Determinants of Interest in Food-Safety Training: A Logistic Regression Approach

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Training in food safety and safe food handling has become critical in recent years as a result of the millions of Americans who are sickened or hospitalized as a result of consuming unsafe food. Food- safety issues have consequently become of utmost importance to consumers, processors, and other food handlers in general. The increasing number of recalls of contaminated food suggests also that there is a continued need to do all that is economically feasible to protect the food system. Despite the importance of food safety, few studies have assessed the need for food safety and/or safe food handling by consumers. These authors are not aware of any studies that have assessed interest in food safety training in Tennessee. A major objective of this paper is to investigate the factors that determine interest in food safety training in Tennessee. In summer 2009, a face-to-face interview of Tennessee consumers was used to assess knowledge, concerns, and training needs for Tennessee consumers. Data were collected from participants in a one-day Small Farm Expo in middle Tennessee. A 21-item questionnaire was used to collect the information presented in this paper. The paper examines issues identified as being of the greatest concern to consumers and identifies factors influencing interest in food -safety training. A logistic regression model was formulated and estimated using the Statistical Package for the Social Sciences (SPSS). Policy implications were drawn from results generated from data analyzed. The paper concludes with suggestions for further research.

Global concern with food safety is currently exacerbated by increasing openness and a more integrated world economy. Bioterrorism and agro-terrorism concerns have led to increased food inspections and more food recalls. In the U.S., for example, the number and size of food recalls have dramatically increased (Mathews, Bernstein, and Buzby 2004). Buzby 2003). Between 1993 and 1996, Class I meat and poultry recalls averaged about 24 per year, amounting to 1.5 million pounds, while between 1997 and 2000 the recalls averaged 41 per year and amounted to 24 million pounds (Buzby 2003). Overall food imports also increased significantly in the last decade. The U.S. now has a protection plan to ensure the safety of food imports (US DHHS and FDA 2007. This paper shares survey results from a study undertaken in Tennessee to investigate the determinants of food safety training in the state, outlines the food recall situation in the U.S., presents survey results, and discusses policy implications.

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The authors extend their sincere thanks to the USDA/NIFA (formerly CSREES) for providing financial support through a funded food safety grant project. Our thanks also go to colleagues in the School of Agriculture & Consumer Sciences, Tennessee State University for providing comments on earlier drafts of the paper, undergraduate and graduate student assistants, and research associates Anonya Akuley-Amenyenu and Cyndi Thompson for preparing the graphs and tables. All errors are the sole responsibility of the authors.

Food-Borne Illnesses: Hospitalizations and Deaths in the United States

Food safety issues have become increasingly important in the face of the millions who become ill from consuming unsafe food or the thousands who are hospitalized or die from food-borne illnesses each year (Acheson and Fiores, 2004a, 2004b; Jones and Gerber 2001). Food-borne illness is responsible for 76 million illnesses, 325,000 hospitalizations, and 5000 deaths in the U.S., annually. (Mead et al, 1999). Foodborne illness results from improper food handling practices by food handlers in foodservice establishments. Food safety education and training can improve knowledge and attitudes of food handlers about proper food handling. Food safety training is usually conducted using traditional methods—lecture and/or viewing videos. (Rajagopal and Strohbehn 2010; Olsen 2010; National Restaurant Association 2008).

The medical costs, productivity losses, and premature death costs associated with food-borne diseases from five sources of pathogens amounted

to $6.9 billion in the United States, according to the ERS (USDA-ERS, 2004; Frenzen et al. 1999). Food safety in the U.S. is the responsibility of the Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA). While the FDA has jurisdiction over food, pet and farm animal feed, the USDA regulates meat, poultry products, and eggs (U.S. Consumer Product Safety Commission n.d.). Recalls are classified as follows: Class I recalls are for health hazard situations where there is a reasonable probability that the use of the product will cause serious, adverse health consequences or death. Class II recalls are for health hazard situations where there is a remote probability of adverse health consequences from the use of the product. Class III recalls are for situations where the use of the product will not cause adverse health consequences. All recalls have information on the specific product being recalled, reason(s) for the recall, class of recall, recall number and date. USDA-FSIS 2010). All product recalls in the U.S. are voluntary.

