Impact of a Poultry and Egg Food Safety Education on 4-H Youth

M. Beaty
Tennessee State University

J.C. Ricketts
Tennessee State University
jricket1@tnstate.edu

S. Godwin
Tennessee State University
sgodwin@tnstate.edu

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This study sought to evaluate a poultry and egg food safety education intervention for 4-H youth. Materials developed and shared with students were infused with key content stemming from microbiological research findings associated with this project and a content analysis of other key findings in the field that consumers ought to know and apply to reduce instances of food-borne illness and death. With financial support from the United States Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) Agriculture and Food Research Initiative (AFRI), the Poultry and Egg Education Project (PEEP) accomplishes this goal for families and communities by evaluating knowledge, attitudes, perceptions and intentions of implementing lessons learned during a workshop on poultry and egg food safety. Among a convenience sample of 4th-6th grade 4-H youth attending various 4-H camps (n = 190), post-test knowledge scores were significantly higher than pre-test scores. The workshop teaching poultry and egg food safety was effective in knowledge creation. Following the workshop youth had positive changes in attitudes, perceptions, and intentions regarding adopting the food safety messages that, if applied, could reduce food-borne illness and death. According to these findings and Ajzen's (1991) Theory of Planned Behavior, we expect participants to implement appropriate food safety behaviors related to handling and use of poultry and poultry products. Continuation, improvement, and expansion of the PEEP curriculum were recommended. Specific curriculum improvement strategies include more age-appropriate options and more formalized lesson plans designed to engage learners. Recommendations for testing an improved curriculum with an experimental design are also made.

Introduction

Each year 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths are attributed to foodborne illness in the United States (US) (Centers for Disease Control and Prevention [CDC], 2016a). On average, one in six Americans becomes sick from foodborne illness each year (CDC, 2016a). These illnesses are a burden to public health and expensive; yet, they are largely preventable (CDC, 2016a). Consumers can greatly reduce their risk of foodborne illness by learning safe purchasing, storing, handling and preparing practices at home (Kosa, Cates, Bradley, Godwin & Chambers, 2014).

Many consumers, however, are not following recommended best food safety practices, contributing to the large numbers of foodborne illness and outbreaks (Kosa et al., 2014). Though many consumers believe it is not common for people in the U.S. to become sick from food prepared in the home, food safety experts report the home is the primary location of foodborne illnesses (Kosa et al., 2014). The danger of foodborne illness is higher among children and youth. A significant portion of foodborne illnesses are caused by *Salmonella* and *Campylobacter*, bacteria commonly found in poultry and eggs (CDC, 2016a).

The Poultry and Egg Education Project (PEEP) has a goal to reduce illnesses from *Salmonella* and *Campylobacter* by educating and improving consumer handling and preparation of raw poultry products in the home. PEEP is the education body, part of an Agriculture and

Food Research Initiative (AFRI) Competitive Grant supported by the National Institute of Food and Agriculture (NIFA) of the United States Department of Agriculture (USDA).

Food safety is the probability of not suffering from consuming a specific food (Henson & Traill, 1993). Of the 48 million foodborne illnesses in the United States each year, *Salmonella* and *Campylobacter* cause nearly 2 million foodborne infections and at least 450 deaths ever year (CDC, 2016c; Scallan et al., 2011). Poultry and eggs pose one of the greatest risks of foodborne disease in the US when compared to other foods (Kosa, Cates. Bradley, Chambers & Godwin, 2014). *Salmonella* is a common cause of food poisoning and symptoms can last up to a week. Similarly, *Campylobacter*, is one of the most common causes of diarrhea in the US (CDC, 2016b). The risk for illnesses associated with both of these pathogens is especially high for older adults, infants and persons with chronic diseases (CDC, 2016c). Safe cooking and pasteurization kill *Salmonella and Campylobacter*. The only way to prevent illnesses associated with these pathogens is to practice recommended food safety best practices. For this reason, education of food safety should include the safety of handling, preparing, and cooking poultry and eggs in the home (Kosa et al., 2014).

