Consumer responses to novel risk information: Evidence from an experiment in urban Kenya

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Abstract

Foodborne illness is a global public health problem, comparable in magnitude to malaria, whose burden is heavily concentrated in developing economies where regulatory capacity is limited. Since contamination is not observable, consumers cannot differentiate between higher and lower risk options. We test the impact of an experiment in which consumers receive information on the risk of contamination with a fungal toxin in formally and informally produced maize flour. We find a 47 percent increase in the share of households consuming the lower-risk product at follow-up in the treatment group relative to the control group, from a base of 38 percent. Our results demonstrate the potential for public surveillance and risk communication to shift demand towards safer product options where regulatory enforcement is weak.

Keywords: Risk communication, food safety, Kenya

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1 Introduction

Foodborne disease accounts for a large health burden, comparable in magnitude to that of malaria (Grace, 2023). This burden is heavily concentrated in low- and middle-income countries (LMICs), where limited public sector capacity and thinly stretched health budgets compound the challenge of upgrading and regulating many small-scale food businesses (Jaffee et al., 2018). Since food safety hazards are extremely costly to observe relative to the value of a typical transaction (Fafchamps et al., 2008), a market failure results in which health risks are not reflected in prices, leading food safety to be under-provided in the absence of government intervention (Antle, 2001).

Food safety surveillance and risk communication, including the provision of information about the high prevalence of hazards in certain foods, can be a cost-effective strategy for reducing food safety risk. This approach is widely used by public health authorities in high-income countries, for example to advise against frequent consumption of fish that may contain high levels of mercury and to warn consumers about the dangers of consuming unpasteurized milk (Shimshack et al., 2007; UK FSA, n.d.). Evidence that food safety concerns affect the dietary choices of LMIC consumers (Liguori et al., 2022) suggests that this type of risk communication could also be effective in these settings.

However, a risk of increasing the salience of food safety hazards is that consumers may overreact. It is well established that people often overreact to small but dreaded risks (Slovic, 2000), potentially leading consumers to spend heavily for a small reduction in risk. Further, as the riskiest foods (fruits, vegetables, and animal-source foods) are generally also those with the highest nutritional value (Grace, 2015), the health costs of shifting diets away from these foods could potentially outweigh the benefits.

In this paper, we examine consumer response to food safety information at the product class level through a randomized risk communication intervention. To avoid the potential for adverse nutritional consequences, we targeted consumption of an easily substituted type of maize flour, which is frequently contaminated with aflatoxin, a carcinogenic fungal byproduct. The information campaign focused on the relatively higher likelihood of contamination in informally milled whole-grain flour (posho), versus formally milled, refined and fortified flour, based on the results of systematic surveillance (Barasa et al., 2023).[1]

Impacts of different types of food safety information on consumer perceptions and choices were assessed through a three-arm randomized controlled trial. Participants in both treatment groups were informed about the health risks associated with aflatoxin exposure, and about recent evidence that posho is over twice as likely to be contaminated above Kenya's regulatory limit by this toxin as branded flour. In one treatment arm, participants were additionally informed of the absolute probability that posho flour failed to meet the safety standard. This design allows us to observe how consumers update their beliefs on the probability of a health hazard in response to new information, and whether providing only relative risk information leads them to under- or over-adjust their beliefs relative to this benchmark. We control for information spillovers by varying the proportion of households assigned to treatment within sampling clusters.

We find that after accounting for spillovers, households assigned to receive any information were 18 percentage points more likely to have lower-risk formally milled flour present in their home during an endline survey two months later than those assigned to the control group, an increase of 47% relative to the control group mean of 38%. In line with the information provided, the perception of a non-zero risk that consuming each type of maize could lead to health problems was higher for both treatment groups than among controls. Also consistent with the message, conditional on perceiving a non-zero risk, the subjective riskiness of branded flour decreased, while that of posho increased.

The perceived likelihood of a food safety threat was higher among those who only received relative risk information compared to those given full information, but this did not

[1]Food safety risk hazards and food safety risks are distinct concepts; the presence of a hazard (e.g., aflatoxin, microbial contamination) may or may not imply a risk (probability and seriousness of health harm), depending on how food is handled. For example, if raw milk is handled carefully and boiled prior to consumption, the presence of microbial hazards may not imply a food safety risk. In the case of aflatoxin in maize flour, however, the hazard translates directly into a food safety risk since the flour is not affected by heat treatment.

result in any difference in consumption choices across these groups. Further, consumers did not alter their overall consumption of maize products in response to risk information, indicating that in this context, food safety information did not meaningfully affect nutrition. Cost-benefit analysis indicates that while information could be a low-cost way for governments to reduce exposure to a food safety hazard, a large portion of the total cost is likely to be borne by consumers as they shift to safer, more expensive products.

The primary contribution of this study is to the literature on consumer response to food safety information. This body of work generally shows far stronger consumer reactions to negative than positive information, presumably based on the correct expectation that most food is safe to consume (Bovay, 2023). While much of the work on the effect of negative food safety information has been conducted in high-income countries (Bovay, 2023; Spalding et al., 2023), or has focused on LMIC exports (Bai et al., 2022), there is evidence that demand in LMICs is also sensitive to food safety scares (Hassouneh et al., 2012). A number of studies in LMICs have examined the effect of positive food safety information on consumer demand, typically through single-interaction willingness-to-pay experiments, a design likely to generate upward-biased due to the salience of food safety in the moment when participants make a choice (Hoffmann et al., 2019). One study conducted in Kenya that tracked demand for a food safety labeled item over time found decreasing impacts of information over time (Hoffmann et al., 2021). Closest to the present study is one by Kariuki and Hoffmann (2022), also in Kenya, in which participants were given information on the contamination of the maize flour they were currently consuming, provided with a recommendation for a relatively safe brand, and revisited two months later. While that study found a lasting impact of information on consumption choice, the cost of scaling-up such an approach would be prohibitive.

More broadly, we contribute to a body of work on the influence of subjective expectations on economic behavior relating to health. Risk perceptions have been identified within the health literature as playing an essential role in determining behavior (Ferrer &

Klein, 2015). Within economics, behavioral 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, 2025), radon poisoning (Smith et al., 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.

The remainder of the paper proceeds as follows. In the next section we describe the context and study design. We then outline our analytical approach in Section 3, and present results in Section 4. Section 5 considers the cost-effectiveness and nutritional trade-offs of the information campaign, and Section 6 concludes with a discussion of the findings and implications for policy.

2 Context & Study Design

2.1 Context

Like many LMICs, 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 (Hoffmann, Alonso, & Kang'ethe, 2023). As a result, a large portion of the food available on the market fails to comply with food safety standards. A recent surveillance study found that 10% of formally refined and packed maize flour, and 24% of informally milled wholegrain maize flour (posho) collected from 10 urban sampling sites in Kenya over the course of a year exceeded the regulatory limit for aflatoxin (Barasa et al., 2023). In addition to increasing the risk of liver cancer, aflatoxin exposure is believed to suppress immune function and contribute to growth faltering among children (Strosnider, et al., 2006).

Strict enforcement of the regulatory standard in this context would imply an unacceptable reduction in food availability. However, steering consumer demand toward a safer product class has the potential to immediately reduce population exposure to a known hazard while expanding the market share of regulated food processing firms, paving the way for ongoing improvements to food safety as regulatory capacity improves. Consumption of formally milled flour is increasing in Kenya, but remains a minority of total maize consumption as of the most recent nationally representative consumption data (Hoffmann et al., 2021).