Methodology

A 21-item questionnaire was developed and used to collect information. Data were collected using face-to-face interview of participants in Nashville in 2009. Seventy useable questionnaires were collected out of one-hundred-and-fifty passed out during a one-day Small Farms Expo organized by Tennessee State University. A logistic regression model was formulated and estimated using the Statistical Package for the Social Sciences (SPSS 2009). Policy implications were drawn from the results thus generated.

Conceptual Model

The binary choice model to be estimated was

(1) Prob (event j occurs) = Prob(Y = j) = F (relevant effect: parameters),

where Y = 1 if the respondent is interested in training and Y = 0 otherwise.

The general model is

(2) Prob (Y = 1) = F($\beta'x$)

(3) Prob (Y = 0) = 1– F($\beta'x$),

where β reflects the impact of changes in the independent variable x on the probability.

A linear logistic regression model $F(x, \beta) = \beta'x$ was estimated. Since $E[y|x] = F(x, \beta)$, the regression model took the form

(4) $y = E[y|x] + (y - E[y|x]) = \beta'x + \varepsilon$.

The marginal effect in probability terms can be calculated as

(5) $\partial/\partial x(\text{Prob } (Y=1|x)) = \beta^*[e^{-x\beta}/(1+ e^{-x\beta})^2]$

Table 1 presents the definitions and expected signs of the explanatory variables in the binary choice model.

Results and Discussion

About 90 percent of study participants considered food safety to be a very important or important issue while seven percent considered it to be somewhat important. Only three percent of respondents considered it to be unimportant. Sixty percent of respondents were male and 40 percent were female. About 34 percent of respondents were 25 years of age or younger, 26 percent were between 26 and 43 years of age, and 40 percent were older than 43 years. More demographic results of survey participants are displayed in Table 2. Further analysis of data showed that while 44.3 percent of the seventy respondents to the survey indicated that they received some food safety training, 55.7 percent indicated that they did not receive any. The binary choice model can be used as a tool in research to better target food safety training to food service workers. A carefully targeted and coordinated training could lead to efficient use of scarce training resources (time and money). Expanding the research to include other regions could provide findings that are more generalized to a larger population.

Furthermore, results show that the estimated binary choice model was very significant, $\chi^2 = 33.827$, $p < 0.001$, –2 log likelihood 49.350 with Negelkerke R-square value of 0.575.

Tennessee consumers' food safety concerns included the following:

Table 1. Estimated Binary Choice Model: Definition of Explanatory Variables and Expected Signs.

Variable	Definition
q3	f(q1, q2, q4, q6,q15, q16, q17, q18, q19, q20)
q1	Respondent assessment of food safety
q2	Food safety training [0 = no; 1 = yes]
q3	Interest in training [0 = no; 1 = yes]
q4	Current in food service [0 = no; 1 = yes]
q6	Adequate training [0 = no; 1 = yes]
q15	Gender [0 = male; 1 = female]
q16	Age [0 = less than 35 years; 1 = older than 35]
q17	Marital status [0 = otherwise; 1 = married
q18	Race [0 = African-American; 1 = other]
q19	Education [0 = <high school; 1 = >high school]
q20	Income [0 = <$20,000; 1 = >$20,000

Variable	Expected Sign
q1 = Assessment of food safety	?
q2 = Food safety training	–
q4 = Currently in food service	?
q6 = Adequate training	–
q15 = Gender	+
q16 = Age	–
q17 = Marital status	?
q18 = Race	?
q19 = Education	+
q20 = Income	–

- Sickness from contaminated food
- Cleanliness of food
- Proper food handling
- Handlers' food safety education
- Harmful bacteria (salmonella e-coli)
- Cross contamination

The binary choice model estimated using the Statistical Package For the Social Sciences (SPSS) shows the following results:

(1) Respondents who believed that food safety was important were more likely to be interested in food safety training.

(2) Participants who thought that Tennessee food-service workers had adequate food safety training were less likely to be interested in training.