Theoretical Framework

This study integrated Ajzen's Theory of Planned Behavior (TPB) (Ajzen, 1991) and Rogers' (2003) Diffusion of Innovation Theory to identify variables that consistently impact behavior change. TPB helps program creators and facilitators address or target specific behaviors (Lobb, Mazzocchi, & Traill, 2006) by focusing on attitudes, intentions, and subjective norms (beliefs and motivations). Diffusion of Innovation theory demands that knowledge and awareness is also a key element in the process of predicting or changing behaviors. Behavioral beliefs are the likely outcomes of the behavior being studied as well as the evaluations of these outcomes. They produce a favorable or unfavorable attitude in the individual toward the behavior (Ajzen, 2006). Attitudes have been shown to influence and predict behavior (Ajzen, 1991; Wilcock, et al., 2004). Therefore, in order for educators to plan and implement food safety curriculum, it is important to understand the consumers' attitudes towards food safety (Wilcock, et al., 2004). Normative beliefs are the beliefs about the expectation of others and the desire to comply with these expectations (Ajzen, 2006). These beliefs are based on the individual's perceived social pressure to perform or not to perform a certain behavior (Ajzen, 1991). The third type of belief included in this theory, control beliefs, is the individual's perceived behavioral control that impacts the performance of the behavior (Ajzen, 2006). This belief is assumed to take into account past experiences, perceived difficulty or ease and anticipated obstacles (Ajzen, 1991). The central factor to this theory is the individual's intention to perform a specific behavior (Ajzen, 1991,). When all three types of the beliefs described combines, an intention is formed (Ajzen, 2006). According to the theory an individual's intention to engage in a certain behavior directly influences the likelihood of that behavior occurring (Ajzen, 1991). This concept is largely due to the assumption an individual's intentions are indicators of motivational factors such as; how much effort they are willing to exert and how hard they are willing to try in order to perform a particular behavior (Ajzen, 1991).

This theory is consistent with other research findings suggesting intention is a strong predictor of behavior (Dedobelleer, Champagne, & Potvin, 1999). Lobb, Mazzocchi, and Traill (2006) used the theory to analyze behaviors associated with risky or health-related actions. Researchers have applied the theory to studies addressing smoking, risky driving, exercise and food choices (Lobb, et al., 2006). Shapiro, Porticella, Jiang, and Gravani (2011) found the theory of Planned Behavior to provide a useful framework for understanding the adoption of safe home food handling practices. During a 5-point Likert scale questionnaire, Shapiro et al., (2011) were better able to understand the gap between awareness, attitude and behavioral intentions. Ultimately, they found knowledge about potential risks and safe practices, behavioral control and social norms played an important role in regulating food handling. However, Shapiro et al., (2011) found knowledge and awareness alone will most likely not bring about change.

Though intention is not the same as behavioral change, it can be a strong driving force to action (Lohse, 2006). Understanding both beliefs and intentions through the theory of planned behavior can help researchers or implementers understand how to impact behavioral change. Which can add knowledge and awareness to interventions to bring about change, and the more favorable the attitude and subjective norm, and the greater the perceived control, the stronger the intention to perform the behavior (Ajzen, 1991). According to Rogers (2003), knowledge and awareness are seminal factors of adopting new ideas and implementing behavior change. Figure 2-1 depicts a conceptual model of how the theoretical framework of this study guided our research plan. It also shows how practitioners can help target improved poultry and egg safety behavior of youth by studying how their knowledge, beliefs, attitudes and intentions affect behavior.

