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Americans' Perceptions of Food Safety: A Comparative Study of Fresh Produce, Beef and Poultry Products

Benjamin Onyango, Neal H. Hooker, William K. Hallman, and Cara L. Cuite

This study examines public perceptions of the safety of fresh produce (spinach and lettuce), beef, and poultry, employing survey data collected during the 2006 nationwide recall of fresh spinach contaminated with *E. coli* O157:H7. The results show that white respondents perceived all products to be safe. In contrast, young people, people with only a high school education, and those with lower household incomes ($50,000 or below), were more likely to view fresh produce, beef, and poultry as unsafe. Trust in the USDA as well as conventional farmers contributed toward more positive perceptions of spinach and lettuce. Low levels of objective knowledge about foodborne pathogens and resulting illnesses contributed to negative food safety perceptions. Efforts should be directed toward additional public education and outreach about general aspects of food safety, especially targeting youth, low income groups, non-whites, and those with education at or below a high school level.

Recent foodborne illness outbreaks and recalls may be contributing to diminishing public trust in the food safety control system. There are more food recalls today than a decade ago (Ollinger and Ballanger 2003). Between 1993–96 and 1997–2000 meat and poultry Class I recalls rose by 70 percent to about 40 recalls per year (Ollinger and Ballanger 2003). Foodborne illness outbreaks can harm the image of a firm, the industry (Verbeke 2001) and, more generally, consumer confidence in civic governance and food policy (Frewer and Salter 2002).

In addition to direct industry costs, foodborne illnesses remain a major public health concern. For example, *E. coli* O157:H7 alone causes approximately 73,000 illnesses, 2,000 hospitalizations, and over 60 deaths in the United States each year, with an associated cost of $405 million annually: $30 million in medical costs, $5 million in lost productivity, and $370 million from premature deaths (Frezen et al. 2005).

While the U.S. food safety system is clearly elaborate, a recent GAO (2008) report finds weakness in government oversight. In particular, the system is riddled with inconsistencies, rendering it ineffective in coordination and inefficient in resource use. The U.S. food safety regulatory system includes a mix of mandatory and voluntary risk management strategies such as Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP)/Sanitation Standard Operating Procedures (SSOP), and Hazard Analysis Critical Control Point (HACCP)-based controls used in various stages of certain supply chains or product categories. Yet there is no single over-riding, holistic program of control or orchestrated risk-based approach to regulation. Resources for standard development through verification/inspection activities are allocated and administered in a fragmented fashion (GAO 2008). Controls are managed by involves many agencies, including the Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), the Centers for Disease Control and Prevention (CDC), the Environmental Protection Agency (EPA), and state and local agencies.

Golan et al. (2004) observe that in the meat and poultry sector a mandatory Pathogen Reduction/HACCP system has been in place since 1997 which encourages the private sector to produce safer meat and poultry products. In comparison, in the produce sector voluntary general guidelines (GAPs and GMPs) exist to safeguard against food contamination. GMPs are mandatory for processors of fresh produce but voluntary for packers (FDA-CFSAN 2004). However, it is unclear why food contamination incidences are on the rise with such systems in place. Rising food contamination incidents may be partly related to changing patterns of food consumption, recognition of new means

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for transmission of organisms, and emergence of pathogens that can cause infections at very low doses. Additionally, incidences of food contamination are compounded by lax consumer behavior at home and in food-service operations (Taylor and Hoffman 2001)

This study explores consumer safety perceptions for produce, beef, and poultry. This is of particular relevance given the different regulatory and enforcement regimes affecting these product categories. We explore relationships between peoples' perceived risks of food contamination and their trust in the institutions ensuring safety. We also explore relationships between food safety perceptions and consumers objective knowledge about food safety. In this study it is fully recognized that produce (spinach and lettuce) are eaten raw, while beef and poultry are largely cooked, suggesting different risk exposures.

We apply a random utility discrete choice model to consumer survey data to explore the hypothesis that public perceptions of safety vary by the type of food. The explanatory variables in the empirical models include trust in food safety-related institutions, awareness of food issues through media exposure, objective food safety knowledge, region, and demographic variables (e.g., age, gender, education, income). The information generated by this study will be useful to policy makers in improving the effectiveness of food safety risk management controls and will contribute to development of best practices in food safety risk communication.