(3) Ethnicity was an important variable in explaining interest in food-safety training. Respondents from ethnic groups other than African-Americans were less likely to be interested in food-safety training

(4) Higher income was significantly related to interest in food-safety training.

Table 2. General Demographic Variables.

Variable	Percent
Gender	
Male	60.0
Female	40.0
Age	
Less than 16 years	2.9
17–25 years	31.4
26–34 years	15.7
35–43 years	10.0
44 years or older	40.0
Marital status	
Never married	38.6
Married	52.9
Divorced	4.3
Separated	2.9
Widowed	1.4
Race	
Black or African-American	52.9
White	45.7
Not reported	1.4
Education	
Less than high school	2.9
High school graduate or GED	14.3
Trade or vocational school	7.1
Some college, no degree	12.9
Associate degree	2.9
Bachelor's degree	24.3
Graduate/post-graduate degree	35.7
Annual income	
Less than $20,000	25.7
$20,000–$29,000	8.6
$30,000–$39,000	18.6
$40,000–$49,000	18.6
$50,000–$59,000	7.1
$60,000 or more	18.6

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Table 3. Interest in Being Trained in Food Safety.

Variable	Percent
Very interested	21.4
Interested	45.7
Somewhat interested	22.9
Not interested	7.1

Table 4. Respondent Work Responsibility.

Variable	Percent
Cooking	8.8
Serving	2.9
Keeping kitchen and dining area clean	4.3
Others	42.9

Table 5. Workers Have Adequate Training.

Variable	Percent
No	35.7
Yes	21.4
Do not know	41.4

Table 6. Coefficients of Estimated Model (Dependent Variable: q3, Interest in Food Safety Training).

Variable	Beta (β) coeff.	Wald statistic	Sig. prob.	Expd. (β)	Marginal effect
q1, Assessment of Food Safety [0 = no; 1= yes]	2.709	9.345	0.002	15.018	0.159
q6, Adequate training [0=no; 1= yes]	–1.163	5.837	0.016	0.312	0.211
q18, Race [0 = African-American; 1= other]	–1.909	5.135	0.023	0.148	0.214
q20, Income [0 =< $20,0001; => $20,000]	1.645	3.795	0.051	5.180	0.223

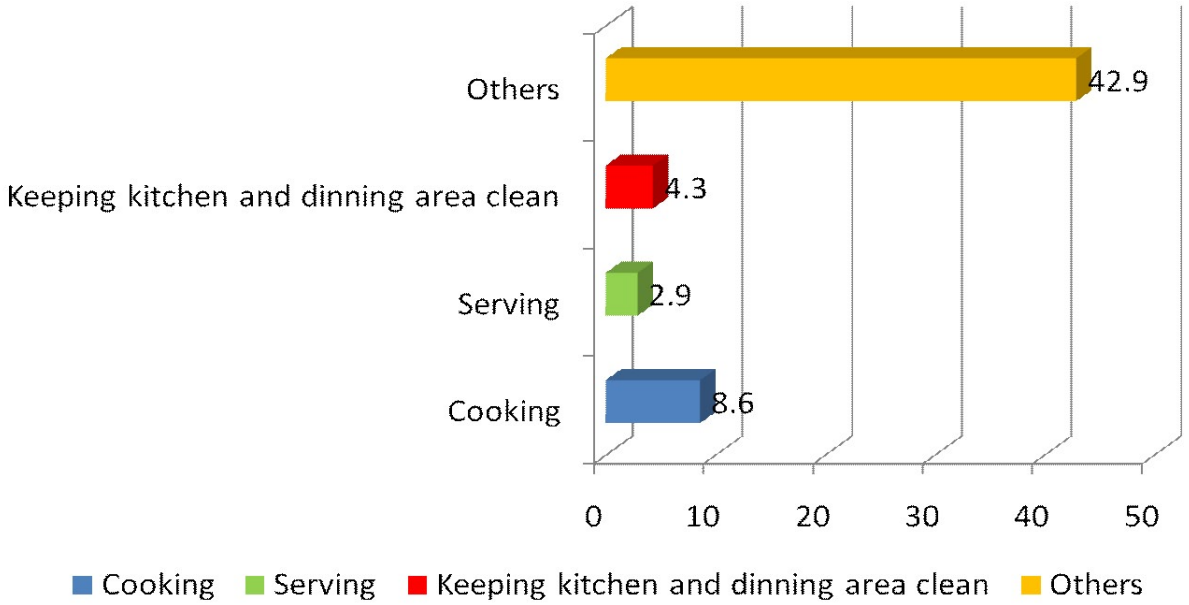

Figure 1. Work Responsibility.

