IFPRI Discussion Paper 02305

December 2024

Consumer Response to Food Safety Risk Information

Vivian Hoffmann

Mike Murphy

Sarah Kariuki

Markets, Trade, and Institutions Unit

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), a CGIAR Research Center established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

AUTHORS

Vivian Hoffmann (v.hoffmann@cgiar.org) is a Senior Research Fellow in the Markets, Trade and Institutions (MTI) Unit at the International Food Policy Research Institute (IFPRI) and an Associate Professor in the School of Public Policy and Administration and Department of Economics at Carleton University, Ottawa, Canada.

Sarah Wairimu Kariuki (s.w.kariuki@cgiar.org) is a Markets and Value Chains Specialist in the Sustainable Agrifood Systems team of the International Maize and Wheat Improvement Center (CIMMYT), Nairobi, Kenya.

Mike Murphy (m.murphy@cgiar.org) is a Senior Research Analyst in IFPRI's MTI Unit. Washington, DC.

Abstract

Unsafe food imposes significant health and productivity burdens on developing countries. We test the impact of a simple information intervention through which low-income urban consumers in Kenya were provided information about the likelihood that maize flour from the formal and informal sector violated a food safety standard. We find a 42 percent increase in the share of households consuming the similarly priced, lower risk formal sector flour type at follow-up in the treatment group relative to the control group, from a base of 33 percent. The intervention was equally effective for households earning below and above the sample median income level. Our results demonstrate the potential for low-cost interventions to increase the salience of food safety as a product attribute in informal markets or where regulatory enforcement is weak.

Keywords: Food safety; information intervention; RCT

Acknowledgements

This work was undertaken as part of the CGIAR Research Initiative on One Health and the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH). The CGIAR Initiative on One Health aims to demonstrate how One Health principles and tools integrated into food systems can help reduce and contain zoonotic disease outbreaks, improve food and water safety and reduce anti-microbial resistance, benefiting human, animal and environmental health. Other CGIAR centers participating in the CGIAR Initiative on One Health include the International Livestock Research Initiative, the International Water Management Initiative, and World Fish. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund: https://www.cgiar.org/funders/.

We thank Ibrahim Ochenje for excellent logistical support, data collection staff for their tireless efforts, and the community health volunteers and residents of Kawangware, Kangemi, Kibera and Athi River for making this research possible. We thank Chris Barrett for insightful comments on this project, and Ruth Hill for detailed feedback on an earlier draft. The opinions expressed here belong to the authors and do not necessarily reflect those of the CGIAR.

1. Introduction

Foodborne illness is responsible for a large share of the global burden of disease, comparable in magnitude to malaria (Grace, 2023). Nearly a third of diarrheal disease cases are believed to be transmitted through food (WHO 2015; Hald et al 2016; Baral and Hoffmann, 2019), implying the potential of additional long-term impacts on child development and adult earnings not captured by standard burden of disease estimates. These impacts are primarily felt by citizens of low- and middle-income countries, yet solutions for improving food safety in these contexts have received comparatively little investment or attention in the economic or public health literature.

Like many low and middle-income countries, Kenya has strict *de jure* food safety regulations, many of them based on risk analysis conducted by and for high-income countries, but weak enforcement. A food sector made up of many small firms, low public budgets, and a complex and sometimes contradictory division of responsibilities across levels of government and line ministries compound the challenge of effective food safety surveillance and enforcement. In the case of the product we study, maize flour, four different government agencies are responsible for food safety compliance from farmer to consumer (Hoffmann, Alonso, & Kang'ethe, 2023). In this context, steering consumer demand toward safer products can be a complementary approach to the enforcement of food safety regulations at production and retail.

We test whether providing information about the relative food safety risk associated with a product category can influence consumption choices. We implemented a randomized controlled trial in low-income urban areas of Nairobi, Kenya. Treated households were provided with information on the probability that two variants of the most commonly consumed staple, maize grain, failed to conform to a regulatory food safety standard. Providing this information led consumers to substitute lower risk formally packaged flour in place of higher risk whole-grain 'posho' flour from the informal sector.

Food safety hazards represent a classic negative externality. Contamination of food with pathogens, toxins, or other harmful non-food substances can occur at any point in the production, processing, storage, transportation and distribution of food. In contrast to other negative product attributes such as bruising or spoilage, food safety hazards are not easily observable to consumers. Further, foodborne illness can be difficult for buyers to attribute to a particular product. This lack of observability implies that market prices fail to reflect food safety (Fafchamps, Hill, and Minten, 2008). Health costs are imposed on both affected individuals and public health systems, but where attribution is not possible or where legal systems are unable to transfer these costs to producers and retailers, private incentives to invest in food safety will be weak.

This study focuses on the specific food safety hazard of aflatoxin in maize flour. Aflatoxins are a group of carcinogens produced by *Aspergillus* flavus, a fungus endemic in soils which commonly affects stored crops including maize, and which are prevalent in the tropics. Consumption of aflatoxins can cause acute liver diseases and is suspected of stunting children's growth and suppressing immune function (Strosnider, et al., 2006).

We implemented the study in low-income areas in urban and peri-urban Nairobi. This is a context in which maize plays an important role in diets as an affordable staple, and where aflatoxin contamination is common. While the track record of regulatory effectiveness in the formal sector in developing economies is mixed (Grace, 2015), previous research in Kenya has shown that processed and packaged maize flour is consistently less likely to be contaminated with aflatoxin than informally marketed posho flour, apparently due to the fact that the most contaminated elements of maize are removed during the formal milling process (Kariuki and Hoffmann, 2022; Hoffmann et al., 2023). In over 1,200 samples collected over the course of a year from 10 urban sites, 10% of formally milled flour packets contained aflatoxin above the regulated maximum, whereas 23% of informally milled posho was in violation of this standard. Consumption of formally milled flour is increasing in Kenya but remains a minority of total maize consumption as of the most recent nationally representative data (Hoffmann, Moser and Herrman, 2021).

The main information treatment provided information on how much higher contamination rates are in informally marketed posho *relative* to formally milled flour. Participants were told that a previous study had found that branded packaged maize flour (unga) contained less than half the level of aflatoxin as flour processed by posho mills. A subset of participants in the treatment group were given additional information on the *absolute* probability that posho failed to meet the safety standard. Comparing the effects of these two treatments allows us to test whether providing information on the overall level of the food safety hazard is necessary for driving behavioral change, and whether doing so has an impact on the overall level of maize flour consumed. While other starches can be substituted for maize flour without much impact on nutrition, most of the foods associated with high risks of contamination with health hazards are nutritious perishables. Understanding how consumers process relative and absolute food safety information is important for understating this potential unintended consequence of providing food safety information,

We find that households assigned to the information treatment were 14 percentage points more likely to have lower-risk formally milled flour present in their home at endline than those assigned to the control group, an increase of 42% relative to the control group level of 33%. Treated individuals' perceptions of the risks associated with both formal and informal flour were higher than those assigned to the control group on both the intensive and extensive margins. Effects on risk perceptions were stronger regarding informally milled flour, in line with the relative risk information provided. We additionally observe a small but non-zero increase in perceived riskiness of maize flour among the control group, suggesting either some spillover of information between treatment groups, or that for reasons unrelated to the intervention, awareness about aflatoxin risk increased during the study period.

Comparing the two versions of this treatment, we do not find differences in terms of impacts on purchasing behavior. We do however find that providing relative risk information alone had a larger impact on the risk perceptions of participants than when the absolute probability of noncompliance with food safety standard for the less safe product was also disclosed. This finding suggests that a negative recommendation without a specified risk level may lead consumers to over-estimate the risk of a health hazard. In the context of this study, however, this overestimation has no detectable impact on purchasing behavior.

Our findings contribute to the literature on consumer demand for safer food. Much of the previous experimental work on this topic, as reviewed by Hoffmann, Moser and Saak (2019) is based on single-interaction experiments. The results of such experiments are likely to be affected by salience of food safety in the moment when participants make a choice. A recent exception is a study by Kariuki and Hoffmann (2022), in which participants were visited two months after they were given information on the contamination of maize flour they had in their homes. While that study showed that this information had a lasting impact on consumption choices, the cost of scaling up such an approach would be prohibitive. The present paper shows that communicating relative risk information based on surveillance data can similarly motivate consumers to choose safer food.

We also contribute evidence on the role of subjective expectations in influencing economic behavior relating to health. Risk perceptions have been identified within the health literature as playing an essential role in determining behaviour (Ferrer & Klein, 2016). Within economics, behavioural impacts of receiving health risk information have been studied for a range of hazards, including HIV/AIDS (Thornton 2008; Dupas 2011; Godlonton et al. 2016; Kerwin 2024), Creutzfeldt-Jakob disease (Adda, 2007), radon poisoning (Smith, Desvousges, & Payne, 1995) and water contamination (Jalan & Somanathan 2008; Bennear et al. 2013). Within this literature, our information intervention most closely resembles that of Dupas (2011), who shows that providing teenage girls with information on the HIV rates of men in different age categories leads them to select younger (safer) partners. On the topic of food safety, a number of recent studies summarized in Bovay (2023) have explored the role of information disclosures by media or government agencies on consumer choices, mainly in the context of the United States. Our experiment allows us to identify both the effect of the intervention on self-reported risk perceptions, and to link this change to change in observed purchases.