2.2 Sampling

We draw our sample from low-income households living in informal settlement areas in urban and peri-urban Nairobi County.[2] To be eligible for inclusion in the study, households had to reside in one of the four study communities, include a child under the age of five years, and have purchased posho flour within the past two weeks. We focus on young children due to the particular 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 each of the study areas. 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 obtained informed consent from the respondent and conducted the baseline interview.[3] Enumerators were able to identify 1673 households from the community health system lists who could be reached by phone, of which 1449 who met screening criteria were successfully interviewed at baseline.[4]

[2] These were: Kawangware, Kangemi, Kibera and Athi River

[3] 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.

[4] We successfully re-interviewed 1309 households at follow up, an attrition rate of approximately 9%.

2.3 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. Seventy-three CHVs were randomly assigned with equal probability to one of two treatment arms: either 50% (low intervention intensity) or 100% (high intervention intensity). In the latter case, every household for which the CHV was responsible was included in the sampling frame, while for the low- intensity treatment half of the CHV's 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 CHV and randomly assigned to one of three groups with equal probability: Control, Relative Risk Information Only (T1) and Full Risk Information (T2).

2.4 Data collection

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, their food consumption, their knowledge of food safety issues, and their risk perceptions. The endline survey, conducted approximately two months later, repeated questions on consumption, food safety knowledge, and risk perceptions, and included additional module on social contacts which we use to assess potential spillover effects.

In the portion of the interview focusing on household food consumption, respondents were asked a series of questions about types of maize flour which had been consumed by the household during the previous week, including branded flour and posho flour, as well as a range of potential 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 branded maize flour that was present in the household, and for permission to photograph this.[5] 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, with branded flour observed in 97% of cases where consumption is reported.

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. In the case of an affirmative response, a series of questions to measure knowledge of these food safety risks followed. 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.[6] To convey probabilities, participants were provided with 100 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 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.

[5]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. We focus on the presence of branded flour since this can be definitively shown, in contrast to absence of posho flour.

[6]To avoid anchoring bias in the survey responses, we randomly varied which type of flour was asked about first.

2.5 Information treatment

At the conclusion of the baseline interview, households assigned to either of the two treatment arms were provided with information about aflatoxin risk in maize flour. Enumerators read a standard treatment-specific script in either Swahili or English (based on the participant's preference) and then provided the participant with a treatment-specific poster summarizing the key information, which they were encouraged to keep and display in their home.

Both treatment groups were informed that aflatoxin cannot be observed visually, and of its negative health effects. They were also told that a previous study had found that branded maize flour contained less than half the level of aflatoxin as flour from posho mills and were advised 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 maize flour brands.[7]

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

3 Statistical analysis

We estimate intent-to-treat effects of the intervention following the registered pre-analysis plan unless otherwise indicated.[8] Our primary outcome of interest is the share of participants who have lower-risk (formally milled, branded) 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 consider two pre-specified secondary outcomes of interest: respondents' subjective

[7]English language versions of the script and posters are included in Appendix A.

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

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 of contamination allows us to see whether the treatment led participants to update their risk perceptions, 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) These outcomes provide information on an important component of the cost of the intervention, and shed light on the willingness of a low-income population to pay for food safety.

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

$$Y_{i,t=1} \; = \; \beta_0 \; + \; \beta_1 \, \text{AnyInformation}_{i,t=1} \; + \; \gamma_1 \, z_i' \; + \; \theta_i \; + \; \varepsilon_i \qquad (1)$$

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_i', selected via post double-selection LASSO (Belloni et al., 2014) from the set of candidate controls listed in our pre-analysis plan, and a CHV-level (sampling strata) fixed effect, θ.[11]

[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 and Roth (2024) provide 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 et al., 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.

$$\text{[excl. } \textit{FullInformation}\text{]: } Y_{i,t=1} = \beta_0 + \beta_1 \, \text{RelativeInformation}_{i,t=1} + \gamma_1 z_i' + \theta_i + \varepsilon_i \quad (2a)$$

$$\text{[excl. } \textit{RelativeInformation}\text{]: } Y_{i,t=1} = \beta_0 + \beta_1 \, \text{FullInformation}_{i,t=1} + \gamma_1 z_i' + \theta_i + \varepsilon_i \quad (2b)$$

$$\text{[excl. } \textit{Control}\text{]: } Y_{i,t=1} = \beta_0 + \beta_1 \, \text{FullInformation}_{i,t=1} + \gamma_1 z_i' + \theta_i + \varepsilon_i \quad (2c)$$

To test for information spillovers, we additionally estimate versions of these specifications that include an indicator for assignment to a high treatment-intensity cluster and interact this with the treatment variable from specification (1).[12] Since sampling intensity was assigned at the CHV level, we exclude these fixed effects, giving the specification:

$$\begin{aligned} Y_{i,t=1} = \beta_0 &+ \beta_1 \, \text{AnyInformation}_{i,t=1} + \beta_2 \, \text{HighIntensity}_i \\ &+ \beta_3 \, \text{AnyInformation}_{i,t=1} \times \text{HighIntensity}_i + \gamma_1 z_i' + \varepsilon_i \qquad (3) \end{aligned}$$

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 information affects consumer choice according to a standard model of Bayesian updating of subjective probabilities, versus by 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

[12] Here we deviate from our pre-analysis plan, where we originally specified that we would use a two-stage least squares estimation to capture spillovers, with reported learning about maize safety as the first-stage outcome. In practice, respondents' reported learning about maize safety was negatively correlated with sampling intensity, leading us to question the reliability of this variable. We describe this approach and present results in Appendix B.

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 Equation (1) a binary indicator which takes the value 1 if the respondent belongs to the particular sub-group at baseline, and zero otherwise, and interact these variables with the treatment indicator:

$$\begin{aligned} Y_{i,t=1} = \beta_0 + \beta_1 \,\text{AnyInformation}_{i,t=1} + \beta_2 \,\text{InSubgroup}_i \\ + \beta_3 \,\text{AnyInformation}_{i,t=1} \times \text{InSubgroup}_i + \gamma_1 z_i' + \varepsilon_i \end{aligned} \tag{4}$$

All of the above specifications are estimated using ordinary least-squares regressions.

4 Results

4.1 Baseline treatment balance

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 C, Table C1). While no statistical difference across groups is detected, we do observe a statistically significantly higher proportion of T1 (Relative Information Only) households with branded 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. The inclusion of the baseline value of the outcome for each regression, as described in the previous section, minimizes any potential bias arising from this baseline imbalance (Frison & Pocock, 1992). We additionally test between (pooled) treatment and control and spillover assignment (Appendix C, Table C2) and find the sample is balanced across these groups.

4.2 Product choice at baseline

Reflecting the eligibility criteria, 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%) reported consuming informally milled posho flour within the past week, and many additionally reported also consuming formally milled branded flour (37.5%). Consuming exclusively branded flour is rare in the sample, accounting for only 3.4% of households. The price of branded flour is slightly higher than posho, at 101 Kenyan shillings (KSh) or 76 US cents per kg, compared to 99 KSh/kg, but this difference is not statistically significant.

4.3 Treatment effects

Prior to the intervention, the majority of the sample (82.5%) were not aware of any food safety threats or concerns associated with maize flour. Only 7.3% of respondents specifically mentioned aflatoxin in response to a follow-up question about the nature of this risk, while 6.1% mentioned a different problem and 4.1% were unable to specify the concern. These responses were balanced across treatment groups (Appendix C, Table C1).