Survey Methods and Variable Development

A survey instrument was used to collect information on public responses to the contaminated spinach recall of 2006. Food safety perceptions and information relating to produce (spinach and lettuce) as well as to fresh beef and poultry (cooked at home) were collected. A nationally representative sample in terms of gender, age, and ethnicity of 1,200 non-institutionalized adult Americans (aged 18 or over) from all 50 states was interviewed by telephone during November 8–29, 2006. Proportional random-digit dialing was used to select survey participant households. A Computer Assisted Telephone Interview (CATI) system was programmed to provide prompts to select the appropriate proportions of male and female participants. The cooperation rate was 48 percent, with a resulting sampling error of ± 2.8 percent.

Survey participants were asked to reveal their views on the safety of bagged fresh spinach, loose fresh spinach, canned spinach, frozen spinach, bagged fresh lettuce, loose fresh lettuce, fresh beef cooked at home, and fresh chicken cooked at home. The exact question used was "On a scale of 0 through 10, where 0 is 'Not safe at all' and 10 is 'Completely safe,' how safe would you say it is right now to eat [*Insert appropriate food (e.g., bagged fresh spinach)*]." Responses to some of the questions were missing and therefore were excluded, leaving a total of 793 completed surveys.

Based on preliminary analyses, the food safety perception variable was re-coded into a binary variable. As can be seen from Table 1, on a scale of 0 to 10 the respondents' mean rating for produce (spinach and lettuce) ranged from 7.05 to 7.88, while the mean rating for the beef and chicken was greater than 8.3. When the raw data is viewed in percentiles a clearer pattern emerges with the safety ratings for beef and chicken relatively higher than those for produce. The lowest quartile (i.e., 25 percent of the respondents) rated bagged and loose spinach and lettuce at five and seven, respectively, while rating beef and chicken at eight. When the ratings across types of produce were combined, about 60 percent of the respondents rated bagged and loose spinach as completely safe, approximately 70 percent of the respondents did so for lettuce, and at least 77 percent of respondents rating chicken and beef as safe. A Mann-Whitney (1947) test confirmed that no information was lost by collapsing the "medium" and "not safe at all" groups into one category. Mann-Whitney is a nonparametric test to compare if two sample means come from the same population. The test is based on the *Z*-value. If the calculated Z-value is significant, it suggests in the context of our study that the categories may be collapsed without loss of information. Using consumers' responses to the above statement, a binary dependent variable *FOODSAFE* (food safety perception) was defined by assigning a value of one if the respondents' safety rating was equal to 8 or more ("completely safe") and zero otherwise.

A theoretical perspective on the impact of awareness on food safety perceptions is provided by the social amplification theory of risk (Kasperson et al. 1988). This theory posits that external events

linked to a greater availability of risk information can increase public risk perceptions (risk amplification), which, in turn, might lead to a decrease in consumer confidence in food safety. Risk amplification is thought to occur because both individuals and the media give greater weight and attention to negative events compared to positive events and because negative information is seen as more credible than positive information (Siegrist and Cvetkovich 2001; Slovic 1993). Given the timing of the spinach contamination and subsequent recall, we hypothesize that increased media attention likely influenced food safety perceptions. Frewer, Raats, and Shepherd (1993) suggest that media attention either may negatively influence consumer perceptions of food safety or may reflect increased consumer concerns about food in general.

Awareness of the food contamination incident and its overall impact on food safety perceptions is also explored using objective knowledge about the risk of *E. coli* (see Table 2 for questions used to test this knowledge). Consumer awareness of food contamination incidences tends to inform public perceptions of food safety. To capture awareness we use an objective measure of consumer knowledge of foodborne illness. We argue that consumers with greater objective knowledge will be better able to interpret information relating to food contamination. Therefore they may in relative terms form more accurate perceptions about food safety in general compared to those with less or no knowledge. We hypothesize that objective knowledge about *E. coli* and subsequent illness may reflect general knowledge about food safety issues and thus may influence risk perceptions. It is assumed that the greater the individual's knowledge, the better placed he or she is to interpret food safety information. It is unclear if such a mechanism would be consistent across food products given the possible interactions with objective knowledge about *E. coli* and product-specific risk; however, this remains a testable hypothesis.

We also explore trust in regulatory agencies, farmers, processors, distributors, wholesalers and retailers in several ways. Trust in regulatory institutions and supply chain agents is assumed to be pivotal in food safety perceptions (Frewer et al. 1996). Research has shown that in the absence of

Table 1. Food Safety Perceptions: Means, Percentiles, and Collapsed Categories.