We demonstrate that providing information on relative risk can make food safety a salient product attribute for low-income consumers and can lead to substantial changes in their purchasing behavior. This approach may be attractive to policymakers in settings where it is either infeasible or undesirable to remove food that does not comply with food safety regulations from the market. Beyond an immediate reduction in exposure among those consumers who follow recommendations, the negative demand shock to a riskier food type could be expected to lead to a contraction in its supply.

2. Study design

Sampling

To be eligible for inclusion in the study, households had to reside in one of the study areas, include a child under the age of five years, and have purchased posho flour within the past two weeks. The focus on young children is due to the vulnerability of this population to aflatoxin exposure (Turner, 2013). The sample was assembled from lists of households containing a child or expectant mother obtained through the community health system in four low-income residential areas in Nairobi County.[1] Enumerators visited randomly selected households from these lists in person to confirm that there was a young child still living in the household and to screen on the second eligibility condition. If both conditions were met, the household was eligible for inclusion in the study and the enumerator proceeded to administer informed consent and conduct the baseline interview.[2] Enumerators were able to identify 1673 households from the community health system lists who

[1] There were: Kawangware, Kangemi, Kibera and Athi River

[2] We additionally screened for respondents reporting symptoms associated with Covid-19 and excluded households where members had recently reported symptoms and had not recently tested negative for the disease.

could be reached by phone, of which 1449 who met screening criteria were successfully interviewed at baseline.[3]

Household interviews

Baseline interviews were conducted from September to November 2022 with the member of the household identified as the primary caregiver of children in the home. Respondents provided data on the composition of their household and their food consumption as well as information about their social network (to capture spillovers), their knowledge of food safety issues, and their risk preferences. Follow-up interviews eliciting the same information (aside from the social networks module) were conducted approximately two months later.

Consumption data

As part of the interview, the respondent was asked a series of questions about types of maize flour which had been consumed by the household during the previous week. Households were asked about their consumption of packaged flour and posho flour separately, as well as a range of starches which could plausibly function as substitutes for maize flour: whole maize grains; flour from other grains; breads; potatoes and sweet potatoes; cassava and rice. Enumerators asked to see any posho or packaged maize flour that was present in the household, and for permission to photograph it.[4] We use this observational information, rather than the respondent's reported consumption, to avoid potential researcher demand effects among treated households, though in practice the two measures are very similar.

Eliciting subjective probabilities

In both survey rounds, we collected data on participants' subjective perceptions of food safety risk. Each participant was first asked whether they were aware of any "food safety threats or concerns" regarding maize flour. If they responded affirmatively, we asked a series of follow-up questions to measure their knowledge of these food safety risks, focusing on whether they named aflatoxin as a risk or described potential negative health outcomes from consuming maize flour consistent with its effects. We then elicited subjective probabilities of food safety risk by asking respondents to share what they believed was the chance that each flour type was affected by the problem they had previously mentioned.[5] To convey probabilities, participants were provided with beans to use as tokens which they could then use to express a likelihood by placing an amount corresponding to the likelihood of an outcome inside a circle drawn by the enumerator, and placing the remaining amount outside of the circle to indicate the converse. This elicitation method has been used in a variety of contexts where access to formal education is limited and has been demonstrated to be robust to a number of variations in experimental design (Delavande, Gine, & McKenzie, 2011). We treat those

[3] We successfully re-interviewed 1309 households at follow up, an attrition rate of approximately 9%.
[4] Some households stored formally milled flour in containers other than its original packaging. In such cases the enumerators were able to verify the source based on the consistency of the flour which is noticeably finer and has a more uniform consistency than flour from posho mills.
[5] To avoid anchoring bias in the survey responses, we randomly varied which type of flour was asked about first.

who said they were not aware of any food safety risk as expressing zero probability that either flour type was affected by a food safety hazard.

Intervention

At the end of the baseline interview, households assigned to the treatment group were provided risk information based on a large-scale aflatoxin monitoring project conducted in Kenya during the year prior to the study (Hoffmann et al., 2023). Over a one-year period, samples of formally milled, packaged and informally milled posho flour were purchased by researchers every two months in ten urban areas. At each sampling location, team members purchased multiple brands of packaged flour based on a list of brands known to be available in the area, visiting at least five retailers (or fewer if they were able to obtain samples of all listed brands), as well as flour from at least five posho mills. Branded and posho samples were then tested to determine their level of aflatoxin contamination. Full details of the study are described in Hoffmann et al. (2023). We make use of data from this study to provide participants with recent and accurate information representing the level of aflatoxin risk they face in local markets.

The script for both treatment groups informed participants that aflatoxin cannot be observed visually, and of its negative health effects. Participants in both groups were told that a previous study had found that branded packaged maize flour (unga) contained less than half the level of aflatoxin as flour from posho mills and given the advice that "if you want to reduce the risk that your family is exposed to aflatoxin, you can do so by buying packaged maize flour". This sentence was included on the posters that both groups received, along with a background showing locally available packaged flour brands.

In T2 households, participants were additionally given information that one in four posho samples collected in Nairobi during the monitoring study had contained aflatoxin levels in excess of the regulatory limit. This text was also included as text on the posters received by T2 households.

Treatment Assignment

Assignment to treatment was implemented ahead of the baseline survey in two stages. Under the community health system, locally recruited community health volunteers (CHVs) are responsible for maintaining contact with and delivering key health information to between 50 and 100 families each. The first stage of randomization was at the CHV level. CHVs were randomly assigned to one of two treatment arms: either 50% (low intervention density) or 100% (high intervention density). In the latter case, every household for which the CHV was responsible was included in the sampling frame, while for the low-density treatment half of the listed households were randomly selected for inclusion, and the remainder excluded. Since CHVs are assigned to households geographically, this assignment generated exogenous geographical variation in the share of households that received information through the study, allowing us to explore potential spillovers.

In the second stage, households were stratified by CVH and randomly assigned to one of three groups with equal probability: *Control*, *Relative Risk Information Only* (T1) and *Full Risk Information* (T2). At the conclusion of the baseline interview, households assigned to either of the two treatment arms were provided with information on aflatoxin risk in maize flour. Enumerators read a standard treatment-specific script in either Swahili or English (based on the respondent's preference) and then provided them with a treatment-specific poster summarizing the key information, which they were encouraged to keep and display in their home.[6]

3. Statistical analysis

To estimate the effects of the treatments, we follow the registered pre-analysis plan.[7] Our primary outcome of interest is the share of participants who have lower-risk (formally milled) flour for consumption present in the household at the time of the endline survey. This is coded as a binary variable, taking a value of 1 if formally milled maize flour (or its packaging material) is observed and 0 otherwise. We use this observational measure (rather than household's reported consumption) to avoid bias from enumerator demand effects, though it should be noted that observed presence may understate the level of consumption since some respondents may consume a given flour type but not have any stored within the household at time of interview.[8]

We consider two pre-specified secondary outcomes of interest: respondents' subjective probability of aflatoxin contamination in lower- and higher- risk flour types, and their total monetary expenditure per household member (using adult equivalent weights) on non-maize starches. Estimating the effect on individuals' subjective probabilities allows us to see whether the treatment led participants to update their risk beliefs, which in turn led them to update their purchasing decisions. We measure the effect on non-maize purchases to test for potential substitution of other starches for maize flour. Since the distribution of quantities is approximately log-normally distributed, we apply the log transformation to this outcome and additionally estimate a linear model to obtain a point estimate of the total (albeit noisy) substitution effect.[9,10] To complement these pre-specified outcomes, we additionally estimate treatment effects on the unit price of maize products both for maize flour (of both types) and overall (including whole grain maize as well as flour) This outcome sheds light on the willingness to pay of a low-income population for food safety.

For each of our outcomes we estimate the following equation to capture the average treatment effect of receiving any information:

$$Y_{i,t=1} = \beta_0 + \beta_1 AnyInformation_{i,t=1} + \gamma_1 z_i' + \theta_i + \epsilon_i \quad (1)$$

Where $Y_{i,t=1}$ is the outcome of interest for person i at time t, and *AnyInformation* is an indicator that takes the value 1 if the household was assigned to either information treatment, and 0 otherwise. We include a vector of control variables, z', selected via post double-selection LASSO (Belloni, Chernozhukov, & Hansen, 2014) from the set of candidate controls listed in our pre-analysis plan, and a CHV-level (sampling strata) fixed effect, θ.[11]

---

[6] Copies of the English language versions of the script and posters are included in Appendix E

[7] The pre-analysis plan is available from the AEA registry at https://www.socialscienceregistry.org/trials/9075

[8] Respondents could also decline to show the enumerator the flour, though in practice this was rare.

[9] The overall share of households reporting zero consumption of non-maize starches at endline is low (3% of sampled households) and does not vary statistically between treatment and control households (p=0.638).

[10] Here we deviate from our pre-analysis plan, which specified that we would use the inverse hyperbolic sine transformation. Chen & Roth (2024) provides a useful discussion of the issues involved in estimation where non-trivial shares of zero values are present.

[11] We implement the procedure in Stata using the *pdslasso* program (Ahrens, Hansen, & Schaffer, 2018).