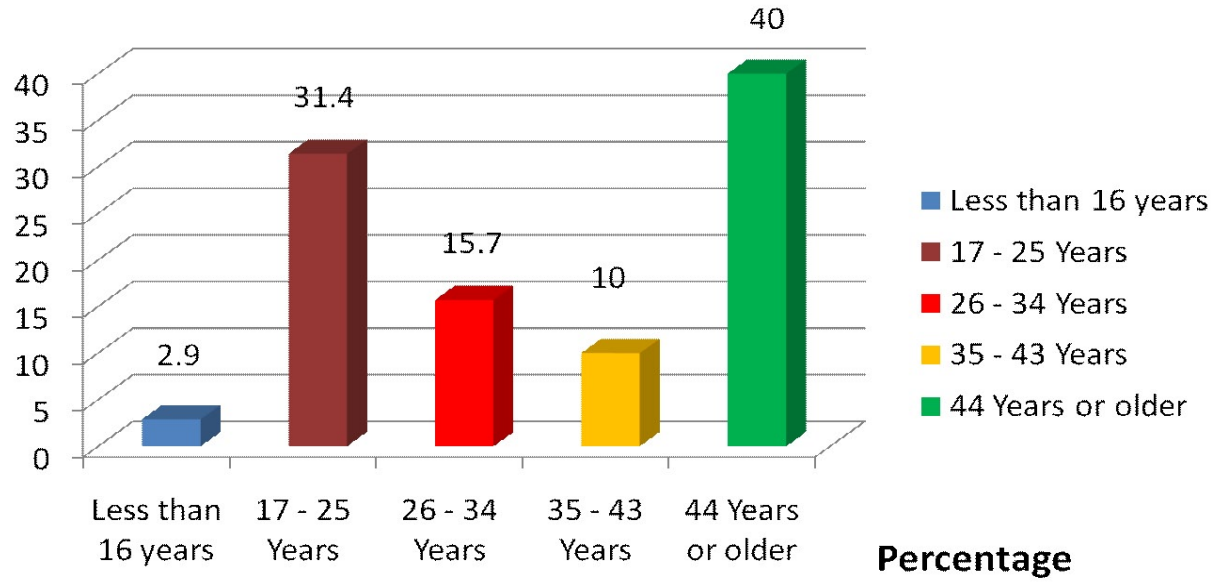

Figure 2. Age.