	Bagged spinach	Loose spinach	Bagged lettuce	Loose lettuce	Fresh beef cooked at home	Fresh chicken cooked at home
Mean	7.05	7.20	7.75	7.88	8.40	8.32
Percentiles						
25	5	5	7	7	8	8
50	8	8	8	9	9	9
75	9	10	10	10	10	10
Percentage: collapsed categories				0–5	6–8	8–10
Bagged spinach				15.71	25.77	58.52
Loose spinach				14.26	25.78	59.96
Bagged lettuce				10.18	21.58	68.23
Loose lettuce				8.81	20.79	70.40
Fresh beef cooked at home				5.46	16.39	78.14
Fresh chicken cooked at home				6.32	16.67	77.01

Scale: 0 through 10, where 0 is "Not safe at all" and 10 is "Completely safe."

Table 2. E-coli Objective Knowledge Questions.

Question	True	Likely true	Likely false	False
Most people infected with E-coli 0157: H7 die as a result of the infection. Would you say this is . . .				
All people are equally susceptible to E-coli infection. Would you say this is . . .				
Contamination with E-coli can come from animal waste. Would you say this is . . .				
All food that is cooked to 120 degrees Fahrenheit is safe to eat. Would you say this is . . .				
Bagged spinach marked as "Triple washed" is certain not to have any E.-coli. Would you say this is . . .				
You can catch E-coli from an infected person through their coughing or sneezing. Would you say this is . . .				

any incidents concerning food products, food safety will be taken for granted by consumers (Green et al. 2003 Regardless of whether consumers are able to judge the safety of the food they buy or eat, it may be necessary for regulators and the food industry to develop and maintain effective consumer protection activities (Bocker and Hnaf 2000; Green, Draper, and Dowler 2003). We query respondents about their attitudes toward federal (USDA, FDA, and CDC) and state agencies, farmers, retailers, and others. Trust for USDA and FDA in particular are closely correlated (0.545). To explore such cross-category and agency relationships in food safety perceptions two compound variables are constructed. SAFE_M&P and SAFE_PROD are the combined safety perceptions of meat and poultry and of produce, respectively. These average scores capture general trust in the respective regulatory agencies. The variables are used to test for "spillover" effects of safety perceptions from meat and poultry to produce and vice-versa.

We hypothesize that the higher public trust is in particular government agencies, the greater the likelihood that food in general will be perceived as safe. If the public has a high degree of trust, then there might be a greater likelihood of rapid restoration of consumer confidence in the safety of the food supply. Alternatively, a high level of trust may be dramatically lost if consumers feel "misled" or that their trust was misplaced.

Gender is one of the socio-demographic variables explored. Women still carry out most food shopping and preparation tasks and may be more knowledgeable or hold different opinions about food safety risk. Age serves as a proxy for possible differences in food safety perceptions due to life experiences. Education is used to capture potential differences due to formal classroom knowledge. Note that this variable is not the same as that based on the *E. coli* questions, which captures issue-specific knowledge; however, these variables may reinforce each other. Individuals with more education may be more aware and knowledgeable about food safety issues. Finally, income is used as a metric of wealth.

Model Specification

A logistic model is estimated to explore factors that influence food safety perceptions. The maximum likelihood (ML) estimation procedure is used to generate parameters. Summary statistics, β-coefficients (and t-ratios), and marginal effects were

obtained using LIMDEP (Econometric Software 2002). The model assumes that the probability P_i (the i^{th} individual's food safety perception is above a threshold level) can be expressed as (Greene 2002)

$$(1)\quad P = F(Z_i) = F(\beta X_i) = 1/[1 + \exp(-Z_i)]\ ,$$

where Z_i denotes individual i's perceived food safety, x_{ij} = jth attribute of the ith respondent, β are the parameters to be estimated, and ε is a random error or disturbance term. People with different socio-demographic characteristics such as income and education may perceive food safety differently. Accordingly, Z_i, the indicator variable for food safety, is modeled as a function of the i^{th} consumer's economic, demographic, and other attributes as

$$(2)\quad Z_i = \log[P_i/(1 - P_i)] = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + \varepsilon_i\ ,\quad i = 1, 2, \ldots, n.$$

In a logit model the estimated parameters of Equation 1 do not directly represent the marginal effects of the independent variables on P_i. For a continuous variable, the marginal effect of x_j on the probability P_i that the dependent variable (y) takes the value $y_i = 1$ is given by

$$(3)\quad \partial P_i/\partial x_{ij} = [\beta_j \exp(-\beta X_i)]/\ [1 + \beta_j \exp(-\beta X_i)]^2.$$