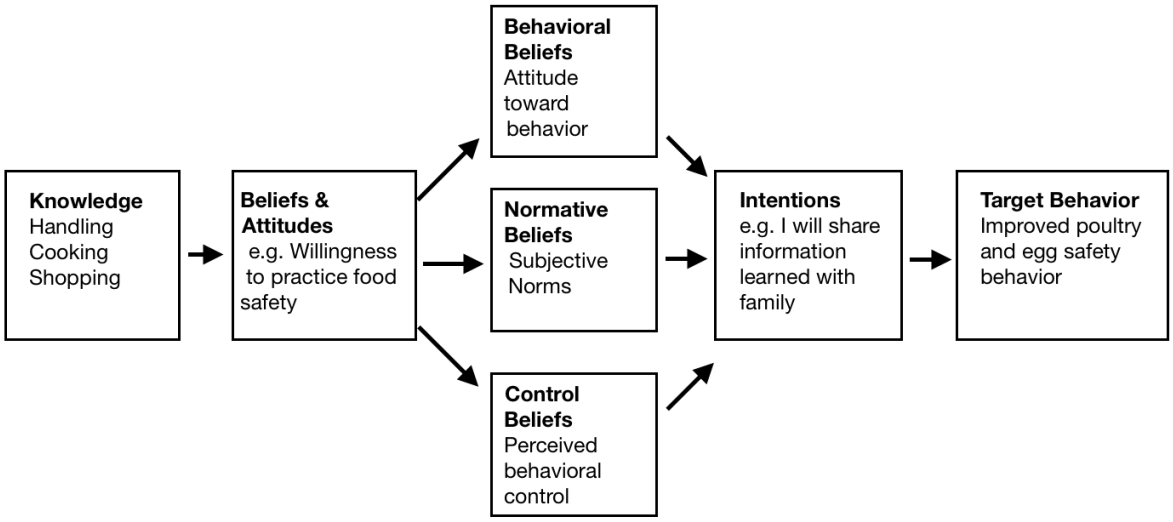

Figure 1. How youth's knowledge, beliefs attitudes and intentions affect behavior of poultry and egg safety practices: A conceptual model

Food safety experts report many Americans believe foodborne illness at home is not very common (Kosa, Cates, Bradley, Chambers & Godwin, 2015). However, approximately one-fifth

of all foodborne diseases in the United States could be attributed to poor food handling practices at home (Gould et al., 2013; Redmond & Griffith, 2003). Although food safety behaviors among consumers in the US typically seem to be improving over time, risky consumer practices are still very common (Hanson, Hughes, & Liu, 2015; Fein et al., 2011). Though most of what we know about consumer food safety practices are the results of self-reported surveys, it should be noted actual food handling practices often differ from self-reported practices (Jay, Cormar & Govenlock, 1999; Wilcock, Pun, Khanona, & Aung, 2004). However, the literature base indicates a strong lack of consumer knowledge or willingness to comply to food safety recommendations.

Lack of knowledge can be a major barrier preventing consumers from changing risky food practices. According to McIntosh, Christensen, and Acuff (1994), consumer knowledge is a major factor in willingness to change current practices. Simply making people aware of foodborne pathogens could play a significant role in reducing foodborne illness (Lin, Jensen, & Yen, 2004). Altekruse, Street, Fein, and Levy (1996) reported those who had heard of *Salmonella* were more likely to follow related food safety recommendations. According to a study of US consumers conducted by Lin et al. (2004), although the majority of participants had heard of *Salmonella* (94%) as a major concern in food safety, only 7% were aware of *Campylobacter*. Additionally, only half of the participants considered food contamination by microorganisms a serious food safety problem (Lin et al., 2004). Though knowledge alone does not automatically lead to safer consumer practices, it enables the consumer to reflect upon their risky practices.

Both knowledge and attitudes of food safety recommendations and practices are affected by various social, cultural, and economic demographics (Lando & Chen, 2012; Lin et al., 2005; Wilcock et al., 2004). Fein et al. (2011) reported younger consumers were more likely to consume risky foods. Additionally, Wilcock et al. (2004) noted many food safety habits and cultural preferences develop at an early age and can become deeply ingrained. Lin et al. (2004) concluded foodborne illnesses may be reduced by increasing both consumer awareness of foodborne pathogens and raising consumer motivation to use food safety information.