We also estimate the effect of each of the individual information treatments (with and without absolute risk information). To avoid bias by estimating a linear model with multiple treatment arms (Goldsmith-Pinkham et al., 2024) we estimate three separate forms of equation 1: two in which we include the control and the respective information treatment, and one in which we exclude the control group and compare the *Full Risk Information* treatment to the *Relative Risk Information Only* treatment, as specified below,

$$\text{excluding } FullInformation\text{: } Y_{i,t=1} = \beta_0 + \beta_1 RelativeInformation_{i,t=1} + \gamma_1 z_i' + \theta_i + \epsilon_i \quad \text{(2a)}$$

$$\text{excluding } RelativeInformation\text{: } Y_{i,t=1} = \beta_0 + \beta_1 FullInformation_{i,t=1} + \gamma_1 z_i' + \theta_i + \epsilon_i \quad \text{(2b)}$$

$$\text{excluding } Control\text{: } Y_{i,t=1} = \beta_0 + \beta_1 FullInformation_{i,t=1} + \gamma_1 z_i' + \theta_i + \epsilon_i \quad \text{(2c)}$$

To explore potential information spillovers, we additionally estimate versions of these specifications with the inclusion of a spillover propensity score and its interaction with the pooled treatment indicator. We calculate the spillover propensity score based on the following equation[12] which we estimate within the control group sample:

$$Spillover_{i,t=1} = \alpha_0 + \alpha_1 HighDensity_i + \alpha_1 PropHH_d + \alpha_3 NoHH_d + \alpha_4 PropSocial_d + \alpha_5 NoSocial_d + \gamma_1 z_i' + \epsilon_i \quad (3)$$

Where *Spillover* is a binary indicator that takes the value 1 if the (control group) respondent reports at endline having learned anything new about food safety problems in maize since the first interview, and 0 otherwise. The variable *HighDensity* is similarly a binary variable where 1 indicates assignment to the high-density treatment arm, and 0 to the low-density treatment arm. *PropHH* is the share of study households within a fixed radius *d* assigned to either treatment group, while *PropSocial* is the share of those households who are known to the respondent within the same radius, who are assigned to either treatment group.[13] The variables *NoHH* and *NoSocial* are indicators which take the value 1 if either of the respective proportion variables takes the value zero. While HighDensity and PropSocial are exogenous conditional on being defined, the missingness indicators *NoHH* and *NoSocial* are correlated with housing density and the number of respondents' social connections, respectively. For this reason, in cases where *PropHH* is selected for inclusion, we also include the *NoHH* variable, and we similarly include *NoSocial* if *PropSocial* is selected. In addition, each of the variables in Equation (3), as well as the vector of baseline controls, z_i', used in the preceding equations are included as candidates for selection via a logistic LASSO model.

Predicted spillover propensity is then included in Equation (4) below, through which we estimate the effect of information spillovers, and the effect of assignment to either treatment net of such spillovers:

$$Y_{i,t=1} = \beta_0 + \beta_1 AnyInformation_{i,t=1} + \beta_2 \widehat{Spillover}_{i,t=1} + \beta_3 AnyInformation * \widehat{Spillover}_{i,t=1} + + (\beta_4 NoHH_d) + (\beta_5 NoSocial_d) + \gamma_1 z_i' + \epsilon_i \quad (4)$$

Lastly, we conduct two heterogeneity analyses on the primary outcome of consuming the lower-risk maize product. The first of these, which was pre-registered, tests whether food safety risk

[12] The version of this equation stated in the pre-analysis plan incorrectly included a fixed effects term for CHV list (the level at which the high-density treatment is assigned) which we omit here.
[13] Based on the respondent's self-report at endline.

information affects consumer choice according to a standard model of Bayesian updating of subjective probabilities, or by strengthening or making more salient the existing beliefs of those who already perceive food safety to be a problem. This test is implemented by testing whether the effect of the treatment varies according to participants' baseline beliefs about the contamination risk associated with the higher risk product at baseline. The second heterogeneity analysis tests whether the treatment effect is stronger for households that reported higher income at baseline. We report this analysis despite the fact that this was not pre-registered due to its considerable policy significance.

For each heterogeneity analysis, we add to Equations (1) and (2) a binary indicator which takes the value 1 if the respondent's value of the variable for which the heterogenous effect is tested at baseline was below the sample median, and zero otherwise, and the interaction of this indicator with the treatment indicator:

$$Y_{i,t=1} = \beta_0 + \beta_1 AnyInformation_{i,t=1} + \beta_2 BelowMedian_i$$
$$+ \beta_3 AnyInformation * BelowMedian_{i,t=1} + \gamma_1 z_i' + \epsilon_i \quad (5)$$

$$Y_{i,t=1} = \beta_0 + \beta_1 RelativeInformation_{i,t=1} + \beta_2 BelowMedian_i$$
$$+ \beta_3 RelativeInformation * BelowMedian_{i,t=1} + \gamma_1 z_i' + \theta_i + \epsilon_i \quad (6a)$$

All specifications are estimated using logistic regression for binary outcomes, and ordinary least-squares for all other outcomes.

4. Results

Balance across treatment groups at baseline

Baseline characteristics are well balanced across the three treatment groups. We apply an omnibus test for overall differences between each set of two groups based on a logistic regression of the relevant group indicator on the full set of potential baseline controls (Appendix A). While no statistical difference across groups is detected, we do observe a statistically significantly higher proportion of T1 (Relative Information Only) households with packaged flour present (36%) relative to 29% in the control and 28% in T2 (Full Information), based on a linear regression of that variable on treatment indicators. For this and all outcome variables we include the baseline value as a control when estimating its respective endline value, and as a candidate control for post-double selection LASSO estimation for all other outcomes.

Product choice & risk perceptions at baseline

Reflecting the eligibility criteria,[14] consumption of maize flour is almost universal in the sample, with 99.8% of households reporting consumption by at least one family member in the seven days prior to the baseline interview. Almost all households (96.4%) report consuming informally milled maize flour, and many additionally report also consuming formally milled flour (37.5%). Consuming exclusively formally milled flour is rare in the sample, accounting for only 3.4% of households.

[14] Only households that reported purchasing posho flour within the past 2 weeks were included in the sample.

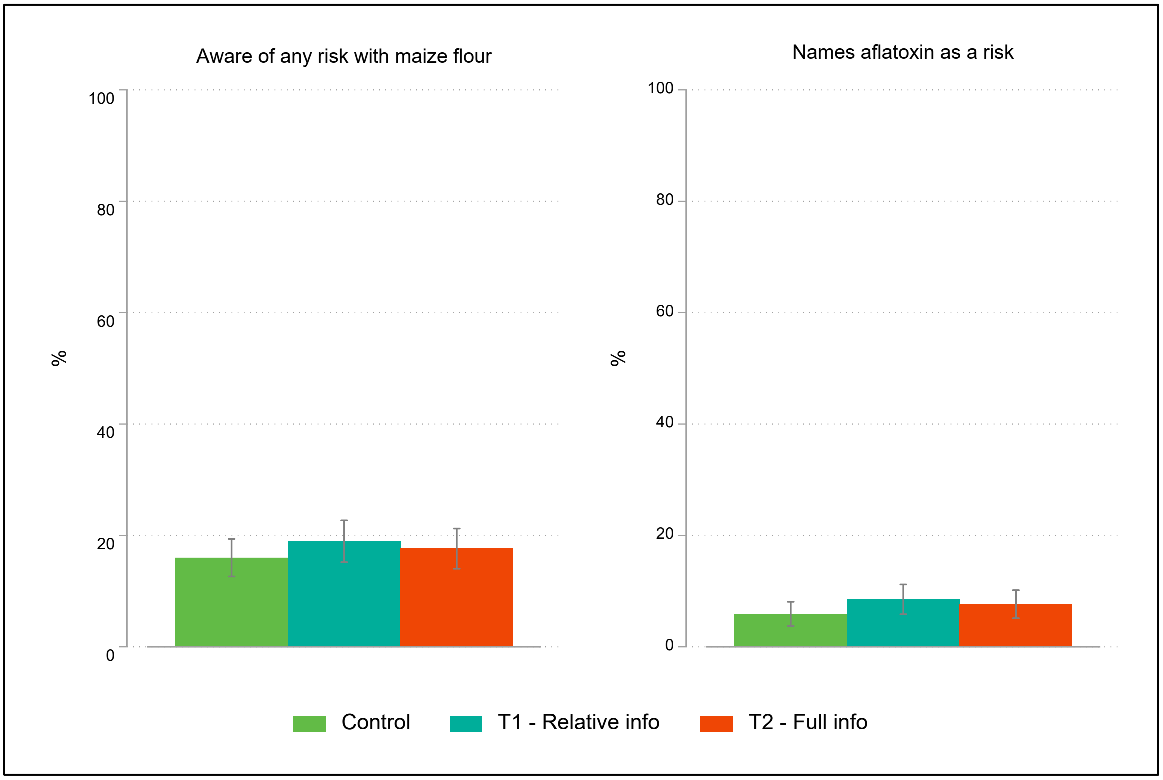
Contrary to evidence from a different Kenyan city showing that posho flour is significantly less expensive than formally milled flour (Kariuki and Hoffmann, 2021), prices for the two goods are essentially the same in this sample: respondents report paying an average of 101 Kenyan shillings (KSh), or 76 US cents per kg, for packaged flour and 99 KSh/kg for posho flour. This surprising finding is likely due to waivers on import duties as well as significant retail subsidies for sifted maize flour in force during the study period.[15]

To avoid potential researcher demand effects, we chose as our primary outcome measure whether formally milled flour could be observed by the enumerator at the conclusion of the endline interview. This avoids potential concerns about reporting bias, though since it reflects stored food at the time of interview it is naturally lower than reported consumption. This could potentially lead us to slightly under-estimate the effect of the intervention on consumption, but in practice the two measures are very close, with packaged flour observed in 97% of households who report it at baseline and endline respectively.