As illustrated in Figure 1, risk perceptions among control households remained similar at endline, but shifted dramatically among those assigned to the two treatment groups. The greatest change was a drop in the proportion of respondents who believed there was no risk, accompanied by a fairly evenly distributed increase in mass in the upper half of the distribution for posho flour and the lower half of the distribution for branded flour. We see some bunching at round numbers, especially at 50% for posho flour for both treatment groups, in line with the known heuristic of assigning even odds to events of unknown probability (Gauvrit & Morsanyi, 2014).

These risk perceptions are summarized in Table 1, which shows that conditional on perceiving a non-zero chance of contamination, the subjective probability that branded flour is affected by a food safety threat was lower in both treatment groups relative to control, while that of posho was higher. These differences reflect the content of the information campaign, which indicated that aflatoxin affects maize generally, and also that branded flour has been found to contain less than half the level of aflatoxin as flour from posho mills.

Table 1: Mean subjective probability that flour is affected by a food safety threat at endline

	Control		Relative Risk		Full Information	
	Formal	Informal	Formal	Informal	Formal	Informal
Any risk (0/1)	0.25	0.27	0.66	0.81	0.57	0.74
Probability | Any risk	0.38	0.47	0.27	0.64	0.22	0.62
Probability	0.09	0.12	0.17	0.51	0.12	0.45

Notes: Table shows unadjusted means by treatment group. "Any risk" indicates the proportion of respondents who reported that a food safety threat is associated with the indicated flour type. Tests of unadjusted means and adjusted means based on specifications (2a), (2b), and (2c) indicate that values of both "Any risk" and "Probability" differ at $p = 0.01$ for all comparisons. Regression results are shown in Appendix C, Tables C3, C4, and C5.

Participants who only received relative risk information assumed the probability that either type of flour contained a hazard was higher than those who were also told the absolute probability that posho was contaminated above the government standard. We interpret this as an over-adjustment of beliefs relative to the full information benchmark.

The information campaign was designed to induce a shift away from posho and toward branded flour. We test for impacts on this outcome and on the cost of this shift through potentially higher unit prices paid for maize flour. We also test for unintended substitution effects. Learning of a food safety hazard present in maize could potentially induce households to switch to higher-priced maize products more generally, if price is used as a proxy for perceived quality and safety. Consumers may also shift their consumption away from maize entirely, into other starchy staples such as rice, potatoes and breads.

This analysis is conducted using Specification 1 to test the impact of receiving either message, with results shown in Table 2. We find that the combined information campaign led to a 15 percentage-point increase in the share of households who had formally milled maize flour in their home compared to those in the control group (Table 2, column 1). This represents a 45% increase in consumption of the good targeted by the information campaign, relative to the 33% of households consuming branded flour in the control group.

The average prices paid (in KSh/kg) for maize flour and maize products generally, by treatment households were slightly higher than that paid control households, but not significantly so (Table 2, columns 2 and 3). This is in line with the similarity of prices paid by the sample for branded and posho flour at baseline. We do not see evidence of substitution away from maize into other starchy staples such as rice, potatoes and breads, using either a linear or log specification (though we note that aggregating reported quantities across substitutes is inherently noisy) (Table 2, columns 4 and 5).

Table 2: Treatment Effects on Branded Product Choice and Substitution

	Observed branded (1)	Maize flour price (2)	Maize product price (3)	Quantity substitutes (4)	Log q
Treatment: Any information	0.15*** (0.03) [0.000]	0.87 (1.04) [0.403]	0.86 (1.13) [0.449]	0.03 (0.06) [0.610]	
Observed branded [BL]	0.19*** (0.04) [0.000]				
Maize flour price [BL]		0.04 (0.04) [0.296]	0.02 (0.04) [0.623]		
Any maize price [BL]		-0.02 (0.03) [0.573]	0.01 (0.04) [0.875]		
Quantity substitutes [BL]				0.17*** (0.05) [0.001]	
Log quantity substitutes [BL]				0.28*** (0.06) [0.000]	
Observations	1306	1230	1232	1242	
Control mean (BL)	0.29	100.25	101.68	1.16	
Control mean (EL)	0.33	97.56	99.65	1.34	

Notes: "Observed branded" is a binary variable taking a value of 1 if any branded maize was observed in the household. Coeffi
least squares regression are reported, with errors in parentheses and p-values in square brackets. Price outcomes are in KS
columns (4) and (5) are kg per adult equivalent. All specifications include the baseline outcome of interest as a control vari
controls are selected via post-double-selection LASSO. *, **, *** indicate significance at the 10%, 5% and 1% levels.

Despite the differences in perceived risks noted above, the share of households with branded flour in their home at endline was identical across the two treatment groups (coefficient 0.00, p-value 0.969, based on Specification 2c) and other consumption and price impacts are also similar across these groups (Appendix C, Table C6).

As there is substantial evidence of peer learning in the context of health information interventions (Benjamin-Chung et al., 2017), we test for information spillovers between treatment and control households by estimating Equation (3). Here, we interact an indicator for assignment to the high intensity sampling treatment (in which 100% of households among those regularly visited by the CHV were invited to participate in the study, compared to 50% of households in the low intensity assignment) with our indicator for assignment to either of the information treatments.

Higher sampling intensity is associated with an 8 percentage-point increase in the observation of branded maize flour among control households ($p < 0.1$, column 5). After controlling for this effect, the magnitude of the information effect increases to 18 percentage-points, a 47% increase compared to the proportion of control households in low-intensity clusters who had branded maize in their homes at endline. Assignment to the high sampling intensity treatment is associated with lower perceived riskiness of branded flour (columns 1 and 2). While these changes are small in magnitude and only marginally significant, their signs are opposite to the direct effect of information, suggesting that information about the relative safety of branded maize flour may have been transmitted from informed to uninformed households more effectively than information about the food safety risks associated with maize generally.

In contrast, we observe positive effects of the high-intensity sampling treatment on perceptions of risk in both branded maize flour and (any) posho risk among respondents in the treatment group. This suggests that in areas where a greater share of people received information directly, discussion among informed households may have exacerbated concerns about the safety of maize flour in general.

4.4 Heterogenous effects

We additionally consider the possibility of heterogeneous treatment effects on the primary outcome of safer flour consumption. Summary results are presented in Table 4, and full regressions are included in Appendix C (Tables C7 and C8). As predicted by a standard Bayesian learning model, those who perceived no food safety risk prior to the intervention updated their beliefs more in response to information than those who were already aware of this risk. However, the impact of the intervention on the presence of branded flour in the home at endline is no stronger for this group.

We find no differential effects by household income level. Households earning below the sample median monthly income of $75 US (among whom mean reported income was $26 US) 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 significant price difference between formally milled flour and posho may underlie this finding. Even so, our findings indicate that very poor households take food safety into account in their consumption choices.

Table 4: Heterogeneous Treatment Effects by Perceived Risk and Household Income

Subgroup (at baseline)	Any risk (Branded) (1)	Risk (Branded) (2)	Any risk (Posho) (3)	Risk (Posho) (4)	Observed branded (5)
Panel A: Perceived risk of posho					
Treatment effect, no perceived risk	0.39***	0.08***	0.54***	0.37***	0.14***
	(0.03)	(0.01)	(0.03)	(0.02)	(0.03)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Treatment effect, some risk	0.24***	-0.03	0.32***	0.31***	0.18**
	(0.07)	(0.03)	(0.06)	(0.05)	(0.07)
	[0.001]	[0.361]	[0.000]	[0.000]	[0.011]
p-value, difference in TE	0.042	0.002	0.001	0.332	0.625
Panel B: Household income					
At or above median income	0.37***	0.06***	0.48***	0.34***	0.19***
	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Below median income	0.37***	0.06***	0.53***	0.38***	0.12***
	(0.04)	(0.02)	(0.04)	(0.03)	(0.04)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.003]
p-value, difference in TE	0.974	0.953	0.308	0.293	0.199

Notes: Ordinary least squares regression, with standard errors 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. All specifications are estimated with community health volunteer (sampling strata) fixed effects, which are also included. *,**,*** indicate significance at the 10%, 5% and 1% levels respectively.

