Biomarkers of aflatoxin exposure, diet, climate and linear growth in rural Ethiopia

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Introduction

• There has been growing recognition that aflatoxins are associated with impaired linear growth of children.
• The relationship between aflatoxin (AF) biomarkers in serum and child growth in Ethiopia has not been investigated.
• We first assess the effect of different factors on exposure:
  – Climate: temperature and relative humidity (fungi thrive better under humid and high-temperature conditions)
  – Diet: importance of maize (more prone to aflatoxins than other cereals)
  – Storage type
  – Seasonality: climate, diet, storage change with seasons
• We assessed children’s exposure to AF in pre-harvest and post-harvest seasons using serum biomarkers and tested the association of their exposure with the linear growth.
Methods – data collection

- AF biomarkers were quantitatively analyzed from a randomly-selected subsample of an ongoing intervention trial on the consumption of quality-protein maize in rural Ethiopia.
- Blood samples were collected from 6-36-month-old children (n=102) in the pre-harvest season (Aug-Sept 2016), and post-harvest season (Feb 2016).
- The AF biomarkers AF-lysine, AFB1, AFB2, AFG1, AFG2, and AFM1 were measured by high-performance liquid chromatography-tandem mass spectrometry.
Methods – GIS analysis

- Climate data were obtained from the World Meteorological Institute, in the format of grid layers with relative humidity and average temperature.
- From the grids, the values for the georeferenced homesteads of the children were extracted.
Methods - Analysis

- Children’s linear growth was assessed by length/height and age converted into Z-scores for height-for-age.
- Information on diets and storage practices were obtained from the survey.
- Correlation and mixed linear regression regression were used for the analysis.
Aflatoxins exposure and seasonality

- A high percentage of children were exposed to AF in serum in both pre-harvest (7% to 31% by AF) and post-harvest (5% to 33% by AF) seasons,
- The exposure did not differ statistically by seasons except for AFG2.
- Cumulative exposure, i.e. children with one or more AF biomarkers in serum, was higher in post-harvest (45%) compared with pre-harvest (40%) seasons (p=0.003).
Exposure and climate

- Pre-harvest, Aflatoxins exposure is not significantly related to either relative humidity or temperature.
- Post-harvest: two correlations significant.
- However: little variation in the locations.

<table>
<thead>
<tr>
<th>Aflatoxins (post harvest)</th>
<th>Statistic</th>
<th>Altitude</th>
<th>Temperature</th>
<th>Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFB1Lysine</td>
<td>Pearson Correlation</td>
<td>-.213</td>
<td>0.204</td>
<td>0.077</td>
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<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.032</td>
<td>0.052</td>
<td>0.470</td>
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<tr>
<td></td>
<td>N</td>
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<td>91</td>
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<tr>
<td>AFB1</td>
<td>Pearson Correlation</td>
<td>-0.066</td>
<td>0.111</td>
<td>0.018</td>
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<td>Sig. (2-tailed)</td>
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<td>0.293</td>
<td>0.867</td>
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<tr>
<td>AFB2</td>
<td>Pearson Correlation</td>
<td>0.043</td>
<td>-0.001</td>
<td>-0.023</td>
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<td>Sig. (2-tailed)</td>
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<td>0.989</td>
<td>0.832</td>
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<tr>
<td>AFG1</td>
<td>Pearson Correlation</td>
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<td>0.075</td>
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<td>AFG2</td>
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<td>Sig. (2-tailed)</td>
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<tr>
<td>AFM1</td>
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<td>0.081</td>
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<td>Sig. (2-tailed)</td>
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<td>0.626</td>
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</table>
Exposure and diet

- No correlation of maize consumption in post-harvest samples
- Two negative correlations in pre-harvest
- No evidence maize consumption increases aflatoxins exposure
Exposure and linear growth

- CAFES and linear growth was not correlated in the pre-harvest season in this sample of children ($r=0.17$, $p=0.095$).
- Cumulative AF exposure in serum (CAFES) was correlated with the linear growth of children in the post-harvest season ($r=-0.21$, $p=0.034$)
Conclusions

- Our findings show that exposure to AF is highly prevalent in the study area (maize growing areas of Oromia).
- We did not find an effect of climate, but the samples all came from a similar climate. For future research, samples should be taken from a wider range of climates.
- We do not find an effect of maize consumption on aflatoxins exposure.
- We do find that cumulative aflatoxins exposure in serum was correlated with the linear growth of children in the post-harvest season.
- Further longitudinal study with a larger samples size is needed to evaluate causal linkages between AF exposure and linear growth in children.
Thank you for your interest!