Because foodborne illness is a national health risk affecting all ages, it is imperative to include teaching youth at an early age about the risks associated with mishandling foods (Richards, Skolits, Burney, Pedigro, & Draughn, 2008). Middle school is an optimal time to teach food safety to youth because they are in the process of developing lifelong behaviors (Richards et al., 2008). In a research study designed to validate an interdisciplinary food safety curriculum for middle school students, Richards et al. (2008) reported a substantial gain in knowledge of food safety concepts after middle school students participated in a food safety curriculum. Additionally, the self-reported attitudes and behaviors of students increased from the post-test to the 6 month follow up test (Richards et al., 2008).

Guion, Simonne and Easton (2004) discovered food safety is a topic youth are interested in during their research study of Florida 4-H youth. Additionally, they reported a large majority of youth indicated they would attend educational programs about food safety (Guion et al., 2004). However, they noted nearly one third of the youth who participated in their study reported

they had not received information on food safety (Guion et al., 2004). Therefore, the need exists for a 4-H educational program on food safety (Guion et al., 2004). Additionally, research suggests the most effective food safety curriculum should be tailored towards changing the behaviors which are most likely to result in foodborne illnesses (Richards et al., 2008) as well as engaging and hands on (Guion et al., 2004).

Furthermore, this study focused on the impact of PEEP among youth, because Extension educators have long realized youth were more receptive than their parents to adopt new information and were more open to new ideas (Kress, 2014; VanHorn, Flanagan, & Thomson, 1998). Because 4-H reaches so many youth in early adolescence, it has the opportunity to significantly influence young people (Boyd, Herring & Briers, 1992).

Ladewig and Thomas (1987) reported that skills and attitudes [such as safe handling and use of poultry and eggs] formed during 4-H do carry into adulthood; and just as youth in the early 1900's lead community change by teaching their families new knowledge, youth today can make an impact by becoming the early adopters of science based knowledge (Kress, 2014) like the findings from our PEEP project. In this way, 4-H is a viable avenue for Cooperative Extension in developing young people to not only become competent adults, but to pave the way to change in their communities (Fox et al., 2003; Kress, 2014).

Purpose and Objectives

The purpose of this study was to gain a better understanding of how providing 4-H youth with poultry and egg safety messages from PEEP could help reduce instances of foodborne illness by examining youths' intentions of implementation of lessons learned during an educational workshop. The objectives of this study included:

1. Determine the major themes of poultry and egg safety developed from the research findings of the PEEP to be used in poultry and egg safety education for youth.
2. Describe pre and post-test knowledge in poultry and egg safety as a result of a one-hour educational workshop at a 4-H youth camp.
3. Describe participants' perceptions, attitudes and intentions regarding proper poultry and egg food safety behaviors.

Methods and Procedures

Our study used mixed methods, content analysis in the first phase of this study, followed by a pre-test, educational intervention, post-test and post-test only survey tool among a convenience sample of 4-H youth.

Content analysis is a research methodology, which seeks to identify and evaluate themes to better understand their meaning (Krippendorff, 2013). By using this method, a large amount of information can be organized into major themes. Three goals were identified in order to complete the content analysis. These goals included:

1. Read and analyze all published findings to date from the USDA-NIFA-AFRI-funded PEEP project being conducted by Tennessee State University, Kansas State University, and Research Triangle International.
2. Identify egg and poultry food safety themes and messages and assign weight to themes based on frequencies of these themes and messages within PEEP research.
3. Determine areas of focus for PEEP lesson/curriculum development.