5 Cost-effectiveness & nutritional trade-offs

In this section, we estimate the impact of the information intervention on hepatocellular cancer (HCC), the most common type of liver cancer. We also consider the tradeoffs of these reduced risks against the nutritional and economic costs of switching from wholegrain to refined maize flour.

While aflatoxin has deleterious effects on various health outcomes – likely including negative child growth impacts (Nejad et al., 2023) – the strongest causal evidence and best-quantified dose-response relationship have been established for the risk of HCC (Liu & Wu, 2010). Noting that this represents a lower bound of the health benefit, we estimate the impact of the intervention on HCC risk. We begin by estimating its effect on exposure, then translate this to impacts on HCC based on previously published relationships, and finally estimate the cost per disability-adjusted life year (DALY) of achieving such a reduction. Formulas and data sources are shown in Appendix C Table C9.

5.1 Impact of the intervention on dietary aflatoxin exposure

To estimate exposure, we use reported consumption of different maize products from the endline survey and mean contamination levels of each product as reported by Barasa et al. (2023). Body weights are calculated from WHO energy requirement tables for individuals aged 12 months and up (FAO, 2005), and from weight-for age tables for those under 12 months (WHO, n.d.). Table 5 shows the results of this analysis using specifications 1 (overall impact, column 1) and 3 (by treatment intensity, column 2). The lack of significant impacts of treatment intensity on reported consumption suggest that information spillovers affected the decision to try branded flour, but had less impact on the amount of different maize products consumed. We therefore use the treatment effect estimated using specification 1 (Table 5, column 1) to estimate health impacts, which indicate that aflatoxin exposure fell by 21% (=10.9/51.2) as a result of the information intervention.

Table 5: Treatment Effects on Aflatoxin Exposure

	Aflatoxin exposure (ng/kg/day)	
	(1)	(2)
Any information	-10.94***	-11.09***
	(2.09)	(3.84)
	[0.000]	[0.004]
High-intensity		-0.98
		(3.06)
		[0.967]
Any info × High intensity		-0.14
		(4.54)
		[0.975]
Baseline exposure	0.37***	0.37***
	(0.05)	(0.06)
	[0.000]	[0.000]
Fixed effects	CHV	Settlement
Observations	1309	1309
Control mean (BL)	53.2	51.5
Control mean (EL)	51.8	51.8

Notes: Specifications include baseline exposure 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 *,**,*** indicate significance at the 10%, 5% and 1% levels respectively. Standard errors are clustered at the CHV level.

5.2 Impact on HCC cases

We multiply the most recent available estimate of Nairobi's population (5,766,990 World Population Review, 2025) by the proportion of those consuming loose maize flour (22%) in the most recent available Kenya Integrated Household Budget Survey (KIHBS) (KNBS, 2018) to estimate the target population of a scaled-up intervention.

We then apply dose-response estimates from risk assessments conducted by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) to estimate the number of HCC cases per 100,000 for each ng/kg bodyweight/day of aflatoxin exposure (JECFA, 2001). The contribution of aflatoxin exposure to HCC risk is 30 times greater for individuals with chronic Hepatitis B virus (HBV) infection than others, so modeling HCC risk is heavily dependent on the prevalence of chronic HBV infection.[13] Population-representative statistics on HBV infection in Nairobi do not exist, and estimates vary widely across studies, ranging from 3.8% and 7.7% for pregnant women attending two major hospitals in the city (Okoth et al., 2006; Ngaira et al., 2016), and 13.3% for the general adult population in two informal settlements (Kerubo et al., 2015). We use mean prevalence across these three studies, based on the logic that women attending major hospitals are a reasonable proxy for the general population, and that those living in informal settlements, who constitute a majority of Nairobi's population according to UN Habitat (Cruz et al., 2006) are likely to be both over-represented among posho consumers and under-represented in hospital data.

This approach yields an estimate of 22.4 HCC cases due to aflatoxin exposure through maize annually in Nairobi. An intervention that achieved an equivalent proportional reduction in exposure (-10.94/51.8 ng/kg/day = -21%) as the one we evaluate would reduce this incidence by 4.7 (=22.4 x 21%). Multiplying this by Hoffman and Jones's estimate that 50.8 DALYs are lost per case of HCC (2021), this implies a potential impact of 240 DALYs averted annually.

5.3 Costs of an information intervention at scale

A scaled-up information intervention on the relative riskiness of alternative foods would consist of two primary components: generating relative risk information and disseminating this to the target population. To detect a difference in regulatory non-compliance of the magnitude observed by Barasa et al. ((Barasa et al., 2023) (10% vs 24% non-compliant) with 95% confidence and 80% power requires a total of 232 samples. For that study, samples were collected at a cost of $3 US each including procurement, labor, and transport, and samples were analyzed at a rate of $33.3 per sample including labor, materials, and laboratory space. The fixed cost of generating relative risk information is thus 232 x $36.33 = $8,422 US.

Providing posters to households is a relatively costly intervention, especially since it

[13] The calculation for HCC cases is as follows: population / 100,000 x mean exposure (ng/kg/day) x [(share of population HBV antigen+) x 0.3 + (share of population HBV antigen-) x 0.001]

would be difficult to specifically target those who consume posho flour. A more cost-effective approach would be to utilize broadcast media. Television is consumed by 85% of Nairobi residents and radio by 61%, with daily consumption the norm for both (Communications Authority of Kenya, 2024). As television and radio reach different audiences, we estimate the cost of a campaign targeting both formats. We assume a cost of $5,000 US to produce a 30-second television message, and $1,000 for a radio message. The television market is highly concentrated, with the most widely watched station claiming 75% of viewers in a typical week, and radio less so with the top three stations commanding 73% of listeners (Media Council of Kenya, 2025). We thus estimate the cost of running the television message on only the most-viewed station, and working with the top three radio stations. Using costs from online sources (Janeson, 2020; marketing.ke, 2024), we estimate the cost of 14-day television and radio campaigns four times per year, with two daily slots during prime time and two additional television slots during off-peak hours at a total of $112,722. The total cost of information generation plus dissemination comes to $121,143 per year.

Assuming 50% of the posho-consuming population in Nairobi is reached through these broadcast media campaigns, the DALY impact estimated above is halved, implying a public cost per DALY averted of $1008. Adding consumers' additional spending on higher-priced branded flour using the estimate in column 1 of Table 3 increases this cost to $2,325.[14] This is near the commonly used "highly cost-effective" benchmark of GDP per capita ($2,206) and well below the "cost-effective" standard of 3 x GDP per capita (Edejer et al., 2003). Further, the public portion of this cost compares favorably to the mean health system expenditure per DALY averted in the medium-HDI group of countries to which Kenya belongs, in terms of GDP per capita (0.67 mean share of GDP / DALY x $2,206 GDP per capita = $1,478 per DALY) (Daroudi et al., 2021).

[14]We estimate the impact of the intervention on consumption of posho flour per kg bodyweight in the sample and apply this to the mean kg bodyweight per capita in Nairobi from KIHBS data to adjust for household composition effects.