Prior to the intervention, few individuals in the sample reported knowing of any risk associated with maize flour (Figure 1). At baseline, respondents were asked whether they knew of "any food safety threats or concerns" regarding maize flour, then asked to describe the risk if they answered affirmatively. A large majority of respondents (82.5%) responded "No" to this question. Only 7.3% of respondents mentioned aflatoxin specifically in their response, with the remaining 10.2% mentioning either another issue (6.1%) or aware of an issue but unable to specify a name for it (4.1%). These responses were balanced across treatment groups (Appendix A).

[15] Relative prices of informally and formally milled flour vary over both space and time in Kenya based on proximity to supply of the two goods and current maize import restrictions, to which formal sector millers are sometimes granted exemptions. In the latter half of 2022, in response to a prolonged drought, both a waiver of import duties and levies on maize, and a retail subsidy of 105 KSh per 2 kg of sifted maize flour were intermittently in force (https://kippra.or.ke/economic-subsidies-the-kenya-experience/). This lines up with the data collection period, which spanned September 16, 2022 to January 25, 2023.

Figure 1 – Risk awareness pre-intervention



Following the intervention, treated households increased their consumption of formal maize flour and updated their perceptions of food safety risk (Table 1).

Table 1 – Effects of receiving any information (Specification 1)

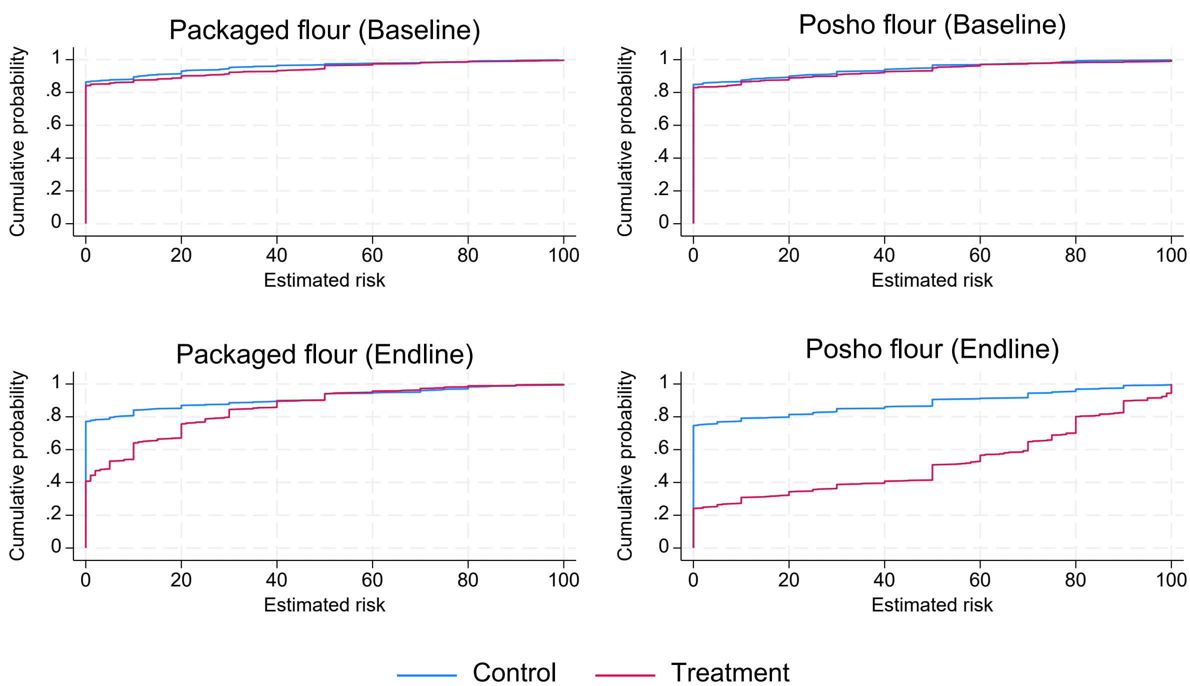
	Observed packaged	Any risk (Packaged)	Risk (Packaged)	Any risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)	(5)
Treatment: Any information	0.14***	0.24***	0.06***	0.22***	0.36***
	(0.02)	(0.01)	(0.01)	(0.03)	(0.02)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observed packaged [BL]	0.15***				
	(0.04)				
	[0.000]				
Any risk (Packaged) [BL]		0.12***	0.01	0.12**	0.08
		(0.03)	(0.03)	(0.05)	(0.07)
		[0.000]	[0.740]	[0.011]	[0.247]
Risk (Packaged) [BL]			0.17***		0.11
			(0.06)		(0.09)
			[0.003]		[0.209]
Any risk (Posho) [BL]				-0.01	-0.12
				(0.04)	(0.08)
				[0.891]	[0.120]
Risk (Posho) [BL]			-0.01		0.11
			(0.04)		(0.08)
			[0.819]		[0.194]
Observations	1300	1299	1253	1299	1253
Control mean (BL)	0.29	0.14	0.04	0.15	0.06
Control mean (EL)	0.33	0.25	0.09	0.27	0.12

Notes: "Observed package" is a binary variable taking a value of 1 if any packaged maize was observed in the household. "Any risk (*flour type*)" is a binary variable equal to 1 if the household reported that a food safety threat or concern is associated with the indicated flour type. "Risk (flour type)" is a variable indicating the respondent's subjective assessment of the probability (out of 100) that the flour type was affected by this food safety concern. Columns (1), (2) and (4) report marginal effects estimated via logit; (3) and (5) report coefficients from ordinary least squares regression. Standard errors of marginal effects or coefficients are reported in parentheses, and p-values are reported in square brackets. All specifications include the baseline outcome of interest as a control variable. Other baseline controls are selected via post-double-selection LASSO from the pre-specified list of candidates. We report coefficients for these baseline variables, but not for community health volunteer (sampling strata) fixed effects, which are also included. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively.

As our primary specification shows, treated households were 14 percentage points more likely to have formally milled maize flour in the home than those in the control group at endline. When asked whether they were aware of any safety issue regarding maize flour, treated households were more likely than control households to report a risk. The share reporting any perceived risk was higher for both packaged flour (19%-points) and for posho flour (22%-points). The average subjective probability of a food safety risk (the respondent's report that of the likelihood of a purchase of a given flour type from a local market) was likewise higher for both product categories, but the shift was much larger for posho flour. The mean risk for packaged flour was 5.8 %-points higher for households assigned to treatment relative to control households, while that for posho was 35.7%-points higher.

Figure 2 shows the shift in each measure graphically, plotting respondents' risk estimates at baseline and endline for each flour type, by treatment group.

Figure 2 – Cumulative distributions of subjective risk assessment, by survey round and flour type.



For both types of flour, the majority of respondents (83-86%) reported no risk at baseline across treatment groups. This share decreases somewhat in the control group in the follow-up survey (69% for packaged flour, 67% for posho flour), likely as a result of spillover effects (see discussion below) and dramatically in the treatment group (35% for packaged flour, 21% for posho). For posho flour, the average subjective probability among control households of contamination in a given batch of flour is 12% at follow-up. For households receiving only relative risk information (T1) the level is much higher (51%) and higher than our measured risk level based on monitoring data (25%). Households in the full information treatment (T2) who were told this value have a lower average estimate (45%) though also over-estimate the level of risk.

To formally test for differences by type of information treatment, we estimate Specification 2c, restricting our sample to treated households, and regressing an indicator for assignment to the full information treatment (relative and absolute risk) to each of our primary outcomes. These results are presented in Table 2.[16]

[16] Results for specifications 2a and 2b are included in Appendix B.

Table 2 – Comparative effects, by type of information treatment (Specification 2c)

	Observed packaged	Any risk (Packaged)	Risk (Packaged)	Any risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)	(5)
Treatment: Full information	0.00	-0.10***	-0.05***	-0.10***	-0.07***
	(0.03)	(0.03)	(0.01)	(0.04)	(0.02)
	[0.907]	[0.004]	[0.001]	[0.007]	[0.005]
Observed packaged [BL]	0.12**				
	(0.05)				
	[0.012]				
Any risk (Packaged) [BL]		0.20***	-0.02	0.30**	
		(0.05)	(0.04)	(0.14)	
		[0.000]	[0.581]	[0.033]	
Risk (Packaged) [BL]			0.10		0.13
			(0.07)		(0.11)
			[0.144]		[0.244]
Any risk (Posho) [BL]				-0.02	-0.07
				(0.13)	(0.09)
				[0.854]	[0.415]
Risk (Posho) [BL]			0.02		0.02
			(0.05)		(0.11)
			[0.738]		[0.858]
Observations	842	839	807	830	807
Control mean (BL)	0.36	0.16	0.06	0.18	0.08
Control mean (EL)	0.51	0.66	0.17	0.81	0.51

Notes: Columns (1), (2) and (4) report marginal effects estimated via logit; (3) and (5) report coefficients from ordinary least squares regression. The omitted category is Treatment 1 (Relative Risk Information Only). Standard errors of marginal effects or coefficients are reported in parentheses, and p-values are reported in square brackets. All specifications include the baseline outcome of interest as a control variable. Other baseline controls are selected via post-double-selection LASSO from the pre-specified list of candidates. We report coefficients for these baseline variables, but not for community health volunteer (sampling strata) fixed effects, which are also included. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively

As Table 2 shows, we find no differential effect across information treatments on the likelihood of a household having formally milled flour in their household at endline; those who received additional information on the absolute likelihood of posho flour contamination were as likely as those who received only relative information to have packaged flour in their home at endline.