However, if the independent variables are also qualitative or discrete in nature, as is the case for all the independent variables used in this study, $\partial P_i/\partial x_{ij}$ does not exist. In such cases, the marginal effect is obtained by evaluating P_i at alternative values of x_j. Marginal effects for such variables are determined as

$$(4)\quad \partial P_i/\partial x_{ij} = P(y_i : x_{ij} = 1) - P(y_i : x_{ij} = 0).$$

The following model is used to predict an individual's food safety perception:

$$(5)\quad FOODSAFE = \beta_0 + \beta_1 FEMALE + \beta_2 YOUNG + \beta_3 MIDAGE + \beta_4 B\_HSCHOOL + \beta_5 TWO\_YRCOLG + \beta_6 WHITE + \beta_7 INCB\_50 + \beta_8 TRUST\_FDA + \beta_9 TRUST\_USDA + \beta_{10} TRUST\_CDC + \beta_{11} SKEP\_FDCORPS + \beta_{12} SKEP\_GROCER + \beta_{13} TRUST\_SGVT + \beta_{14} TRUST\_ORGFARM + \beta_{15} TRUST\_CONFARM + \beta_{16} QUIZ + \beta_{17} MEDIA + \beta_{18} WEST + \beta_{19} COMB + \varepsilon\ ,$$

where the variables are defined and listed in Table 3. The asterisk is assigned to the variable's reference category against which the influence of other categories on food safety perception is measured. Separate models for produce (four models), and one each for beef and poultry are estimated, as public food safety perceptions may not be homogenous across people; therefore the most flexible functional form is used.

Empirical Results

Six different logistic models are estimated to explain food safety perceptions. Four of the models relate to spinach and lettuce in their loose and bagged forms, while the remaining two cover beef and chicken cooked at home. The estimated model coefficients, associated t-ratios, and marginal effects of the explanatory variables on the dependent variable are reported in Tables 4 through 6. These tables also report the estimated log likelihood functions of the unrestricted and restricted (i.e., all slope coefficients are zero) models, McFadden's R^2, and prediction success.

Risk Perceptions: Bagged and Loose Spinach

Sixty-two and 63 percent of the respondents perceived bagged and loose spinach to be safe for consumption, respectively. From Table 4 it can be seen that the coefficients of young (<35 years of age and 35–54), high school and below education, and an income of $50,000 and below were negative and statistically significant at a ten percent or lower level. These groups were more likely to view spinach in its bagged form as unsafe for consumption, compared to individuals 55 years or older, those with greater than a high school level of education, and those with annual incomes above $50,000. Similar results were obtained for loose spinach. The coefficient for whites was positive and significant at the one percent level for both bagged and loose spinach, suggesting they are more likely to view both forms of spinach as safe for consumption compared to people from other races.

The trust coefficient for food corporations was negative and statistically significant at the one percent level for both bagged and loose spinach. Conversely, the coefficient for conventional farmers was positive and statistically significant for

Table 3. Descriptive Statistics.

Variable	Description of variable	Mean	Std. dev.
FEMALE	1 = respondent is female; 0 = male	0.56	0.50
YOUNG	1= age less than 35 years; 0 = otherwise	0.21	0.41
MIDAGE	1 = age is between 35 and 54 years; 0 = otherwise	0.47	0.50
MATURE*	1 = age 55 or higher; 0 = otherwise	0.32	0.47
B_HISCHOOL	1 = Below high school level of education; 0 = otherwise	0.32	0.47
TWO_YRCLG	1 = some two year college education; 0 = otherwise	0.27	0.44
FYRCLG_AB*	1 = four year college education or higher; 0 = otherwise	0.41	0.49
INCB_50	1 = (annual) income below $50,000; 0 = otherwise	0.42	0.49
WHITE	1 = respondent is white (White); 0 = otherwise	0.82	0.39
TRUST_FDA	1=if respondent trusts the FDA to ensure the safety of the U.S food supply; 0 = otherwise	0.61	0.49
TRUST_USDA	1=if respondent trusts the USDA to ensure the safety of the U.S food supply; 0 = otherwise	0.64	0.48
TRUST_CDC	1 = respondent trusts the CDC to ensure the safety of the U.S food supply; 0 = otherwise	0.69	0.46
SKEP_FCORP	1 = if respondent is skeptical about food companies efforts to ensure safety of the U.S food supply; 0 = otherwise	0.53	0.50
SKEP_GROCER	1 = if respondent is skeptical about grocery stores efforts to ensure safety of the U.S food supply; 0 = otherwise	0.62	0.49
TRUST_GVT	1 = if respondent trusts state government to ensure safety of the U.S food supply; 0 = otherwise	0.49	0.50
TRUST_ORGFARM	1 = if respondent trusts organic farmers to ensure safety of the U.S food supply; 0 = otherwise	0.61	0.49
TRUST_CONFARM	1 = if respondent trusts conventional farmers to ensure safety of the U.S food supply; 0 = otherwise	0.56	0.50
ECOLI_OBJ_KNOW	Number of correct answers to e-coli food illness questions.	3.36	1.51
WEST	1 = if respondent's reported region was west; 0 = otherwise.	0.20	0.40
MEDIA	Number of times a respondent makes use of the media to obtain news/information (newspapers, TV, magazines, etc.)	17.88	7.84
SAFE_M&P	Average perceived safety of beef and chicken cooked at home	1.57	0.75
SAFE_PROD	Average perceived safety of fresh spinach and lettuce	2.68	1.63

