Methods and results

We studied 480 children (aged 9 months to 5 years) from 16 villages in four geographic zones (four in each zone): Sudan savannah, north Guinea savannah, south Guinea savannah, and coastal savannah. The Ministries for Health in Benin and Togo gave ethical approval, and parents gave informed consent. We determined...
Aflatoxin-albumin concentration (trend test: F = 15.19, P = 0.0001, r² = 0.3766; and F = 8.48, P = 0.0038, r² = 0.3680).

Concentrations of aflatoxin-albumin adducts categorised into four groups for height for age and weight for age scores on the basis of the WHO classification of malnutrition (z score ≤ -3) and severe malnutrition (≤ -3). Median mean geometric adduct concentrations are shown, with 95% confidence intervals, adjusted for weaning status, agro-ecological zone, and socioeconomic status. Height for age and weight for age z scores were significantly associated with aflatoxin-albumin concentration (trend test: F = 15.19, P = 0.0001, r² = 0.3766; and F = 8.48, P = 0.0038, r² = 0.3680).

Weight for age scores, according to the median value of a World Health Organization reference population. A z score ≤ -2 is classified as malnutrition, and ≤ -3 represents severe malnutrition. We also determined weaning status and the socioeconomic status of the mother and family. We assessed aflatoxin exposure over the previous two to three months by measuring aflatoxin bound to albumin in blood.

We detected aflatoxin-albumin adducts in 475/479 (99%) samples (one sample missing), with a geometric mean concentration of 32.8 (range 5-1064) pg/mg albumin. Aflatoxin-albumin concentration increased with age up to 3 years, after which it reached a plateau. In the 302 children aged 3 years or under, the mean aflatoxin-albumin concentration was 2.5-fold higher in fully weaned age groups for height for age and weight for age z scores on the basis of the World Health Organization classification of malnutrition (z score ≤ -3) and severe malnutrition (≤ -3). Median mean geometric adduct concentrations are shown, with 95% confidence intervals, adjusted for weaning status, agro-ecological zone, and socioeconomic status. Height for age and weight for age z scores were significantly associated with aflatoxin-albumin concentration (trend test: F = 15.19, P = 0.0001, r² = 0.3766; and F = 8.48, P = 0.0038, r² = 0.3680).

Prevalence of malnutrition was 33% for stunting (height for age z score ≤ -2), 29% for being underweight (weight for age z score ≤ -2), and 6% for wasting (weight for height z score ≤ -2). Children with stunting or who were underweight had 30-40% higher mean aflatoxin-albumin concentrations. After adjustment as above, the negative correlation between individual aflatoxin-albumin concentration and each of the three growth parameters was highly significant (P = 0.001 for height for age, P = 0.005 for weight for age, and P = 0.047 for weight for height). In a categorical analysis, the association with aflatoxin-albumin concentration was again significant, with clear dose-response relations with height for age and weight for age z scores (figure).

**Comment**

This study reveals a striking association between exposure to aflatoxin in children and both stunting (a reflection of chronic malnutrition) and being underweight (an indicator of acute malnutrition). In West Africa, people are chronically exposed to high levels of aflatoxins starting in utero and continuing throughout life. In this study, children still partially breast fed had lower exposure, almost certainly reflecting lower toxin levels in milk than in weaning and family foods. Thus growth faltering occurs at a time of change to solid foods, when there is co-exposure to aflatoxin and a plethora of infectious hazards (for example, malaria, diarrhoea, respiratory infections). Whether the association between aflatoxin exposure and impaired growth is a direct result of aflatoxin toxicity or reflects consumption of fungus affected food of poor nutritional quality cannot be confirmed from the cross sectional design. However, these observations emphasise the need to investigate this question and to develop strategies to reduce exposure to aflatoxin, possibly involving interventions targeted at the post-weaning period in African children.

We thank C Aquerereburu for participating in the planning process; M Koubre, Amik Gandjeto, Zenato Assani, Marius Adjagba, and G Ayeni from IITA Benin, who participated in the field work; and the people of Benin and Togo who agreed to be part of this research.

**Contributors:** YYG, KC, AH, PCT, AJH, and CPW were all responsible for the design of the study. KC, AH, SE, and AJH took part in the fieldwork. YYG, PCT, and CPW were responsible for the laboratory analysis. YYG and SE computed the data and conducted the statistical analysis. All authors contributed to writing the manuscript. CPW is guarantor of the paper.

**Funding:** This study was funded by a grant from GTZ (project no 9878694:901.00) and support to CPW and PCT from a grant from the NIEHS, USA (no ES06052).

**Competing interests:** None declared.


(Accepted 20 February 2002)
private practice. Top merit awards are awarded for national and international standing within the specialty and can more than double a consultant’s basic salary. Any time that a hospital doctor devotes to computing does not lead to increased income potential.

Conclusions

Over many years, general practice computing has prospered, whereas hospital clinical computing has not. Differences in leadership and economic incentives partially explain this. In general practice the government and the profession worked together to remove barriers and provide incentives to computerisation. In hospitals the opposite happened. Changes are needed to provide professional leadership and economic incentives in both primary and secondary sectors. An early step would be to establish united stakeholder organisations for clinical users and information technology professionals in health care, covering all aspects of healthcare computing.

The NHS is now planning to deploy integrated patient record systems across both primary and secondary care.10 The examples of Kaiser Permanente and the Veterans Administration suggest that such systems may play a critical part in improving effectiveness and efficiency.11 However, such a project faces several technical obstacles, mainly associated with scalability. It is much easier to computerise small general practices than large complex hospitals, let alone provide integrated services across an organisation as large as the NHS. These technical issues—which include patient record architecture, terminology, interoperability standards, security, and developments in computer technology—are the subject of my second article.

I thank Jeremy Wyatt for comments on an earlier draft of this article.

Competing interests: I have participated in many of the events described and have provided consultancy services to various NHS organisations and other British and international health care institutions.

Corrections and clarifications

UK junior doctors’ career destinations, job satisfaction, and future intentions: questionnaire survey

A lapse in concentration as we processed this paper by Jean M Davidson and colleagues (28 September, pp 685-6) led to the omission of an authors’ amendment at proof stage. The paragraph that starts, “We asked respondents to score five statements about job satisfaction” was misleading. It should have read: “We asked respondents to score each of five statements about job satisfaction on a five point ordered scale from ‘strongly agree’ to ‘strongly disagree.’ The statements were ‘I find my work interesting and challenging work’; ‘I feel dissatisfied in my current post’; ‘Most days I am enthusiastic about my work’; and ‘I am often bored with my work.’ We calculated a job satisfaction score for each respondent over all five statements, by assigning a value of 1 to 5 for the responses, from the least to most positive answer, and totalling them: 20 or more represented a positive response, and average, on all statements, and we suggest that this shows a high level of satisfaction.”

Dietary allergy exposure and impaired growth in young children from Benin and Togo: cross sectional study

An error crept into this paper by Y Y Gong and colleagues (6 July, pp 20-1). Unfortunately, $< 2$ and $< 3$ (referring to $z$ scores) were inadvertently replaced with $\leq 2$ and $\leq 3$ in both the text (methods and results section) and the figure caption. The correct symbols appeared in the figure.

Mental health campaigners cancel march because of fears of backlash

In this news article by Zosia Kmiotekiewicz (14 September, p 562), we wrongly referred to Rampton as a prison. It is of course a high security hospital.