ABSTRACT

Objectives: Developing a framework to provide decision makers with a multi-faceted evaluation of the impact of dietary shifts on risk of illness in the U.S. population.

Methods: We collected representative data on prevalence and concentration of inorganic arsenic and aflatoxin in infant rice and oat cereal. Exposure to these contaminants through consumption and risk of illness from cancer were assessed per consumer based on data from the National Health and Nutrition Examination Survey and published dose-response and related data. The expected number of additional cases of illness and disability-adjusted life years (DALYs) for the U.S. population were estimated. The public health impact of shifts in consumption from one product to the other considered marginal and joint consumption and characterized uncertainty arising from estimates of contaminant concentrations, bioavailability and dose-response models. Monte Carlo simulations were developed in R and a R Shiny app was created.

Results: Based on current consumption of infant rice and oat cereal and preliminary data on the arsenic contamination in infant rice cereal, the estimated additional DALY for the total US population from inorganic arsenic and aflatoxin is 4,600 (CI 90% [370; 8,400]). If all consumers shift their consumption (maintaining equivalent servings) to only infant rice or only infant oat cereal, the estimated DALY increases by a factor of 1.4 and decreases by a factor of 0.4 relative to the baseline, respectively. Changes in contaminant concentrations or percent consumers also significantly impact risk. Uncertainty in risk estimates is primarily driven by the dose-response models for this case study.

Conclusions: The current risk-risk framework can provide decision makers with a nuanced understanding of the impact of consumption shifts on public health and reveals parameters that drive predicted changes in public health. The framework showcased in this case study is applicable to food safety and nutrition questions. The Shiny app provides a real-time visualization tool to facilitate understanding and allow direct query by decision makers.

RESULTS

BASELINE

Based on current consumption of infant rice and oat cereal and preliminary data on the arsenic contamination in infant rice cereal, the estimated additional DALY for the total US population from iAs and aflatoxin is 4,600 (CI 90% [370; 8,400]) and the additional number of cancer illnesses is 370 (CI90% [29, 743]).

WHAT IF THERE IS A POPULATION SHIFT IN CONSUMPTION?

WHAT IF THERE IS A SHIFT IN CONTAMINATION LEVEL?

CONCLUSIONS

• The current case study illustrates how modeling can be used to quantitively assess the potential impact of policy on consumer behavior and resulting health outcomes for food safety and nutrition questions.
• These preliminary results provide insight into the impact of the recommendations to vary grain intake for infants who might otherwise consume only rice. These results can be updated when new data become available.
• The risk-risk framework developed in this case study can provide decision makers with a nuanced understanding of the impact of consumption shifts on public health and reveals parameters that drive predicted changes in public health.

ACKNOWLEDGEMENTS

The authors acknowledge and thank our CFSAN colleagues for sharing data and fruitful discussions. This work was carried out under official FDA duties and contract (HHFS223201710033I with Goldbelt C6, LLC (RP)).