* implies that the variable was dropped to avoid dummy variable trap.

Table 4. Maximum Likelihood Estimates of Model Coefficients and Estimated Marginal Effects of Independent Variables.

	Bagged spinach			Loose spinach		
Variable	Coefficient	t-ratio	Marginal effect	Coefficient	t-ratio	Marginal effect
Constant	-1.2350	-2.08	-	-1.3518	-2.29	-
FEMALE	0.0128	0.07	0.00	0.1366	0.75	0.03
YOUNG	-0.5826	**-2.26**	**-0.14**	-0.4234	**-1.67**	**-0.10**
MIDAGE	-0.2791	-1.31	-0.06	-0.0385	-0.18	-0.01
B_HISCHO	-0.8383	**-3.60**	**-0.20**	-0.5331	**-2.29**	**-0.12**
TWO_YRCL	-0.3181	-1.39	-0.07	-0.3407	-1.51	-0.08
INCB_50	-0.5780	**-2.93**	**-0.13**	-0.6696	**-3.41**	**-0.15**
WHITE	0.6831	**2.84**	**0.16**	0.7213	**3.05**	**0.17**
TRUST_FDA	-0.3005	-1.17	-0.07	-0.2877	-1.13	-0.06
TRUST_USDA	0.6070	**2.34**	**0.14**	0.3403	1.32	0.08
TRUST_CDC	-0.0280	-0.11	-0.01	-0.0137	-0.06	0.00
SKEP_FDCORPS	-0.5922	**-2.61**	**-0.14**	-0.6067	**-2.68**	**-0.14**
SKEP_GROCER	0.0808	0.36	0.02	0.0928	0.41	0.02
TRUST_GVT	0.0006	0.00	0.00	0.0370	0.15	0.01
TRUST_ORGFARM	0.2694	1.16	0.06	0.1969	0.86	0.04
TRUST_CONVFARM	0.4853	**1.97**	**0.11**	0.5197	**2.13**	**0.12**
OBJ_KNOW	0.1158	**1.89**	**0.03**	0.1289	**2.12**	**0.03**
MEDIA	-0.0248	**-2.10**	**-0.01**	-0.0217	**-1.85**	**0.00**
WEST	-0.3075	-1.38	-0.07	-0.2493	-1.12	-0.06
SAFE_M&P	1.1777	**9.18**	**0.27**	1.1393	**9.12**	**0.26**
LL	-398.58			-403.35		
RLL	-527.89			-522.33		
Chi square	258.60			237.96		
DF	19			19		
McFadden R^2	0.24			0.23		
% of correct prediction	75.66			75.03		
	Predicted			Predicted		
Actual		**0**	**1** Total	**0**	**1**	Total
	0	176	128 304	159	134	293
	1	65	424 489	64	436	500
Total		241	552 793	223	570	793

Table 5. Maximum Likelihood Estimates of Model Coefficients and Estimated Marginal Effects of Independent Variables.