5.4 Nutritional trade-offs

While whole grain maize flour is more likely to be contaminated with aflatoxin due to the concentration of this toxin in the bran and germ. Removing these components of the grain through milling also implies reduced micronutrient content and dietary fiber (Gwirtz & Garcia-Casal, 2014). Micronutrient fortification of processed flour is required by Kenyan law and despite imperfect compliance, average levels of key micronutrients in branded flour are higher in formally processed, refined maize flour than in whole-meal posho flour (Barasa et al., 2023). However, fortification does not replace dietary fiber, so weighing the health cost of lower dietary fiber against the benefits of reduced exposure to toxins is important.

Adequate consumption of dietary fiber is associated with lower cholesterol (Brown, Rosner, W., & F.M., 1999) and has been shown to reduce hypertension (Streppel et al., 2005). A meta-analysis by Reynolds et al (2019) reports results from randomized trials showing beneficial impacts of fiber on bodyweight, cholesterol and systolic blood pressure, and from observational studies linking insufficient dietary fiber to increased mortality from coronary heart disease and colorectal cancer. A recent dietary analysis found that fiber intake among Nairobi adults was generally above the minimum recommended daily level of 25 grams, with 75% consuming at least 40 grams and 26.7% of this from grains and cereals (Vila-Real et al., 2022). Assuming the fiber contribution of cereals and grain products fell by 90%, using published estimates of fiber content of whole and refined maize flour (Haytowitz et al., 2019; Kamotho et al., 2017) the 25th percentile of fiber consumption would still exceed 30 grams per day. We conclude that the negative impact on dietary fiber consumption is likely to be outweighed by the benefit of reduced cancer risk.

6 Conclusion

In this paper we provide novel evidence that informing consumers about the relative food safety of substitute product classes affects their risk perceptions and consumption choices.

The information provided is based on surveillance data showing that sifted, branded maize flour in Kenya contains lower levels of a foodborne hazard than informally processed whole grains (Barasa et al., 2023). These products are functionally and available at similar prices, implying negligible behavioral costs. Further, the nutritional cost of substituting whole grain flour with refined, fortified flour is negligible in this context. We find a 45-47% increase in the proportion of households consuming the safer product and estimate a reduction of 21% in the risk of cancer due to contamination with the hazard of concern among the population reached.

We find no evidence that consumers substituted away from the broader food category about which negative safety information was provided. This is encouraging, as a major concern related to the communication of food safety risks is their potential to shift diets away from highly nutritious, but also sometimes contaminated, foods. Further, treatment effects are statistically equivalent for households below and above the sample median income, indicating that even severely budget constrained households put a positive value on food safety.

However, the extent to which these results can be generalized beyond the specific context of maize in urban Kenya is an open question. Consumers may react differently to messages about different foods, and monitoring unintended effects on diet in response to food safety risk messaging remains important. Further, the price difference between more contaminated posho and safer branded flour was economically small at 2%, and statistically insignificant. This likely facilitated a larger, and less income-elastic response that might be expected in the face of a larger food safety premium.

Cost-effectiveness simulations suggest that where reliable evidence on the relative safety of alternative food products exists, providing such information has the potential to achieve significant improvements to public health at a lower cost than typical health system expenditures. This approach may be attractive to policymakers in settings where it is either infeasible or undesirable to prevent food that does not comply with food safety regulations from entering the market. Beyond an immediate reduction in hazard exposure among consumers who follow recommendations, the negative demand shock to a riskier food type could lead to a contraction in its supply. However, the net social benefits of this approach must consider the costs incurred by consumers, which may be substantial.

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8 Appendix A - Experimental scripts

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.

9 Appendix B - Two stage estimation

In this appendix we provide a description of our original spillover estimation strategy included in the pre-analysis plan, and present results from this estimation.

In this approach, we estimate additional specifications for our primary outcomes of interest, updating specification (1) to include a spillover propensity score and its interaction with the pooled treatment indicator. To generate this spillover propensity we estimate the following equation for the control group sample:

$$\begin{aligned} \text{Spillover}_{i,t=1} = \alpha_0 + \alpha_1 \, \text{HighIntensity}_i + \alpha_2 \, \text{PropHH}_d + \alpha_3 \, \text{NoHH}_d \\ + \alpha_4 \, \text{PropSocial}_d + \alpha_5 \, \text{NoSocial}_d + \gamma_1 z_i' + \varepsilon_i \qquad (A1) \end{aligned}$$

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 HighIntensity is similarly a binary variable where 1 indicates assignment to the high-intensity treatment arm, and 0 to the low-intensity 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 whom the respondent knew at endline within the same radius, who are assigned to either treatment group. We select the radius d by estimating equation (A1) using all potential radii (from 50m up to 1km in ten-meter increments) and selecting the specification with the lowest estimated Bayesian Information Criteria (BIC) value.

The variables NoHH and NoSocial are indicators which take the value 1 if the respective proportion variable takes the value zero. While HighIntensity 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 (A1), as well as the vector of baseline controls used in our primary equation are included as candidates for selection via a logistic LASSO model.

Predicted spillover propensity is then included in Equation (A2) below, through which we estimate the effect of information spillovers, and the effect of assignment to either treatment net of such spillovers:

$$
\begin{aligned}
Y_{i,t=1} = \beta_0 + \beta_1\, \text{AnyInformation}_{i,t=1} + \beta_2\, \widehat{\text{Spillover}}_{i,t=1} \\
+ \beta_3\, \text{AnyInformation}_{i,t=1} \times \widehat{\text{Spillover}}_{i,t=1} + \beta_4\, \text{NoHH}_d + \beta_5\, \text{NoSocial}_d \\
+ \gamma_1 z_i' + \varepsilon_i \qquad (A2)
\end{aligned}
$$

The results from this estimation are presented below.

Appendix Table B1- Main specification estimated with spillover propensity score

	Any risk (Branded) (1)	Risk (Branded) (2)	Any risk (Posho) (3)	Risk (Posho) (4)	Observed branded (5)
Treatment: Any information	0.57***	0.13***	0.62***	0.39***	0.13*
	(0.08)	(0.04)	(0.07)	(0.06)	(0.08)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.095]
Spillover propensity	1.10*	0.51*	0.89	0.04	-1.01*
	(0.59)	(0.27)	(0.54)	(0.42)	(0.61)
	[0.064]	[0.054]	[0.104]	[0.916]	[0.096]
Any information × Spillover	-2.00***	-0.74**	-1.25*	-0.35	0.27
	(0.74)	(0.33)	(0.67)	(0.53)	(0.75)
	[0.007]	[0.026]	[0.062]	[0.512]	[0.724]
Observed branded [BL]					0.20***
					(0.04)
					[0.000]
Any risk: Branded [BL]	0.23**	0.01	0.21***	0.11	
	(0.10)	(0.03)	(0.08)	(0.07)	
	[0.018]	[0.653]	[0.008]	[0.111]	
Risk: Branded [BL]	-0.02	0.14**		0.07	
	(0.12)	(0.06)		(0.09)	
	[0.842]	[0.015]		[0.455]	
Any risk: Posho [BL]	0.05		-0.05	-0.15*	
	(0.10)		(0.10)	(0.08)	
	[0.598]		[0.650]	[0.051]	
Risk: Posho [BL]		-0.00	0.13	0.14*	
		(0.04)	(0.11)	(0.09)	
		[0.956]	[0.249]	[0.099]	
Observations	1306	1253	1306	1253	1306
Control mean (BL)	0.14	0.04	0.15	0.06	0.29
Control mean (EL)	0.25	0.09	0.27	0.12	0.33

Notes: Ordinary least squares regression. Specifications always include the baseline outcome of interest as a control variable, along with other baseline outcomes among the set of candidate controls selected via LASSO. We report coefficients for baseline outcomes included in the model; coefficients on other baseline variables selected by PDSLASSO are not reported. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively. Spillover propensity is estimated by regressing endline self-reports of having received additional food safety information since baseline on high-intensity treatment, social network controls (with geographic radius selected by model fit), and baseline controls selected by PDSLASSO.