In terms of perceived risk, however, we do find statistically significant differences by treatment. As reflected in the distributions in Figure 2, households receiving the full information treatment revised their assessments of the probability of contamination upwards by less than those receiving only relative risk information, though both groups' subjective assessments on average were higher than the true risk level. Notably, the effect of the treatment on the extensive margin of risk perception was lower in the full information treatment relative to the relative risk only treatment: households were less likely to report any risk associated with packaged flour (9%-points) or with posho flour (10%-points).

We additionally consider the possibility of heterogeneous treatment effects. We find evidence that the effect of treatment on changes in perceived risk associated with maize flour is conditioned by respondents' baseline beliefs about the relative safety of posho flour. As predicted by a standard Bayesian learning model, those who perceived no food safety risk prior to the intervention update their beliefs more in response to information than those who were already aware of this risk.

We find no differential effects by household income level (Appendix C). Households earning below the sample median of US$75, among whom mean reported income was $26, were just as likely to be consuming posho at baseline as those earning above this level, and the treatment had no differential impact on this group. The lack of a price difference between formally milled flour and posho at the time of the study may underlie the similarly of effects. Even so, our findings indicate that very poor households do take food safety into account in their consumption choices.

Learning of a food safety hazard present in maize could potentially induce households to switch to higher-priced maize products, as a potential proxy for perceived quality and safety. It could likewise lead to substitution away from maize entirely, into other starchy stables (such as rice, potatoes and breads) to test whether households switched to more expensive maize products. To test for these effects we estimate Specification 1, with the unit price paid per kg of maize flour, the unit price of maize products generally, and the quantity of other starches consumed (kg per adult equivalent) as outcome variables (Table 3).

Table 3 – Effect of treatment on expenditures on maize flour and substitutes (Specification 1)

	Maize flour price	Maize product price	Quantity substitutes	Log quantity substitutes
	(1)	(2)	(3)	(4)
Treatment: Any information	0.87	0.86	0.03	0.04
	(1.04)	(1.13)	(0.06)	(0.04)
	[0.403]	[0.449]	[0.610]	[0.389]
Maize flour price [BL]	0.04	0.02		
	(0.04)	(0.04)		
	[0.296]	[0.623]		
Any maize price [BL]	-0.02	0.01		
	(0.03)	(0.04)		
	[0.573]	[0.875]		
Quantity substitutes [BL]			0.17***	-0.01
			(0.05)	(0.04)
			[0.001]	[0.771]
Log quantity substitutes [BL]			0.28***	0.38***
			(0.06)	(0.05)
			[0.000]	[0.000]
Observations	1230	1232	1242	1219

	Maize flour price	Maize product price	Quantity substitutes	Log quantity substitutes
	(1)	(2)	(3)	(4)
Control mean (BL)	100.25	101.68	1.16	-0.09
Control mean (EL)	97.56	99.65	1.34	-0.01

Notes: Coefficients from ordinary least squares regression are reported, with errors in parentheses and p-values in square brackets. Price outcomes in column (1) and (2) are in KSh/kg. Quantities in columns (3) and (4) are kg per adult equivalent. All specifications include the baseline outcome of interest as a control variable. Other baseline controls are selected via post-double-selection LASSO from the pre-specified list of candidates. We report coefficients for these baseline variables, but not for community health volunteer (sampling strata) fixed effects, which are also included. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively

In terms of prices for maize products, we find no evidence to suggest that treated individuals paid more for maize, either for maize flour (1) or maize products overall (2). Similarly, we do not observe any evidence of substitution into other starches, using either a linear (3) or log (4) specification (though we do note that aggregating reported quantities across substitutes is inherently somewhat noisy).

Lastly, we consider the role of potential information spillovers on our results. To explore this, we estimate a spillover propensity score using Equation (3) and then interact it with the treatment indicator according to Equation (4). We estimated the spillover propensity model over a range of potential distances in increments of 10 meters over a range of 100-5,000 meters and selected the radius with the best fit based on each model's Bayesian Information Criterion (BIC), which was 1180m. Results for this model are shown in Appendix D. Overall, the rate of reported spillovers in the control group is low, at 10%, though contrary to our expectation it is lower in the high-intensity sampling area (8%) than in the low-intensity sampling area (15%).[17] The median spillover propensity score in the sample is 0.10. Spillover effects and treatment effects net of these, estimated via Equation (4), are shown in Table 4 below.

[17] It is unclear why this self-reported measure would be higher in areas with fewer sampled units. One potential explanation is that peers may be more likely to discuss the experience of being interviewed in cases where only one has been interviewed than in cases where both peers were interviewed.

Table 4 – Treatment effects interacted with estimate spillover propensity

	Observed packaged	Any risk (Packaged)	Risk (Packaged)	Any risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)	(5)
Any treatment	0.16***	0.43***	0.06***	0.57***	0.38***
	(0.04)	(0.03)	(0.02)	(0.03)	(0.02)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Spillover	-0.34	0.44	0.28**	0.56**	0.22
	(0.27)	(0.26)	(0.12)	(0.24)	(0.19)
	[0.210]	[0.100]	[0.021]	[0.021]	[0.250]
Treatment x Spillover	0.06	-0.67***	-0.10	-0.68***	-0.21
	(0.21)	(0.20)	(0.09)	(0.19)	(0.15)
	[0.786]	[0.001]	[0.285]	[0.000]	[0.156]
No study households within radius	0.37	-0.35	-0.16	-0.48	-0.36
	(0.49)	(0.47)	(0.21)	(0.43)	(0.33)
	[0.451]	[0.459]	[0.457]	[0.260]	[0.283]
No treated households known	-0.00	-0.08**	-0.01	-0.09**	-0.03
	(0.04)	(0.04)	(0.02)	(0.03)	(0.03)
	[0.955]	[0.029]	[0.647]	[0.013]	[0.279]
Observed packaged [BL]	0.18***				
	(0.04)				
	[0.000]				
Any risk (Packaged) [BL]	0.07	0.20**	-0.01	0.20**	0.11
	(0.09)	(0.10)	(0.04)	(0.08)	(0.07)
	[0.453]	[0.041]	[0.823]	[0.011]	[0.129]
Risk (Packaged) [BL]		0.00	0.17***		0.10
		(0.12)	(0.06)		(0.09)
		[0.979]	[0.004]		[0.294]
Any risk (Posho) [BL]	-0.03	0.07	0.01	0.01	-0.14*
	(0.10)	(0.10)	(0.05)	(0.10)	(0.08)
	[0.747]	[0.476]	[0.778]	[0.907]	[0.071]
Risk (Posho) [BL]			-0.01	0.10	0.14
			(0.05)	(0.11)	(0.09)
			[0.809]	[0.346]	[0.101]
Observations	1306	1306	1253	1306	1253
Control mean (BL)	0.29	0.14	0.04	0.15	0.06
Control mean (EL)	0.33	0.25	0.09	0.27	0.12

Notes: Ordinary least squares regression. Specifications always include the baseline outcome of interest as a control variable, and other baseline outcomes within the set of candidate controls to be selected via LASSO. We report coefficients for these baseline outcomes, coefficients of other baseline variables are not reported. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively

We do not find any effects associated with spillovers on the likelihood of participants having packaged maize flour present in their home at endline, though we do see evidence of spillover effects on subjective risk perceptions. The results in columns (2) and (4) imply that a household with a spillover propensity of 1 would have similar endline beliefs about the likelihood of contamination in packaged and posho flour specifically as those who were provided information directly through the intervention. In practice however, the overall rate of spillovers is low, with only 10% of control households reporting having heard any information regarding food safety, indicating a modest overall effect. There is no evidence of an additional effect of spillovers on treated households. There is also a statistically significant increase in the average risk level reported for packaged flour. While the spillover effect on the perceived risk level of posho flour is positive, it is not statistically significant.

5. Conclusion and policy implications

In this paper we test the effects of providing information on food safety risks for formally and informally milled maize flour to a vulnerable population. Systematic testing of formally versus informally traded maize flour has shown formally registered, packaged products to contain lower levels of a foodborne hazard (Kariuki & Hoffmann, 2022). Microbial analysis of packaged versus informally traded milk also show this pattern (Baker et al, 2022). On the other hand, this result is not borne out in comparative studies on meat sold by formal sector versus informal butchers (Roesel & Grace, 2014). The results of the present study indicate that where reliable evidence on the relative safety of alternative products exists, information provision can be an effective and low-cost intervention for the reduction of foodborne illness.

We find that study households who received our information treatment updated their beliefs about the risks associated with consuming different categories of maize flour, and as a result changed their purchasing behaviour and substituted lower-risk formally milled flour in place of higher-risk informally milled posho flour. Comparing effects of the two sub-treatments, we find that providing relative risk information alone, without information on the overall probability of contamination, led to higher subjective evaluations of contamination risk. This suggests that in the absence of specific risk information, food safety recommendations may lead consumers to over-estimate the risk of a health hazard. However, given that this did not affect observed purchase behaviour, the difference may have little practical significance.