	Bagged lettuce			Loose lettuce		
Variable	Coefficient	t-ratio	Marginal effect	Coefficient	t-ratio	Marginal effect
Constant	-0.9924	-1.62	-	-0.7832	-1.25	-
FEMALE	0.0186	0.10	0.00	0.0590	0.30	0.01
YOUNG	0.3120	1.14	0.06	0.1226	0.44	0.02
MIDAGE	0.1408	0.64	0.03	-0.0076	-0.03	0.00
B_HISCHO	-0.1274	-0.51	-0.02	-0.2792	-1.10	-0.05
TWO_YRCL	-0.2349	-0.99	-0.05	-0.3594	-1.49	-0.07
INCB_50	-0.6532	**-3.13**	**-0.13**	-0.3777	**-1.78**	**-0.07**
WHITE	0.3567	1.43	0.07	0.4766	**1.88**	**0.09**
TRUST_FDA	-0.4180	-1.56	-0.08	-0.2944	-1.09	-0.05
TRUST_USDA	0.4794	**1.79**	**0.09**	0.5211	**1.89**	**0.10**
TRUST_CDC	0.1075	0.42	0.02	0.1633	0.63	0.03
SKEP_FDCORPS	-0.4543	**-1.90**	**-0.09**	-0.5654	**-2.30**	**-0.10**
SKEP_GROCER	0.0034	0.01	0.00	-0.0211	-0.08	0.00
TRUST_GVT	0.2981	1.16	0.06	0.1051	0.40	0.02
TRUST_ORGFARM	0.2027	0.85	0.04	0.1238	0.51	0.02
TRUST_CONVFARM	0.3319	1.30	0.06	0.0774	0.29	0.01
OBJ_KNOW	-0.0398	-0.62	-0.01	-0.0490	-0.74	-0.01
MEDIA	-0.0022	-0.18	0.00	-0.0041	-0.32	0.00
WEST	-0.2844	-1.22	-0.06	-0.0293	-0.12	-0.01
SAFE_M&P	1.2101	**10.01**	**0.23**	1.2670	**10.52**	**0.23**
LL	-372.82			-361.10		
RLL	-481.07			-467.31		
Chi square	216.49			212.42		
DF	19			19		
McFadden R^2	0.23			0.23		
% of correct prediction	78.81			80.20		

	Predicted				Predicted		
Actual		0	1	Total	0	1	Total
	0	107	127	234	101	118	219
	1	41	518	559	39	535	574
Total		148	645	793	140	653	793

Table 6. Maximum Likelihood Estimates of Model Coefficients and Estimated Marginal Effects of Independent Variables.

	Fresh beef cooked at home			Fresh chicken cooked at home		
Variable	Coefficient	t-ratio	Marginal effect	Coefficient	t-ratio	Marginal effect
Constant	-0.6844	-1.02	-0.09	-0.4828	-0.72	-0.06
FEMALE	-0.2414	-1.13	-0.03	-0.4783	**-2.25**	**-0.06**
YOUNG	-0.2083	-0.69	-0.03	-0.2625	-0.88	-0.04
MIDAGE	-0.3506	-1.39	-0.04	-0.2844	-1.15	-0.04
B_HISCHO	0.5260	**1.87**	**0.06**	0.3764	1.37	0.05
TWO_YRCL	0.0679	0.26	0.01	0.1693	0.65	0.02
INCB_50	-0.0062	-0.03	0.00	0.1557	0.66	0.02
WHITE	0.4530	**1.72**	**0.06**	-0.2737	-1.00	-0.03
TRUST_FDA	0.3382	1.17	0.04	0.2943	1.03	0.04
TRUST_USDA	-0.0176	-0.06	0.00	-0.3562	-1.17	-0.05
TRUST_CDC	0.3452	1.23	0.05	0.3061	1.11	0.04
SKEP_FDCORPS	-0.1269	-0.46	-0.02	-0.0531	-0.19	-0.01
SKEP_GROCER	-0.3900	-1.38	-0.05	-0.3239	-1.16	-0.04
TRUST_GVT	0.0554	0.19	0.01	0.4713	**1.68**	**0.06**
TRUST_ORGFARM	-0.5982	**-2.26**	**-0.07**	-0.0698	-0.27	-0.01
TRUST_CONVFARM	0.1004	0.35	0.01	-0.1535	-0.54	-0.02
OBJ_KNOW	0.0963	1.35	0.01	0.1254	**1.78**	**0.02**
MEDIA	0.0156	1.13	0.00	0.0207	1.49	0.00
WEST	0.1424	0.54	0.02	-0.1219	-0.48	-0.02
SAFE_PROD	0.6556	**10.00**	**0.08**	0.6819	**10.38**	**0.09**
LL	-311.12			-317.31		
RLL	-408.19			-414.70		
Chi square	194.15			194.78		
DF	19			19		
McFadden R^2	0.24			0.23		
% of correct prediction	81.97			83.35		