For goal one, we critically reviewed and analyzed findings in 22 articles, posters and research presentations coming from our USDA-NIFA-AFRI PEEP project. To complete goal two, we used a frequency system (Stemler, 2001) based on keywords, to identify poultry and egg food safety themes in the aforementioned sources. Additionally, within each theme, more detailed sub themes were identified. Each theme mentioned was counted as one frequency per source. A total number of sources mentioning each theme was established.

Themes and subthemes were labeled with a keyword written on sticky notes to bookmark them in articles. A sticky note with a number was also placed on each article, poster or presentation to give it a case number. Excel was used to input themes or subthemes addressed in each source. For goal three of the content analysis, frequency scores were used to determine which messages and themes were of the highest concern. The subthemes with the highest frequency scores under each major theme were labeled as crucial areas of improvement.

Once the content analysis was complete and themes were identified, the results were brought before a panel of experts and scientists who conducted the studies under investigation for verification. Themes and subthemes were used to create the workshop on poultry and egg food safety that was disseminated to participants.

Objectives two and three were accomplished with a survey research design. A one-hour workshop for middle school aged 4-H youth at select locations around Tennessee was conducted on the poultry and egg food safety themes. The tone of the workshop was informal and casual, and allowed for group discussion.

The population was 4-H youth who attended 4-H summer camps and day camps in 2016. The goal was to obtain a criterion sample of youth in grades four through six, from each of the three regions of Tennessee. A total of 190 youth completed a pre-test and post-test questionnaire of poultry and egg food safety knowledge, participated in the one-hour workshop, and completed a posttest only questionnaire measuring perceptions, attitudes and intentions regarding proper poultry and egg food safety behaviors. Only participants who completed all three parts were analyzed.

An email was sent to Extension 4-H agents conducting 4-H camps in every region in May of 2016. A second email was sent two weeks after the first email to agents whom had not responded. Once an agent responded and agreed to the researcher administering the workshop at camp, parent consent forms were sent to the agents who also collected them for us. At the conclusion of each workshop, surveys and consent forms were collected and assigned a code representing each participant.

In order to measure the changes in food safety knowledge, a pre-test/post-test questionnaire with twelve items, including multiple choice and true/false questions, were administered to reflect the major themes (handling, cooking, and shopping) of PEEP identified in the content analysis. These items were validated by two experts in food science, and administered at the beginning of the workshop and then immediately after. It is important to note that the short time between the pre and post-test could be a threat to the internal validity of the content assessment.

An eighteen-item post workshop survey, with scale reliabilities from (α = .73 to .88), was administered at the conclusion of the workshops to identify youths' attitudes (α = .83), intentions (α = .88), and perceptions (α = .73) of the information learned during the workshop. The survey items included general statements about the effectiveness of the workshop as well as content specific intention statements relating to the themes of the content analysis. The survey was created using a 5-point summated rating scale of agreement (Vagias, 2006) with the options, strongly agree, agree, neither agree nor disagree, disagree and strongly disagree.

Questionnaires were graded and scored by hand. For each individual question in the pre-test questionnaire and post-test questionnaire, the number one was entered if the participant correctly answered the question and a zero was entered if the question was answered incorrectly. Data from the Excel document was imported into a file using Statistical Package for Social Sciences (SPSS) version 18.0 for Windows. A paired samples t-test was completed to compare pre-test and post-test knowledge scores. Cohen's Interpretation of Effect Size (Cohen, 1988) was used to determine significant differences in means of scores for each individual question as well as the questionnaire as a whole. Significance was set at $p < 0.05$ and Cohen's interpretation of effect size intervals were used to interpret *d*, 0.2 = small, 0.5 = medium, 0.8 = large.

For the post-test only surveys of perceptions, attitudes, and intentions, the following rating scale was implemented. Strongly agree=5, Agree=4, Neither agree nor disagree=3, Disagree=2, and Strongly disagree=1. The mean, standard deviation, and frequency of each item was calculated. For reporting purposes, frequency and percent scores for agree and strongly agree were added together to create a total agree score. Likewise, disagree and strongly disagree responses were added together to create a total disagree score.