Treatment effects are statistically equivalent between those in the sample with lower versus higher incomes. This shows that even households with limited means put a positive value on food safety. Whether such a result would hold if the safer food were more costly than the less safe option remains an open and important question. The fact that the safer product was, at the time of the study, equivalent in price to the less safe option precludes estimation of either households' willingness to pay for this attribute or the income elasticity of demand for food safety. Replication of our approach in a setting where food safety comes at a premium price would allow for such analysis.

We find no evidence of substitution away from the product class about which information about a food safety hazard was provided. While the nutritional value of maize versus alternative starches is trivial, substitution away from highly nutritious, but also high-risk foods such as meat and fresh vegetables could potentially lead to unintended adverse effects when raising consumer awareness of food safety risks. The finding of no such effect in this context mitigates this concern to some extent.

However, as substitution effects are likely to be product-specific, additional research on this point remains important.

An information intervention of the type described could be conducted within the context of well-child clinics or routine household visits by community health volunteers. Costs would be limited to testing food samples to establish the relative level of risk by category, and printing posters for distribution. To detect a difference in regulatory non-compliance of the magnitude observed in the Nairobi sample (10% vs 24% non-compliant) with 95% confidence and 80% power requires a total of 232 samples. With sample collection costs of $3 US per sample including the cost of procurement, labor, and transport, and analysis costs of $33.3 per sample including labor, materials, and laboratory space, the fixed cost of generating relative risk information is $8,421.6 US. The self-adhesive A3 posters used in the present study were purchased at a cost of $0.90 each. Cost savings on posters could be achieved through bulk ordering, and potentially by reducing their size.

To date, the majority of research on behavioural responses to information on aflatoxin risk has focused on maize-producing households. Interventions promoting production and post-harvest practices to mitigate this risk have proven effective (Pretari, Hoffmann and Tian, 2019; Bauchet et al. 2021; Magnan et al., 2021; Deutschmann et al., 2023). Our findings demonstrate that a low-cost information provision intervention was able to alter consumers' perceptions and induce them to switch to a lower-risk alternative. This demonstrates that product safety is a salient concern for consumers even in low-income settings. More broadly, our results show that informational interventions have the capacity to reduce the environmental health risks faced by consumers in low-income countries, enabling them to mitigate the hazards they face in settings where regulatory enforcement is partial or absent. Citizens in developing economies face significant environmental health risks, including that of unsafe food. Empowering them with information can complement supply-side regulation to improve health outcomes.

References

Adda, J. (2007). Behavior towards health risks: An empirical study using the "Mad Cow" crisis as an experiment. *Journal or Risk and Uncertainty, 35*(3), 285-305. doi:10.1007/s11166-007-9026-5

Ahrens, A., Hansen, C., & Schaffer, M. (2018). pdslasso and ivlasso: Progams for post-selection and post-regularization OLS or IV estimation and inference. Retrieved from http://ideas.repec.org/c/boc/bocode/s458459.html

Baker, K., Hoffmann, V., Simiyu, S., Sewell, D. K., Tsai, K., Cumming, O., & Mumma, J. (2022). Milk Product Safety and Household Food Hygiene Influence Bacterial Contamination of Infant Food in Peri-Urban Kenya. *Frontiers: Public Health*. doi:10.3389/fpubh.2021.772892

Bauchet, J., Prieto, S. and Ricker-Gilbert, J., 2021. Improved drying and storage practices that reduce aflatoxins in stored maize: experimental evidence from smallholders in Senegal. *American Journal of Agricultural Economics*, *103*(1), pp.296-316.

Belloni, A., Chernozhukov, V., & Hansen, C. (2014). High-Dimensional Methods and Inference on Structural and Treatment Effects. *Journal of Economic Perspectives, 28*(2), 29-50. doi:DOI: 10.1257/jep.28.2.29

Bennear, L., Tarozzi, A., Pfaff, A., Balasubramanya, S., Matim Ahmed, K., & Van Geen, A. (2013). Impact of a randomized controlled trial in arsenic risk communication on household water-source choices in Bangladesh. *Journal of Environmental Economics and Management, 65*(2), 225-240. doi:10.1016/j.jeem.2012.07.006

Bovay, J. (2023). Food safety, reputation, and regulation. *Applied Economic Perspectives and Policy, 45*(2). doi:10.1002/aepp.13315

Chen, J., & Roth, J. (2024). Logs with Zeros? Some Problems and Solutions. *Quarterly Journal of Economics, 139*(2), 891-936. doi:https://doi.org/10.1093/qje/qjad054

Delavande, A., Gine, X., & McKenzie, D. (2011). Measuring subjective expectations in developing countries: A critical review and new evidence. *Journal of Development Economics, 94*(2).

Deutschmann, J., Bernard, T., & Yameogo, O. (2023). Contracting and quality upgrading: evidence from an experiment in Senegal. *Working Paper*.

Dupas, P. (2011). Do Teenagers Respond to HIV Risk Information? Evidence from a field experiment in Kenya. *American Economic Jounal: Applied Economics, 3*(1), 1-34.

Fafchamps, M., Hill, R. V., & Minten, B. (2008). Quality control in nonstaple food markets: Evidence from India. *Agricultural Economics, 38*(3), 251-266.

Ferrer, R., & Klein, W. M. (2016). Risk perceptions and health behavior. *Current Opinion in Psychology, 1*(5), 85-89. doi:10.1016/j.copsyc.2015.03.012

Goldsmith-Pinkham, P., Hull, P. and Kolesár, M., 2024. Contamination bias in linear regressions. *American Economic Review*, *114*(12), pp.4015-4051.

Godlonton, S., Munthali, A., & Thornton, R. (2016). Responding to Risk: Circumcision, Information and HIV Prevention. *Review of Economics and Statistics, 98*(2), 333-349. doi:10.1162/REST_a_00516

Grace, D. (2015). Food Safety in Low and Middle Income Countries. *International Journal of Environmental Research and Public Health, 12*(9). doi:10.3390/ijerph120910490

Grace, D. (2023). Burden of foodborne disease in low-income and middle-income countries and opportunities for scaling food safety. *Food Security, 15*(6), 1475-1488.

Hald, T., Aspinall, W., Develeesschauwer, B., Cooke, R., Corrigan, T., & Havelaar, A. (2016). World Health Organization estimates of the relative contributions of food to the burden of disease due to selected foodborne hazards: a structured expert elicitation. *PLoS One, 12*(12). doi::e1001921. 10.1371/journal.pmed.1001921

Hoffmann, V., & Baral, S. (2019). *Foodborne disease in Kenya: Country-level cost estimates and the case for greater public investment*. Washington DC: International Food Policy Research Institute.

Hoffmann, V., Alonso, S., & Kang'ethe, E. (2023). Food safety in Kenya: Status, challenges, and proposed solutions. In M. K. Clemens Breisinger, *Food Systems Transformation in Kenya: Lessons from the Past and Policy Options for the Future* (pp. 105-129). Washington DC: IFPRI. doi:https://doi.org/10.2499/9780896294561_05

Hoffmann, V., Barasa, A., Murphy, M., Ndisio, B., & Okoth, S. A. (2023). Aflatoxin Contamination of Maize Flour in Kenya: Results from Multi-City, Multi-Round Surveillance. *IFPRI Discussion Paper 02217*. doi:https://doi.org/10.2499/p15738coll2.137033

Hoffmann, V., Jones, K., & LeRoy, J. (2019). he impact of reducing dietary aflatoxin exposure on child linear growth: a cluster randomized controlled trial in Kenya. *BMJ: Global Health, 4*(1).

Hoffmann, V., Moser, C., & Saak, A. (2019). Food safety in low and middle-income countries: The evidence through an economic lens. *World Development, 123*.

Hoffmann, V., Moser, C., & T.J., H. (2021). Demand for aflatoxin-safe maize in Kenya: Dynamic response to price and advertising. *American Jouranl of Agricultural Economics, 1*, 275-295.

Jalan, J., & Somanathan, E. (2008). The importance of being informed: Experimental evidence on demand for environmental quality. *Journal of Development Economics, 87*(1), 14-28. doi:10.1016/j.jdeveco.2007.10.002

Kariuki, S., & Hoffmann, V. (2022). Can information drive demand for safer food? Impact of bran-specific recommendations and test results on product choice. *Agricultural Economics, 53*(3), 454-467.

Kerwin, J. (2024). Scared Straight or Scared to Death? Fatalism in Response to Disease Risks. *Working Paper*. Retrieved from http://www.jasonkerwin.com/Papers/ScaredStraight/Kerwin_ScaredStraight_Latest.pdf

Magnan, N., Hoffmann, V., Opoku, N., Garido, G., & Kanyam, D. (2021). Information, technology, and market rewards: Incentivizing aflatoxin control in Ghana. *Journal of Development Economics, 151*. doi:https://doi.org/10.1016/j.jdeveco.2020.102620

National Toxicology Program. (2021). 15th Report on Carcinogens. doi:10.3390/ijerph120910490

Pretari, A., Hoffmann, V. and Tian, L., 2019. Post-harvest practices for aflatoxin control: Evidence from Kenya. *Journal of Stored Products Research*, *82*, pp.31-39.

Roesel, K., & Grace, D. (2014). *Food safety and informal markets: Animal products in sub-Saharan Africa.* London: Routledge.

Smith, V. K., Desvousges, W. H., & Payne, J. W. (1995). Do Risk Information Programs Promote Mitigating Behavior. *Journal of Risk and Uncertainty, 10*, 203-221.