	Predicted				Predicted		
Actual		0	1	Total	0	1	Total
	0	70	97	167	82	90	172
	1	46	580	626	42	579	621
Total		116	677	793	124	669	793

both bagged and loose spinach at five percent or lower, while the coefficient of trust for the USDA was positive and statistically significant only for bagged spinach at the five percent or lower level. The results suggest that those trusting the USDA and conventional farmers were more likely to view bagged and loose spinach as safe for consumption compared to those not trusting the USDA and conventional farmers. This outcome is interesting as the FDA regulates produce, yet the results show no impact of trust in the FDA on food safety perceptions for these produce items.

The coefficients on objective *E. coli* knowledge were positive and significant at five percent or lower levels of significance. The estimated coefficients suggest that those with above average objective knowledge compared to those with lower scores were more likely to perceive spinach (in its bagged and loose forms) as safe for consumption. The coefficient testing for cross food-category effects (SAFE_M&P) was positive and significant, suggesting that public perceptions of the safety of (bagged or loose) spinach was enhanced if consumers held positive perceptions of the safety of meat and chicken products. This result may be due to confusion over regulatory authority (consumers judging that the USDA was the lead agency and thus associating the safety of meat and poultry with that of spinach) or may mean that consumers consider all products to hold similar risk profiles.

The likelihood ratio test of overall model significance yields statistics of 258 and 237, respectively, for bagged and loose spinach, which are greater than the 95 percent critical value of the chi-square distribution with appropriate degrees of freedom. This implies that the two models have significant explanatory power. The estimated McFadden's R^2 were 0.24 and 0.23, for bagged and loose spinach models, respectively, with a prediction success rate of about 75 percent.

Risk Perceptions: Bagged and Loose Lettuce

Food safety perceptions for lettuce were almost ten percent higher than those of spinach. Seventy and 72 percent of the respondents perceived fresh bagged and loose forms of lettuce as safe for consumption. Table 5 shows that the coefficient on income of $50,000 and below was negative and statistically significant at the one and five percent level for bagged and loose lettuce, respectively. Similar to the case with spinach, those with an annual income of $50,000 and below were more likely to perceive lettuce as unsafe for consumption. On the other hand, whites were more likely to perceive loose lettuce as safe for consumption. Results for the trust variables compare fairly well to those of spinach. Those with lower trust in food companies were more likely to perceive bagged and loose lettuce as unsafe for consumption. Trust in the USDA and, analogous to the case with spinach, consumers' perceptions of meat and poultry safety had a positive impact on perceived lettuce safety. Media exposure, region, and objective knowledge were not significantly related to fresh lettuce safety perceptions.

The likelihood ratio test of overall model significance yielded statistics of 216 and 212 for bagged and loose lettuce, respectively, which are greater than the 95 percent critical value of the chi-square distribution with appropriate degrees of freedom. This implies that the models have significant explanatory power. The model's estimated McFadden's R^2 was 0.23, with almost equal success rates of 79 percent and 80 percent, respectively.

Risk Perceptions: Fresh Beef and Chicken Cooked at Home

Compared to both spinach and lettuce, more people perceived fresh beef and chicken cooked at home to be safe (approximately 80 percent). As can be seen from Table 6, the coefficient for whites was positive and statistically significant at the ten percent level for beef but not for chicken The coefficient for high school education and below was positive and statistically significant at the ten percent level, suggesting that those with less education are more likely to view beef cooked at home as safe. The coefficient of gender was negative and significant at the ten percent level. Females were less likely to view chicken cooked at home as safe.

In terms of trust, the coefficients for state government and organic farmers were statistically significant but with opposite effects on safety perceptions. In the case of chicken safety perceptions, those trusting state government were likely to perceive chicken cooked at home as safe. On the other hand, those trusting organic farmers were less likely to perceive beef cooked at home as safe for consump-

tion. This may be due the fact that beef and poultry are perceived as products with distinct risk profiles. Additionally, the negative impact on beef may be a result of trust in organic famers evoking a different set of trust dimensions on part of the consumer over and above conventional beef.The likelihood ratio tests of overall model significance yield statistics of 194 for both fresh beef and chicken cooked at home, which is greater than the 95 percent critical value of chi-square distribution with appropriate degrees of freedom. This implies that the two models have significant explanatory power. Estimated McFadden's R^2 were 0.24 and 0.23, for beef and chicken, respectively. The estimated models had prediction success rate of 81 percent and 83 percent, respectively.

