

Conclusions

Consumers do act on their perceptions of the risk of foodborne illness. Our results showed a significant association between risk motivation and cooking and ordering choices. The reasons respondents gave for changing their hamburger cooking and ordering choices in the previous 5 years (between 1991 and 1996) also support the link between risk perceptions and behavior. The \$7.4 million annual savings from estimated reductions in medical costs and lost productivity due to a single pathogen, *E. coli* O157:H7, illustrates the benefits of investing in changing consumer behavior. Further, specific food safety messages about cooking and ordering hamburgers may encourage consumers to handle other foods more safely as well, so benefits of individual messages may exceed their original scope.

Our results provide the basis for several recommendations for the design and targeting of food safety education efforts. First, when we combined a model of the risk of infection with estimates of changes in cooking and ordering behavior data, we found that convincing consumers to stop eating rare hamburgers contributes much more to reducing the risk of infection than doing the same for medium-rare hamburgers, even though rare hamburgers are eaten less often than medium-rare. Because the destruction of *E. coli* O157:H7 organisms increases logarithmically with temperature (Marks et al., 1998), moving from rare to medium-rare provides a much larger reduction in absolute risk of *E. coli* O157:H7 infection than a change from medium-rare to well-done—a reduction of 50.12 cases per million for switching from rare to medium-rare, compared to a reduction of 0.81 cases per million for switching from medium-rare to well-done. Thus, while rare hamburger eaters may be more difficult to convince, the benefits of targeting this group should be explored further.

Second, our results highlight the need to target consumers in the South and Northeast regions and in large cities for consumer education to encourage ordering thoroughly cooked hamburgers. Consumer education to encourage thorough cooking of hamburgers at home should be broadly dispersed, since cooking hamburgers lightly was not significantly different across different regions, ethnicities, incomes, or metropolitan sizes after accounting for risk perceptions and tastes. Household size was the only significant household characteristic associated with cooking hamburgers lightly.

Third, the importance of foodborne illness experience suggests that conveying the consequences of foodborne illness can help motivate consumers to follow food safety recommendations. Fourth, our results also suggested that television and magazine stories may be effective channels for increasing consumers' risk motivation. More research is needed, however, to determine whether the information sources cited by respondents with higher risk motivation are likely to be effective channels for increasing risk motivation, or whether individuals with higher risk motivation are more likely to seek out certain information sources.

Finally, the importance of palatability motivation suggests that food safety education must convey not only the risk of lightly cooked hamburgers, but should include information on how to retain juiciness and flavor in a thoroughly cooked hamburger. The recommendation to use a thermometer may help retain desirable palatability characteristics in safely cooked hamburgers.

Our results also suggest directions for future research. First, the discrepancies among different measures of hamburger cooking behavior must be resolved. A more accurate measure of the frequency of consumption of unsafely cooked hamburgers will improve models of the risk from pathogens found in ground beef and be useful in monitoring changes in behavior. This is true for other unsafely prepared foods as well.

Second, further data on dose-response relationships for several pathogens will enable researchers to refine the estimates of *E. coli* O157:H7 illness reductions and incorporate reductions in other illnesses as well. This will improve estimates of the benefits of changes in consumer behavior.

Third, further research is needed to provide more refined measures of the proportion of hamburgers consumed rare rather than rare or medium-rare combined, and the effects of risk and taste preferences on this behavior. Accurate estimates of the proportion of hamburgers consumed rare and identification of factors that affect consumption of rare hamburgers are important in estimating the impact of efforts to change behavior. Consumption of rare hamburgers is infrequent, however, so a larger sample size is required to study this behavior in more depth.

Fourth, research is also needed to study differences in awareness of food safety information from different

sources. For example, respondents citing magazines as a food safety information source reported higher risk perceptions for lightly cooked hamburger, but this could be because people who may already have higher risk perceptions may be more likely to notice food safety information in magazines.

Finally, the issue of palatability in hamburger cooking behavior suggests palatability may be an important factor to add to research in nutrition as well. For example, consumer preferences for fiber content could be an important determinant of diet that should be accounted for in measuring the effect of nutrition knowledge on fiber intake.