Strosnider, H., Azziz-Baumgartner, E., Banziger, M., Bhat, R., Breiman, R., Brune, M., . . . Henry, S. (2006). Public health strategies for reducing aflatoxin exposure in developing countries. *Environmental Health Perspectives, 114*(12), 1898-1903. doi:10.1289/ehp.9302

Thornton, R. L. (2008). The Demand for, and Impact of, Learning HIV status. *American Economic Review, 98*(5), 1829-1863. doi:10.1257/aer.98.5.1829

Turner, P. C. (2013). The Molecular Epidemiology of Chronic Aflatoxin Driven Impaired Child Growth. *Scientifica, 152879*. doi: https://doi.org/10.1155/2013/152879

WHO. (2015). *Estimates of the Global Burden of Foodborne Diseases.* New York: WHO.

Appendix A – Treatment Balance

Balance table

	Mean				p-value			
	Control	Treatment	T1 only	T2 only	Control vs. Treatment	Control vs. T1	Control vs. T2	T1 vs. T2
Observed packaged flour	0.29	0.32	0.36	0.28	0.139	0.009	0.867	0.007
Observed posho flour	0.54	0.50	0.50	0.49	0.132	0.276	0.138	0.879
Reports packaged flour	0.38	0.43	0.47	0.38	0.069	0.004	0.798	0.002
Reports posho flour	0.98	0.96	0.95	0.96	0.017	0.013	0.149	0.448
Reports maize grain	0.33	0.32	0.32	0.31	0.579	0.713	0.572	0.796
Any risk: Packaged	0.14	0.16	0.16	0.15	0.293	0.299	0.488	0.720
Risk: Packaged flour	4.39	5.91	6.41	5.41	0.089	0.054	0.361	0.419
Any risk: Posho flour (BL)	0.15	0.17	0.18	0.17	0.350	0.384	0.520	0.783
Risk: Posho flour	5.66	6.75	7.55	5.98	0.259	0.183	0.769	0.325
Difference in risk	1.27	0.85	1.14	0.56	0.600	0.905	0.414	0.634
Maize price (kg)	101	101	101	101	0.764	0.600	0.965	0.641
Total maize expenditure (KSh)	517	501	503	499	0.407	0.538	0.365	0.855
Household size	4.99	4.89	4.85	4.93	0.188	0.159	0.512	0.498
Child < 1 year old	0.10	0.10	0.10	0.10	0.811	0.824	0.851	0.987
Child 1-2 years old	0.26	0.29	0.28	0.30	0.200	0.421	0.267	0.640
Child 3-5 years old	0.70	0.69	0.68	0.70	0.589	0.559	0.773	0.741
Child 6-12 years old	0.66	0.65	0.64	0.66	0.849	0.625	0.808	0.437
Child 13-17 years old	0.40	0.36	0.38	0.35	0.171	0.396	0.147	0.385
Adult over 50 years old	0.13	0.12	0.10	0.14	0.644	0.239	0.627	0.101
Respondent age	32.72	32.70	32.63	32.77	0.958	0.875	0.935	0.799
Respondent is female	0.94	0.92	0.93	0.92	0.159	0.318	0.163	0.852
Respondent is married	0.74	0.72	0.75	0.70	0.598	0.717	0.200	0.116
Education level: No formal	0.16	0.14	0.13	0.15	0.194	0.078	0.599	0.237
Education level: Primary	0.46	0.46	0.46	0.45	0.828	0.929	0.763	0.880
Education level: Secondary	0.29	0.31	0.32	0.30	0.384	0.324	0.627	0.617
Education level: Technical	0.07	0.09	0.09	0.09	0.344	0.439	0.440	0.980
Education level: University	0.01	0.01	0.01	0.00	0.370	0.599	0.251	0.289
Monthly income (KSh)	11613	12020	11529	12501	0.574	0.920	0.297	0.267
Asset: Smartphone	0.68	0.71	0.73	0.68	0.179	0.065	0.759	0.203
Asset: Solar panel	0.02	0.03	0.03	0.03	0.062	0.259	0.071	0.476
Asset: Grid connection	0.84	0.83	0.83	0.83	0.615	0.628	0.699	0.857
Asset: TV	0.73	0.75	0.76	0.73	0.470	0.157	0.988	0.203
Asset: Computer	0.02	0.04	0.04	0.03	0.176	0.152	0.440	0.540
Asset: DVD player	0.13	0.15	0.16	0.13	0.201	0.095	0.644	0.297
Asset: Electric cooker	0.08	0.08	0.09	0.06	0.823	0.308	0.330	0.042

	Mean				p-value			
	Control	Treatment	T1 only	T2 only	Control vs. Treatment	Control vs. T1	Control vs. T2	T1 vs. T2
Asset: Charcoal stove	0.77	0.77	0.79	0.76	0.725	0.375	0.763	0.205
Asset: Gas cooker	0.68	0.74	0.72	0.75	0.043	0.144	0.051	0.431
Housing index	-0.08	0.05	0.09	0.01	0.010	0.019	0.136	0.360
Daily fuel expenditure (KSh)	66	67	64	70	0.752	0.410	0.224	0.004
Daily electricity expenditure (KSh)	3	4	4	4	0.107	0.360	0.163	0.845
Monthly rent expenditure (KSh)	3518	3598	3590	3605	0.537	0.656	0.506	0.917
Risk preference	4.98	5.11	5.00	5.21	0.433	0.915	0.262	0.421
Knowledge: Is a poison	0.05	0.06	0.05	0.06	0.457	0.660	0.419	0.706
Knowledge: Comes from fungus	0.02	0.02	0.01	0.03	0.915	0.404	0.583	0.084
Knowledge: Grows on maize	0.01	0.01	0.02	0.00	0.763	0.343	0.469	0.129
Knowledge: Can't observe	0.09	0.08	0.09	0.07	0.414	0.756	0.230	0.491
Knowledge: Cooking aflatoxin (BL)	0.15	0.16	0.17	0.16	0.474	0.437	0.749	0.643
Knowledge: Causes illness	0.02	0.01	0.01	0.01	0.072	0.251	0.033	0.517
Knowledge: Causes cancer	0.00	0.02	0.02	0.01	0.021	0.034	0.130	0.395
Knowledge: Impairs development	0.00	0.00	0.00	0.00	0.957	0.957	0.969	0.988
Knowledge: Jaundice	0.00	0.00	0.00	0.00	0.323	0.325	-	0.325
Knowledge: Stomach problems	0.13	0.14	0.14	0.14	0.663	0.661	0.810	0.855
				Joint orthogonality F-test	0.678	0.430	0.808	0.479

Notes: F-tests for overall differences between each set of groups are based on logistic regressions of the relevant treatment indicator on the full set of potential baseline controls, restricting the sample to two groups being compared. Tests of equality for each variable are based on linear regressions of each variable on one treatment indicator, again restricting the sample to two groups.

Appendix B – Primary specification by individual treatment

Specification 2a – Control vs. relative risk information treatment

	Observed packaged (1)	Any risk (Packaged) (2)	Risk (Packaged) (3)	Any risk (Posho) (4)	Risk (Posho) (5)
Treatment: Relative risk information	0.13***	0.22***	0.08***	0.26***	0.39***
	(0.03)	(0.04)	(0.01)	(0.05)	(0.02)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observed packaged [BL]	0.14***				
	(0.04)				
	[0.001]				
Any risk (Packaged) [BL]		0.08**	-0.04	0.15**	
		(0.04)	(0.05)	(0.06)	
		[0.048]	[0.392]	[0.017]	
Risk (Packaged) [BL]			0.26***		0.24***
			(0.07)		(0.09)
			[0.000]		[0.007]
Any risk (Posho) [BL]			0.06	0.02	-0.08
			(0.06)	(0.05)	(0.08)
			[0.273]	[0.647]	[0.269]
Risk (Posho) [BL]		0.08	-0.05		0.07
		(0.07)	(0.07)		(0.09)
		[0.238]	[0.433]		[0.431]
Observations	867	860	841	860	841
Control mean (BL)	0.29	0.14	0.04	0.15	0.06
Control mean (EL)	0.33	0.25	0.09	0.27	0.12

Notes: (1), (2) and (4) are marginal effects estimated via logit, (3) and (5) are ordinary least squares. Specifications always include the baseline outcome of interest as a control variable, and other baseline outcomes within the set of candidate controls to be selected via LASSO. We report coefficients for these baseline outcomes, coefficients of other baseline variables are not reported. All specifications include community health volunteer (sampling strata) fixed effects. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively

Specification 2b – Control vs. full information treatment

	Observed packaged	Any risk (Packaged)	Risk (Packaged)	Any risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)	(5)
Treatment: Full information	0.13***	0.25***	0.04***	0.34***	0.33***
	(0.04)	(0.02)	(0.01)	(0.02)	(0.02)
	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]
Observed packaged [BL]	0.21***				
	(0.05)				
	[0.000]				
Any risk (Packaged) [BL]		0.20***	-0.01	0.16*	
		(0.04)	(0.04)	(0.08)	
		[0.000]	[0.812]	[0.053]	
Risk (Packaged) [BL]			0.17**		0.12
			(0.07)		(0.10)
			[0.014]		[0.225]
Any risk (Posho) [BL]				0.00	-0.05
				(0.09)	(0.08)
				[0.985]	[0.562]
Risk (Posho) [BL]			-0.02		0.17*
			(0.06)		(0.10)
			[0.749]		[0.091]
Observations	848	878	858	878	858
Control mean (BL)	0.29	0.14	0.04	0.15	0.06
Control mean (EL)	0.33	0.25	0.09	0.27	0.12