Comparing the Marginal Effects: Spinach and Lettuce

Evaluating the results in terms of marginal effects, people in the $50,000-and-below income bracket were 13 percent and 15 percent less likely to perceive spinach in its bagged or loose forms, respectively, as safe. On the other hand, the likelihood was 13 percent and eight percent for lettuce (bagged or loose, respectively) for the people in the same income group. As lettuce was not subject to the recall, it was expected to be perceived as having lower risk than spinach. However, this was not the case. For example, whites perceived bagged spinach to be relatively safer (16 percent more likely to be safe) compared to loose lettuce (nine percent). People with a high school education and below were 20 percent and 12 percent less likely to perceive bagged and loose spinach as safe, respectively. Similarly, young people (<35 years of age) were 14 percent and ten percent less likely to perceive spinach in its bagged or loose form as safe. Respondents trusting the USDA compared to those not trusting the agency, were between nine percent and 14 percent more likely to perceive bagged lettuce, loose lettuce, and bagged spinach as safe for consumption. Conversely, those respondents with lower levels of trust in food corporations were between nine percent and 14 percent less likely to perceive spinach and lettuce in their bagged or loose form as safe. People trusting conventional farmers were 11 percent and 12 percent more likely to perceive spinach in its bagged and loose form as safe. Similarly, individuals with above average objective knowledge were three percent more likely to perceive spinach as safe. Media influence was only observed for spinach, with those more often exposed to media being one percent less likely to perceive spinach as safe.

Comparing the Marginal Effects: Beef and Chicken

Unlike spinach and lettuce, the meat and poultry products results show no consistent pattern. That said, females were six percent less likely to perceive chicken as safe. On the other hand, those respondents trusting state government to ensure safety were six percent more likely to perceive chicken as safe for consumption. Similarly, whites and those with no more than a high school education were six percent more likely to perceive beef as safe. Conversely, respondents' trust in organic farmers contributed to negative perceptions, leading to a seven percent lower likelihood of perceiving beef as safe for consumption.

Overall Comparison: Risk Perceptions across the Six Food Categories

Comparisons of food safety perceptions were made using the marginal effects of the explanatory variables. Few consistent results were seen across the six food categories. The role of sociodemographic variables such as education, gender, age and income, while playing significant roles in the individual regression results described above, were not consistent across the six models. While the media is thought to be important in shaping safety perceptions, no significant differences were observed between produce, meat, and poultry safety perceptions when accounting for media use.

The results suggest that people's beliefs that meat and poultry are safe reinforced their safety perceptions about produce. Those believing that beef and chicken cooked at home was safe were about 26 percent more likely to perceive produce (spinach or lettuce) in bagged or loose form as safe for consumption. On the other hand, believing that fresh produce is safe had a smaller impact on meat and poultry safety perceptions. Those believing that produce was safe were about nine percent more likely to view meats as safe.

Conclusions

This paper examines public perceptions of the safety of fresh produce, beef, and poultry products following an event involving a nationwide food recall. Although there were few consistent socio-demographic impacts across the six food categories, the results suggest that safety perceptions may differ across the type of food. The results highlight the importance of trust in government agencies and other supply chain agents. Interestingly, confidence in the USDA was viewed positively and contributed toward the view that fresh produce was safe for consumption despite the fact that the FDA is responsible for regulating the safety of fresh produce.

The results also show that low objective knowledge about foodborne pathogens and resulting illnesses may lead to the public perceiving that all food may be unsafe for consumption. Results indicate that whites perceived produce, meat and poultry to be safe for consumption. This contrasts with views held by younger people and those belonging to the lower income groups (<$50,000), who viewed produce, meat, and poultry to be equally unsafe. This calls for additional public education and outreach efforts on general food safety topics targeting youth, low-income groups, and those with education at or below a high school level. In addition, there is a need for regulatory agencies to improve public confidence in them, given current low levels of public trust in their role of safeguarding the food supply.

This study contributes to the emerging literature on food safety, particularly in modeling public views. In general, the information generated will inform policy makers, farmers and marketers that contamination may occur anywhere. There is need for preventing or minimizing such occurrences, which can shift food demand in the short run. However, given the scope of the survey data, not all foods are covered; consumers likely perceive other foods outside this set differently. We suggest, therefore, that future studies incorporate public opinions regarding a larger spectrum of foods.

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