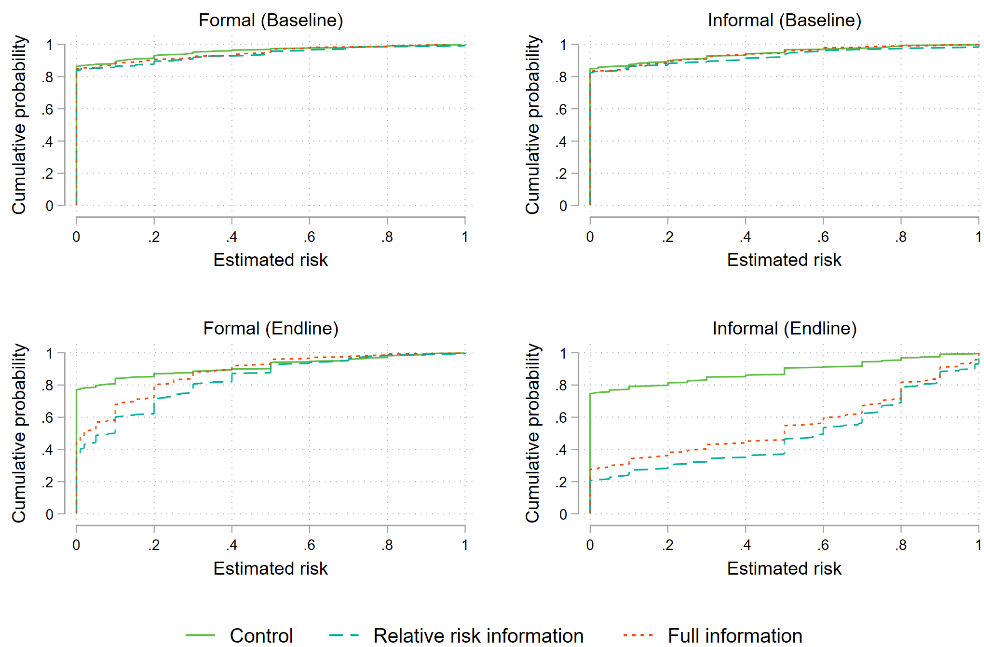
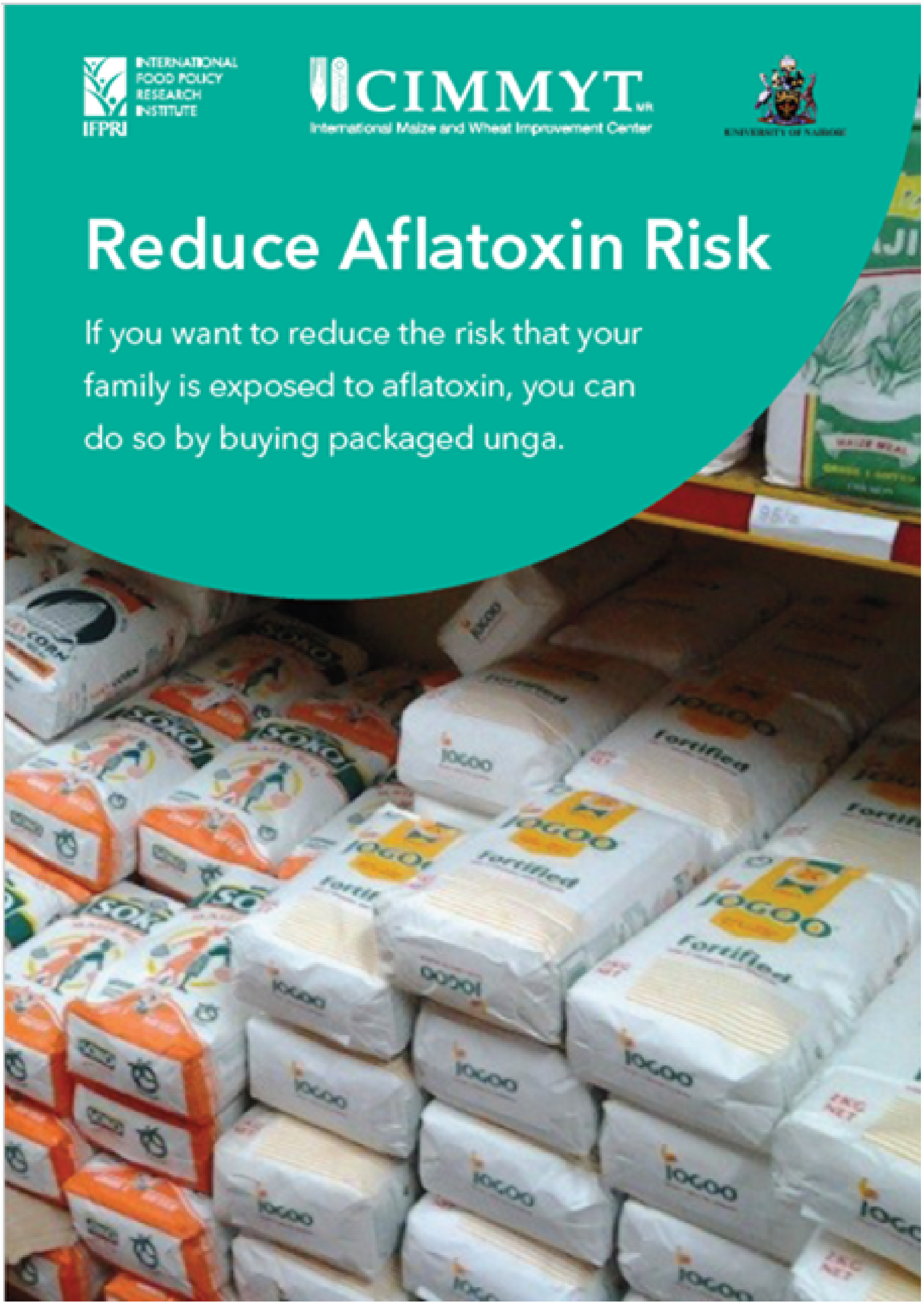


Figure 1: Cumulative distributions of subjective risk assessment, by product type



Appendix Figure 1- T1 Poster

Appendix Figure 2- T2 Poster

10 Appendix C- Supplementary tables

(see next page)

Table C1- Balance across Treatment Groups

	Mean				p-value			
	Control	Treatment	T1 only	T2 only	Control vs Treat	Control vs T1	Control vs T2	T1 vs T2
Observed branded 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 branded 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 (Branded)	0.14	0.16	0.16	0.15	0.293	0.299	0.488	0.720
Risk (Branded)	4.39	5.91	6.41	5.41	0.089	0.054	0.361	0.419
Any risk (Posho) [BL]	0.15	0.17	0.18	0.17	0.350	0.384	0.520	0.783
Risk (Posho)	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 (KSh/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: No formal	0.16	0.14	0.13	0.15	0.194	0.078	0.599	0.237
Education: Primary	0.46	0.46	0.46	0.45	0.828	0.929	0.763	0.880
Education: Secondary	0.29	0.31	0.32	0.30	0.384	0.324	0.627	0.617
Education: Technical	0.07	0.09	0.09	0.09	0.344	0.439	0.440	0.980
Education: 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
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 pair of groups are based on logistic regressions of the relevant treatment indicator on the full set of potential baseline controls, restricting the sample to the 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 the two groups.