Notes: (1), (2) and (4) are marginal effects estimated via logit, (3) and (5) are ordinary least squares. Specifications always include the baseline outcome of interest as a control variable, and other baseline outcomes within the set of candidate controls to be selected via LASSO. We report coefficients for these baseline outcomes, coefficients of other baseline variables are not reported. All specifications include community health volunteer (sampling strata) fixed effects. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively

Appendix C – Heterogeneity

Heterogeneity – No risk from posho reported at baseline

	Observed packaged	Any risk (Packaged)	Risk (Packaged)	Any risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)	(5)
Treatment: Any information	0.18**	0.24***	-0.03	0.32***	0.31***
	(0.07)	(0.07)	(0.03)	(0.06)	(0.05)
	[0.011]	[0.001]	[0.361]	[0.000]	[0.000]
No risk from posho [BL]	-0.09	-0.32***	-0.14***	-0.36***	-0.16***
	(0.06)	(0.06)	(0.03)	(0.06)	(0.04)
	[0.153]	[0.000]	[0.000]	[0.000]	[0.000]
Treatment x No Risk	-0.04	0.15**	0.11***	0.22***	0.05
	(0.08)	(0.08)	(0.03)	(0.07)	(0.05)
	[0.625]	[0.042]	[0.002]	[0.001]	[0.332]
Observations	1309	1309	1256	1309	1256
Control mean (BL)	0.29	0.86	0.29	1.00	0.37
Control mean (EL)	0.33	0.52	0.20	0.58	0.25

Heterogeneity – At or above median income at baseline

	Observed packaged	Any risk (Packaged)	Risk (Packaged)	Any risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)	(5)
Treatment: Any information	0.12***	0.37***	0.06***	0.53***	0.38***
	(0.04)	(0.04)	(0.02)	(0.04)	(0.03)
	[0.003]	[0.000]	[0.000]	[0.000]	[0.000]
At or above median income	-0.05	0.06	0.02	0.07*	0.02
	(0.05)	(0.05)	(0.02)	(0.04)	(0.03)
	[0.320]	[0.206]	[0.266]	[0.085]	[0.627]
Treatment x Median Income	0.07	0.00	-0.00	-0.05	-0.04
	(0.06)	(0.06)	(0.03)	(0.05)	(0.04)
	[0.199]	[0.974]	[0.953]	[0.308]	[0.293]
Observations	1309	1309	1256	1309	1256
Control mean (BL)	0.29	0.86	0.29	1.00	0.37
Control mean (EL)	0.33	0.52	0.20	0.58	0.25

Appendix D – Spillover radius estimation & first-stage regressions

	Learned anything regarding food safety (1)
CHV-level treatment [BL]	-0.05**
	(0.02)
	[0.023]
PropHH	-0.39
	(0.26)
	[0.132]
NoHH	0.00
	(.)
	[.]
PropSocial	-0.00
	(0.04)
	[0.955]
NoSocial	0.04
	(0.04)
	[0.370]
Packaged flour observed (BL)	-0.02
	(0.03)
	[0.376]
Any risk: Packaged flour (BL)	0.09
	(0.08)
	[0.290]
Risk: Packaged flour (BL)	0.04
	(0.09)
	[0.685]
Any risk: Posho flour (BL)	-0.02
	(0.09)
	[0.772]
Risk: Posho flour (BL)	-0.07
	(0.10)
	[0.470]
Consumed packaged flour (BL)	0.07***
	(0.03)
	[0.005]
Household consumed: Posho flour (7 days)	0.08
	(0.07)
	[0.200]
Household consumed: Whole maize grains (7 days)	0.02
	(0.02)
	[0.387]

	Learned anything regarding food safety
	(1)
Maize price (BL)	0.00
	(0.00)
	[0.772]
Value of all maize (BL)	0.00
	(0.00)
	[0.713]
Household size (BL)	0.01
	(0.01)
	[0.318]
Has infant (BL)	-0.03
	(0.04)
	[0.393]
Has toddler (BL)	-0.03
	(0.03)
	[0.289]
Has young child (BL)	-0.02
	(0.03)
	[0.463]
Has older children (BL)	-0.02
	(0.02)
	[0.352]
Has teenager (BL)	-0.06**
	(0.03)
	[0.019]
Has member over 50 (BL)	0.00
	(0.04)
	[0.939]
Age of respondent	0.00
	(0.00)
	[0.526]
Female respondent	-0.04
	(0.03)
	[0.305]
Married respondent	0.04
	(0.02)
	[0.122]
Education: Did not complete primary	0.08
	(0.13)
	[0.556]
Education: Completed primary	0.07

	Learned anything regarding food safety
	(1)
	(0.13)
	[0.601]
Education: Completed secondary	0.10
	(0.12)
	[0.404]
Education: Technical school	0.07
	(0.13)
	[0.596]
Education: University	0.00
	(.)
	[.]
Monthly income (BL)	-0.00
	(0.00)
	[0.220]
Smartphone	0.01
	(0.02)
	[0.543]
Solar panel	-0.13*
	(0.08)
	[0.100]
Connection to electric grid	0.03
	(0.04)
	[0.378]
TV	-0.00
	(0.02)
	[0.900]
Computer/laptop	0.04
	(0.05)
	[0.382]
DVD player	0.00
	(0.03)
	[0.877]
Electric cooker/hot plate	-0.02
	(0.04)
	[0.533]
Charcoal stove / jiko	-0.06**
	(0.03)
	[0.032]
Has gas cooker (BL)	0.01
	(0.02)

	Learned anything regarding food safety
	(1)
	[0.599]
Housing index	0.03**
	(0.01)
	[0.014]
Daily fuel expend (BL)	-0.00
	(0.00)
	[0.124]
Daily electricity expend (BL)	0.00
	(0.00)
	[0.186]
Monthly rent (BL)	-0.00
	(0.00)
	[0.826]
Risk tolerance	0.00
	(0.00)
	[0.198]
Knowledge: Is a poison	-0.03
	(0.05)
	[0.558]
Knowledge: Comes from fungus	-0.05
	(0.08)
	[0.528]
Knowledge: Grows on maize	0.05
	(0.09)
	[0.564]
Knowledge: Can't observe	0.02
	(0.05)
	[0.649]
Knowledge: Cooking aflatoxin (BL)	0.01
	(0.07)
	[0.856]
Knowledge: Causes illness	-0.15
	(0.13)
	[0.237]
Knowledge: Causes cancer	0.08
	(0.07)
	[0.235]
Knowledge: Impairs development	0.26*
	(0.16)
	[0.094]

	Learned anything regarding food safety
	(1)
Knowledge: Causes jaundice	0.00
	(.)
	[.]
Knowledge: Causes stomach problems	-0.02
	(0.05)
	[0.703]
Observations	1304

*Notes: Logistic regression with enumerator fixed effects. Results are calculated using a radius of 118m, selected using model fit. *,**,*** indicate significance at the 10%, 5% and 1% levels, respectively*

Appendix E – Experimental script

T1- Relative information only treatment

Now I'm going to give you information about aflatoxin, a food safety problem that affects maize.

Aflatoxin is invisible. You cannot tell by looking at maize or maize flour whether it is contaminated with aflatoxin.

Aflatoxin harms health. Consuming food with unsafe levels of aflatoxin can damage the liver and cause cancer. If aflatoxin is consumed by young children, their growth and development may be affected.

Packaged unga is tested for aflatoxin by the government. The government of Kenya has set a rule for how much aflatoxin should be allowed in food that is sold, and regularly tests packaged unga to make sure that it is safe.

Our research team tested many samples of maize flour from all over Kenya.

We found that branded packaged maize flour (unga) contained less than half the level of aflatoxin as flour from posho mills.

Remember, aflatoxin is invisible, so even if the maize grains you buy for milling look good, they may contain a lot of aflatoxin.

If you want to reduce the risk that you or your family are exposed to aflatoxin, you can do so by buying packaged unga instead of posho flour.

T2- Full information treatment

Now I'm going to give you information about aflatoxin, a food safety problem that affects maize.

Aflatoxin is invisible. You cannot tell by looking at maize or maize flour whether it is contaminated with aflatoxin.

Aflatoxin harms health. Consuming food with unsafe levels of aflatoxin can damage the liver and cause cancer. If aflatoxin is consumed by young children, their growth and development may be affected

Packaged unga is tested for aflatoxin by the government. The government of Kenya has set a rule for how much aflatoxin should be allowed in food that is sold, and regularly tests packaged unga to make sure that it is safe.

Our research team tested many samples of maize flour from all over Kenya.

One in every four tins of posho we tested contained more aflatoxin than is legally permitted in Kenya.

You see these four bags of posho? [show 4 laminated cut-out images of posho, one of which is marked with a "!" sign] We found that for every four batches of posho tested, one was contaminated with aflatoxin beyond the legal level set by the government of Kenya.

We found that branded packaged maize flour (unga) contained less than half the level of aflatoxin as flour from posho mills.

Remember, aflatoxin is invisible, so even if the maize grains you buy for milling look good, they may contain a lot of aflatoxin.

If you want to reduce the risk that you or your family are exposed to aflatoxin, you can do so by buying packaged unga instead of posho flour.