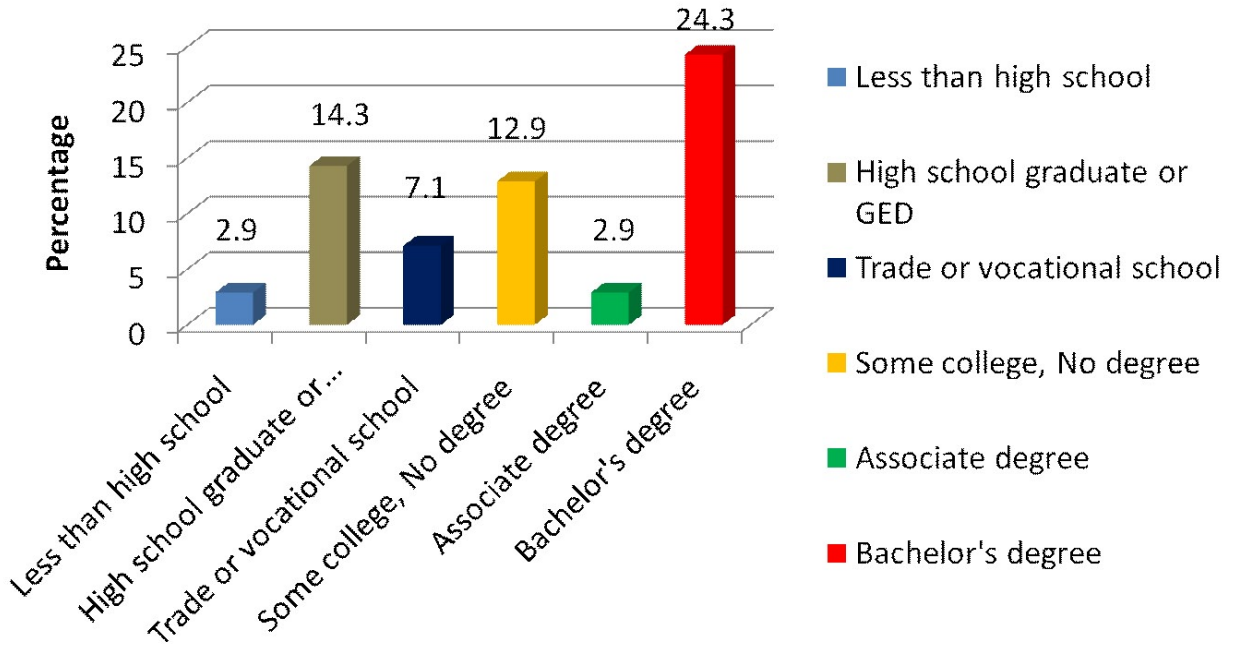

Figure 3. Education.

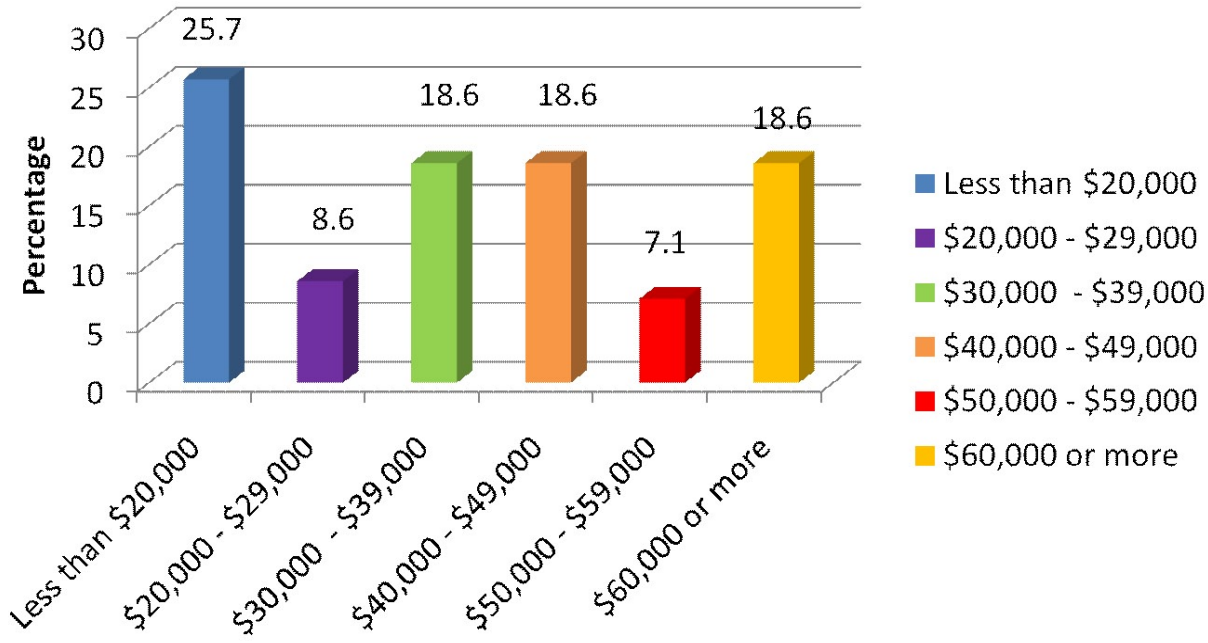

Figure 4. Annual Income.