Table C2- Balance across Treatment Groups, High Intensity Clusters

	Mean				p-value			
	Low Control	High Control	Low Treatment	High Treatment	Within low intensity	Within high intensity	Within control	Within treatment
Observed branded flour	0.30	0.28	0.35	0.30	0.206	0.384	0.684	0.188
Observed posho flour	0.52	0.55	0.46	0.52	0.231	0.316	0.477	0.253
Reports branded flour	0.38	0.37	0.44	0.42	0.219	0.182	0.808	0.593
Reports posho flour	0.98	0.98	0.94	0.97	0.040	0.175	0.988	0.107
Reports maize grain	0.36	0.32	0.30	0.32	0.202	0.910	0.500	0.618
Any risk (Branded)	0.17	0.12	0.18	0.15	0.674	0.346	0.105	0.154
Risk (Branded flour)	0.05	0.04	0.08	0.05	0.018	0.622	0.688	0.012
Any risk (Posho) [BL]	0.17	0.14	0.20	0.16	0.319	0.610	0.354	0.126
Risk (Posho flour)	0.06	0.05	0.08	0.06	0.195	0.604	0.576	0.117
Difference in risk	1.46	1.18	0.01	1.27	0.352	0.920	0.841	0.271
Maize price (KSh/kg)	105.19	99.95	102.51	99.98	0.275	0.985	0.144	0.312
Total maize expenditure (KSh)	525.89	511.98	517.91	492.38	0.811	0.393	0.719	0.411
Household size	5.16	4.91	4.85	4.91	0.005	0.987	0.179	0.735
Child < 1 year old	0.11	0.10	0.10	0.10	0.551	0.902	0.571	0.996
Child 1–2 years old	0.30	0.24	0.29	0.29	0.666	0.071	0.052	0.902
Child 3–5 years old	0.70	0.70	0.68	0.69	0.677	0.720	0.951	0.765
Child 6–12 years old	0.70	0.64	0.68	0.63	0.864	0.909	0.284	0.278
Child 13–17 years old	0.42	0.39	0.38	0.36	0.377	0.295	0.621	0.605
Adult over 50 years old	0.17	0.11	0.15	0.11	0.381	0.992	0.044	0.152
Respondent age	32.50	32.84	33.43	32.32	0.318	0.399	0.657	0.203
Respondent is female	0.93	0.95	0.92	0.93	0.494	0.219	0.480	0.535
Respondent is married	0.71	0.75	0.70	0.73	0.897	0.567	0.449	0.422
Education: No formal	0.17	0.16	0.14	0.14	0.396	0.332	0.744	0.927
Education: Primary	0.47	0.46	0.45	0.46	0.787	0.981	0.801	0.925
Education: Secondary	0.28	0.29	0.31	0.30	0.501	0.574	0.813	0.850
Education: Technical	0.08	0.07	0.09	0.09	0.688	0.378	0.771	0.864
Education: University	0.00	0.02	0.00	0.01		0.375	0.040	0.027
Monthly income (KSh)	11392	11723	12125	11966	0.444	0.805	0.799	0.878
Asset: Smartphone	0.67	0.68	0.71	0.71	0.376	0.321	0.869	0.962
Asset: Solar panel	0.01	0.02	0.05	0.02	0.005	0.748	0.837	0.141
Asset: Grid connection	0.81	0.85	0.81	0.84	0.906	0.414	0.407	0.520
Asset: TV	0.74	0.72	0.73	0.75	0.860	0.237	0.734	0.627
Asset: Computer	0.02	0.03	0.03	0.04	0.620	0.194	0.689	0.351
Asset: DVD player	0.12	0.13	0.13	0.15	0.589	0.251	0.795	0.388
Asset: Electric cooker	0.05	0.09	0.08	0.08	0.137	0.530	0.158	0.839
Asset: Charcoal stove	0.80	0.75	0.75	0.79	0.316	0.257	0.310	0.376
Asset: Gas cooker	0.63	0.71	0.72	0.75	0.045	0.283	0.124	0.517
Housing index	-0.08	-0.08	0.10	0.02	0.099	0.056	0.968	0.454
Daily fuel expenditure (KSh)	65.97	65.66	66.34	66.79	0.934	0.752	0.957	0.906
Daily electricity expenditure (KSh)	3.57	3.15	4.87	4.05	0.255	0.256	0.719	0.598
Monthly rent expenditure (KSh)	3361	3596	3434	3681	0.739	0.598	0.501	0.403
Risk preference	5.08	4.93	5.42	4.95	0.242	0.935	0.655	0.053
Knowledge: Is a poison	0.07	0.04	0.08	0.05	0.671	0.562	0.358	0.205
Knowledge: Comes from fungus	0.03	0.02	0.04	0.01	0.404	0.531	0.522	0.065
Knowledge: Grows on maize	0.02	0.00	0.00	0.01	0.194	0.085	0.177	0.083
Knowledge: Can't observe	0.13	0.08	0.11	0.07	0.489	0.592	0.128	0.095
Knowledge: Cooking aflatoxin [BL]	0.18	0.14	0.19	0.15	0.741	0.541	0.205	0.182
Knowledge: Causes illness	0.02	0.02	0.01	0.01	0.606	0.074	0.818	0.390
Knowledge: Causes cancer	0.00	0.01	0.03	0.01	0.005	0.380	0.151	0.131
Knowledge: Impairs development	0.00	0.00	0.00	0.00	0.339	0.691	0.316	0.669
Knowledge: Jaundice	0.00	0.00	0.00	0.00		0.330		0.324
Knowledge: Stomach problems	0.17	0.11	0.17	0.13	0.840	0.551	0.085	0.195
Joint orthogonality F-test					0.919	0.875	0.868	0.200

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.

Table C3- Specification 2a – Control vs. relative risk information treatment

	Non-zero risk (Branded) (1)	Risk (Branded) (2)	Non-zero risk (Posho) (3)	Risk (Posho) (4)
Treatment: Relative risk information	0.41***	0.08***	0.54***	0.39***
	(0.03)	(0.01)	(0.03)	(0.02)
	[0.000]	[0.000]	[0.000]	[0.000]
Any risk (Branded) [BL]	0.13	-0.04	0.21**	
	(0.11)	(0.05)	(0.10)	
	[0.268]	[0.392]	[0.031]	
Risk (Branded) [BL]		0.26***	0.24***	
		(0.07)	(0.09)	
		[0.000]	[0.007]	
Any risk (Posho) [BL]	0.14	0.06	0.01	-0.08
	(0.11)	(0.06)	(0.12)	(0.08)
	[0.222]	[0.273]	[0.939]	[0.269]
Risk (Posho) [BL]	-0.05	0.10	0.07	
	(0.07)	(0.13)	(0.09)	
	[0.433]	[0.411]	[0.431]	
Observations	877	841	877	841
Control mean (BL)	0.14	0.04	0.15	0.06
Control mean (EL)	0.25	0.09	0.27	0.12

Notes: "Non-zero 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. All columns report estimation from ordinary least squares regression. Standard errors of coefficients are reported in parentheses, and p-values 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 baseline outcome variables where included or selected. Other selected controls and community health volunteer (sampling strata) fixed effects are included in estimation but not reported. *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Table C4- Specification 2b – Control vs. full information treatment