An Analysis of Variance (ANOVA) test was used to determine if there was a significant difference between knowledge, perceptions, attitudes and intentions among different state regions represented by youth at the workshops. There were no geographic differences for knowledge, $F(3, 186)=1.84$, $p < .05$ or perceptions, attitudes and intention, $F(3, 185) = 2.13$, $p < .05$. Therefore we can surmise that the sample was representative of the population because there were no differences based on geography. It should also be noted that 4-Hers are historically a very homogenous group and we did not expect to see differences between them.

Results/Findings

In the content analysis of PEEP research, a total of 22 articles, posters and presentations of the PEEP were analyzed. Based on frequency scores, three major themes were identified.

These themes were handling and storage behaviors (f = 36); cooking behaviors (f = 25); and shopping behaviors (f = 26). Each major theme was then separated into sub themes. For handling and storage behaviors, three sub themes were created: cross contamination (f=13); storage of poultry and eggs at home (f = 11); and washing and sanitizer use (f = 12). The cooking behaviors theme was separated into four subthemes. The highest scoring sub theme in this category was identified as thermometers and food temperatures (f = 11). The subthemes for cooking behaviors are visual cues for doneness (f = 8); runny, undercooked or raw eggs (f = 5); and thawing (f = 1). The shopping behaviors theme was separated into four sub themes as well. They are separating poultry from other foods when shopping (f = 10); utilizing grocery store meat plastic bags (f = 7); purchasing eggs (f = 4); and hand sanitizers at grocery stores (f = 5)

To complete goal three of the content analysis, subthemes with the highest frequency scores were identified. Under the handling and storage behaviors theme, the subtheme with the highest frequency score was cross contamination (f = 13). The other two subthemes, storage of poultry and eggs at home (f = 11) and hand washing and sanitizer use (f = 12) were very close behind cross contamination. The subtheme with the highest frequency score under cooking behaviors was thermometer use and food temperatures (f = 11). The subtheme with the highest frequency score under shopping behaviors was separating poultry from other foods when shopping in the grocery store (f = 10). Table 1 summarizes themes and subthemes identified in the content analysis and the corresponding sources in which the themes were found.

A paired-sample t-test was conducted to compare 4-H members' knowledge of poultry and egg safety before the workshop and after the workshop. A total of (n = 190) youth completed both the pre-test and post-test questionnaires. Table 2 summarizes pre-test and post-test scores of the youth who participated in the study. There was a significant difference in the overall pre-test scores for poultry and egg safety knowledge before the workshop (M = 6.61, SD = 1.74) and overall posttest scores (M = 10.46, SD = 1.65); $t(189) = -24.61$, $p < .001$. The effect size for the difference was large, Cohen's d = 2.21 (Table 3). In Table 3, there is a summary of the percent correct and incorrect responses for knowledge by sub-theme. Change in percent of correct responses from before to after the workshop is also presented.

For the handling theme, there was a significant difference in pre-test (M = 3.38, SD = 1.03), and post-test (M = 4.57, SD = .73) knowledge scores, $t(189) = -14.682$, $p < .01$. The effect size was large, Cohen's d = 1.15, indicating an increase in knowledge on handling practices. For the cooking theme, there was a significant difference in pre-test (M = 1.58, SD = 1.06) and post-test (M = 3.97, SD = 1.10) knowledge scores, $t(189) = -23.440$, $p < .001$. The effect size was very large, Cohen's d = 2.25. There were five questions relating to the cooking theme. For the shopping theme, there was a significant difference in pre-test (M = 1.66, SD = .58) and post-test (M = 1.90, SD = .33) knowledge scores, $t(189) = -5.399$, $p < .001$. The effect size was medium, Cohen's d = .41. There were two questions relating to the shopping theme.

Means and standard deviations were calculated to analyze the youth's responses to the post workshop survey describing perceptions, attitudes and intentions regarding the information they learned. Frequencies for objective three were calculated by adding agree and strongly agree

answers to create a total agree, and disagree and strongly disagree answers to create a total disagree (Table 4).

Table 1

Summary of Sources and Themes Identified in the Contents Analysis

Source	Source Type	H^1	H^2	H^3	C^1	C^2	C^3	C^4	S^1	S^2	S^3	S^4
Andrews (2014a)	News	1	1	1		1	1		1	1	1	1
Andrews (2014b)	News	1	1	1					1	1		
Chambers (2014)	Presentation		1	1	1				1	1		1
Chen, Godwin & Chambers (2016)	Article	1										
Chen et al. (2014)	Presentation	1							1	1		
Donelan et al. (2015)	Article	1	1						1	1		1
Freeman (2014)	News	1		1	1	1	1					1
Godwin & Cates (2015)	Presentation	1		1	1	1			1	1		
Godwin (2015)	Presentation	1	1	1					1			
Godwin (2014c)	Presentation				1	1						
Harding (2014)	Presentation	1		1	1	1	1					
Kilozo-Nthenge et al. (2016)	Article	1	1									
Koppel et al. (2016)	Article	1	1								1	
Koppel et al. (2014)	Presentation	1	1								1	
Kosa et al. (2015a)	Article		1	1	1	1	1				1	
Kosa et al. (2015b)	Article	1	1	1	1	1		1	1			
Kosa et al. (2014)	Presentation				1							
Kosa et al. (in-review)	Article				1							
Lafferty (2014)	Presentation								1			1
Maughan et al. (2015a)	Article			1	1							
Maughan et al. (2016)	Article		1	1	1	1	1					
Work (2014)	Presentation			1					1	1		
Total		**13**	**11**	**12**	**11**	**8**	**5**	**1**	**10**	**7**	**4**	**5**

Note. H1= cross contamination, H2= storage of poultry and eggs, H3= hand washing and sanitizer use, C1= thermometer use and food temps, C2= visual cues for doneness, C3= runny, undercooked and raw eggs, C4= thawing, S1= separating poultry and eggs at the grocery store, S2= grocery store meat bags, S3= purchasing eggs, and S4= hand sanitizer at the grocery store

Table 2

Summary of Means and Differences of Pre-test and Post-test Knowledge by Theme

Theme	Pre-test Knowledge *M (SD)*	Post-test Knowledge *M (SD)*	*t*	*df*	*p*	Cohen's *d*
Handling	3.38 (1.03)	4.57 (.73)	-14.682	189	.00	1.15
Cooking	1.58 (1.06)	3.97 (1.10)	-23.440	189	.00	2.25
Shopping	1.66 (.58)	1.90 (.33)	-5.399	189	.00	.41
Overall	6.61 (1.74)	10.46 (1.65)	-24.61	189	.00	2.21

Note. Handling (scale = 0 to 5), Cooking (scale = 0 to 5), Shopping (scale = 0 to 2); *Cohen's d*, Small (0.2), Medium (0.5), Large (0.8). $p < 0.05$.

Table 3

Pre-test and Post-test Knowledge of Poultry and Egg Safety (n = 190)

Item	Pre-test Knowledge %		Post-test Knowledge %		%
	Correct	Incorrect	Correct	Incorrect	Change
Length of time for hand-washing	47	53	93	6	46
Using soap	90	10	92	7	2
Hand-washing frequency	93	7	97	3	4
Shopping order	87	13	96	3	9
Bagging poultry at the store	78	22	93	6	15
Using a thermometer to ensure safety	67	33	95	5	28
Safe thawing	17	83	70	30	53
Time to cook after thawing	30	70	58	42	28
Internal cooking temperature of poultry	28	72	87	12	59
Home refrigerator settings	50	50	89	11	39
Temperatures where bacteria grows best	16	84	86	14	70
Properly storing poultry	59	41	84	15	25

Overall, youth demonstrated high intentions of practicing food safe poultry and egg behaviors. 89% of participants indicated they would remember to wash their hands before handling or preparing food. 81% agreed to wash their hands with soap for at least 20 seconds. 83% reported they were less likely to cause cross contamination by using the same plates or utensils for cooked and raw poultry. Participants also showed high intentions of sharing what they have learned with their family members (72%), as well as reminding them about certain safety procedures.