	Non-zero risk (Branded) (1)	Risk (Branded) (2)	Non-zero risk (Posho) (3)	Risk (Posho) (4)
Treatment: Full information	0.33***	0.04***	0.47***	0.33***
	(0.03)	(0.01)	(0.03)	(0.02)
	[0.000]	[0.002]	[0.000]	[0.000]
Any risk (Branded) [BL]	0.17	-0.01	0.19*	
	(0.11)	(0.04)	(0.10)	
	[0.123]	[0.812]	[0.053]	
Risk (Branded) [BL]		0.08	0.17**	0.12
		(0.16)	(0.07)	(0.10)
		[0.597]	[0.014]	[0.225]
Any risk (Posho) [BL]	0.07	0.00	-0.05	
	(0.13)	(0.14)	(0.08)	
	[0.560]	[0.986]	[0.562]	
Risk (Posho) [BL]	-0.02	0.16	0.17*	
	(0.06)	(0.15)	(0.10)	
	[0.749]	[0.280]	[0.091]	
Observations	885	858	885	858
Control mean (BL)	0.14	0.04	0.15	0.06
Control mean (EL)	0.25	0.09	0.27	0.12

Notes: See notes to Table C3. “Non-zero risk (flour type)” and “Risk (flour type)” are defined as in Table C3. All specifications are estimated by ordinary least squares with standard errors in parentheses and p-values in square brackets. Baseline outcomes and other baseline controls selected via post-double-selection LASSO are included, along with community health volunteer (sampling strata) fixed effects. *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Table C5- Specification 2c – Relative risk vs. full information treatment

	Non-zero risk (Branded)	Risk (Branded)	Non-zero risk (Posho)	Risk (Posho)
	(1)	(2)	(3)	(4)
Treatment: Full information	-0.08***	-0.05***	-0.08***	-0.07***
	(0.03)	(0.01)	(0.03)	(0.02)
	[0.009]	[0.001]	[0.005]	[0.005]
Any risk (Branded) [BL]	0.30**	-0.02	0.20**	
	(0.13)	(0.04)	(0.10)	
	[0.023]	[0.581]	[0.056]	
Risk (Branded) [BL]		0.10	0.13	
		(0.07)	(0.11)	
		[0.144]	[0.244]	
Any risk (Posho) [BL]		-0.05	-0.07	
		(0.13)	(0.09)	
		[0.682]	[0.415]	
Risk (Posho) [BL]	0.02	0.10	0.02	
	(0.05)	(0.13)	(0.11)	
	[0.738]	[0.458]	[0.858]	
Observations	850	807	850	807
Control mean (BL)	0.16	0.06	0.18	0.08
Control mean (EL)	0.66	0.17	0.81	0.51

Notes: See notes to Table C3. "Non-zero risk (flour type)" and "Risk (flour type)" are defined as in Table C3. All specifications use ordinary least squares with standard errors in parentheses and p-values in square brackets. Baseline outcomes and other baseline controls selected via post-double-selection LASSO are included, along with community health volunteer (sampling strata) fixed effects. *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Table C6- Effect of treatment on expenditures on maize flour and substitutes (Specification 2c)

	Observed branded (1)	Maize flour price (2)	Maize product price (3)	Quantity substitutes (4)	Log quantity substitutes (5)
Treatment: Any information	0.01	-225.27	-113.52	0.07	0.07
	(0.03)	(212.14)	(106.08)	(0.06)	(0.05)
	[0.866]	[0.288]	[0.285]	[0.267]	[0.185]
Observed branded [BL]	0.15***				
	(0.05)				
	[0.003]				
Maize flour price [BL]		-1.26	-0.63		
		(2.37)	(1.18)		
		[0.596]	[0.596]		
Any maize price [BL]		1.88	0.94		
		(3.55)	(1.78)		
		[0.596]	[0.596]		
Quantity substitutes [BL]				0.15**	-0.01
				(0.06)	(0.05)
				[0.011]	[0.856]
Log quantity substitutes [BL]				0.27***	0.39***
				(0.07)	(0.06)
				[0.000]	[0.000]
Observations	812	804	804	812	796
Control mean (BL)	0.36	491.19	362.51	1.22	-0.13
Control mean (EL)	0.51	308.12	205.54	1.37	0.05

Notes: Ordinary least squares regression with standard errors in parentheses and p-values in square brackets. All specifications include the relevant baseline outcome as a control variable. Other baseline controls are selected via post-double-selection LASSO from the pre-specified list of candidates. Community health volunteer (sampling strata) fixed effects are also included but not reported. *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Table C7- Heterogeneity – No risk from posho reported at baseline

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

Notes: Ordinary least squares regression, with standard errors in parentheses and p-values 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. All specifications include community health volunteer (sampling strata) fixed effects. *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Table C8- Heterogeneity – At or above median income at baseline

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

Notes: Ordinary least squares regression, with standard errors in parentheses and p-values 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. All specifications include community health volunteer (sampling strata) fixed effects. *, **, *** indicate significance at the 10%, 5% and 1% levels respectively.

Table C9- Back-of-the-envelope health impact and cost-effectiveness calculations

	Description	Value	Formula / source
(a)	Exposure in control group (ng/kg/day)	51.80	Authors' calculations from study data
(b)	Impact of intervention on exposure (spec 1)	-10.94	Table 5, column 1
(c)	% reduction		$= (b)/(a)$
(d)	HBVag+ prevalence	8.30%	Mean of Okoth et al. (2006), Ngaira et al. (2016), Kerubo et al. (2015)
(e)	Population of Nairobi	5,766,990	World Population Review (Nairobi population)
(f)	Nairobi HHs consuming posho	0.22	2015/16 KIHBS
(g)	Nairobi population consuming posho	1,268,738	$= (e) \times (f)$
(h)	HCC per relevant population / year	22.39	$= \frac{(g)}{100{,}000} \times (a) \times \big[(d) \times 0.3 + (1-d) \times 0.3\big]$ (JECFA, 2001)
(i)	HCC cases averted / year	4.73	$= (h) \times (c)$
(j)	Proportion reached by campaign	0.5	Assumed
(k)	DALYs saved / year	120.2	Hoffmann & Jones (2021)
(l)	Ad production (TV and radio)	6,000	TV @ 5000, radio @ 1000; marketing.ke
(m)	TV airtime, 4× per year	60,000	Janeson.co.ke TV advertising rates
(n)	Radio airtime, 4× per year	52,722	marketing.ke, cost proportional to audience
(o)	Total media costs	112,722	$\approx (l) + (m) + (n)$
(p)	Sample analysis cost (per sample)	33.3	Barasa et al. (2023)
(q)	Procurement cost (per sample)	3	Barasa et al. (2023)
(r)	Total cost per sample	36.3	$= (p) + (q)$
(s)	Number of samples	232	Power calculations based on Barasa et al. (2023)
(t)	Total cost of surveillance	8,422	$= (r) \times (s)$
(u)	kg posho change / kg bodyweight (sample)	0.011	Authors' calculations from study data
(v)	Mean bodyweight, Nairobi (kg)	56.7	2015/16 KIHBS
(w)	kg posho change / week / person, Nairobi	0.63	$= (u) \times (v)$
(x)	Change in maize flour price (USD)	0.01	Table 3, column 1, converted to USD and CPI-adjusted
(y)	Cost / year / person (USD)	0.249	$= (w) \times (x)$
(z)	Total additional expenses on maize flour (USD)	158,234	$= (g) \times (j) \times (y)$
	Total cost per DALY (USD)	2,325	$= \big[(o) + (t) + (z)\big]/(k)$

Notes: Table reports indicative calculations for health impacts, programme costs, and cost per disability-adjusted life year (DALY) associated with the intervention, using parameters and sources listed in the right-hand column.