According to the findings, youth will help keep kitchen areas clean (73%, M =3.95, SD =1.02), remind family members to put away leftovers (74%, M = 3.97, SD = 0.96), remind family members of safe thawing procedures (74%, M = 4.03, SD = 1.02), and remind family members to use cooking thermometers (73%, M = 4.02, SD = 0.94).

Table 4

Youth Attitudes, Intentions, and Perceptions Regarding PEEP Recommendations

Item	Agree %	Neither %	Disagree %	*M*	*SD*
Attitudes about…					
This information is important to learn	82	9	5	4.20	0.98
How enjoyable learning the material was	74	14	8	4.03	1.04
Remembering where to store eggs and poultry	76	15	6	4.00	0.91
Not consuming raw or runny eggs	74	14	9	3.99	1.06
Practicing food safety procedures at home	66	23	8	3.83	0.91
Intentions to…					
Wash hands before handling or preparing food	89	5	3	4.34	0.74
Refrain from using the same plate or utensils for cooked poultry and raw poultry	83	9	5	4.16	0.9
Use soap and water for 20 seconds	81	12	4	4.15	0.95
Remind family not to thaw poultry on the kitchen counter or under hot water	74	17	4	4.03	1.02
Remind my family to use cooking thermometers to check for doneness	73	19	5	4.02	0.94
Remind family to put away leftover food within one hour	74	17	5	3.97	0.96
Help family keep kitchen area clean	73	17	6	3.95	1.02
Share information learned with family	72	20	5	3.91	0.92
Perceptions of…					
Importance of food safety at home	86	7	3	4.24	0.84
Properly washing hands	82	11	4	4.19	0.86
Safe internal temps for poultry/egg dishes	81	12	3	4.14	0.97
New knowledge about poultry and egg safety	83	6	5	4.09	1.14
Cross contamination and prevention	78	11	7	4.02	1.09
Total				**4.04**	**0.71**

Note: Agree = Agree + Strongly Agree; Disagree = Disagree + Strongly Disagree; 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree or Disagree, 4 = Agree, 5 = Strongly Agree.

Overall 83% of participants agreed they new knowledge about poultry and egg safety as a result of the workshop. Additionally, 86% of participants agreed they understood the importance of food safety at home. Furthermore, youth reported learning about food safety practices, such as, safe internal temperatures for poultry and egg dishes (81%), ways to prevent cross contamination (78%), and how to properly wash hands with soap and running water (82%).

Conclusions and Recommendations

Content analysis yielded themes representing poultry and egg food safety concepts that were taught to 4-H youth in Tennessee. The handling and storage behavior theme was the theme with the highest frequency score (f = 36). This theme was separated into three subthemes: cross

contamination, storage of poultry and eggs at home, and hand washing and sanitizer use. The cooking behaviors themes had a frequency score of 34 (f = 25) and included the subthemes: thermometer use and food temperature, visual cues for doneness, runny, undercooked or raw eggs, and thawing. The last theme identified in the content analysis was shopping behaviors, which included a breakdown of 4 subthemes: separating poultry from other foods, utilizing meat plastic bags, purchasing eggs, and hand sanitizer.

In our study using a one-hour workshop format, 4-H youth's basic knowledge of food safety concepts increased; youth perceptions to lessons learned in the workshop were very positive; participants reported they learned new things about poultry and egg safety; participants agreed it was important for youth to learn about poultry and egg safety; youth attitudes/beliefs after the workshop were very positive; youth were more willing to practice various food safety procedures, such as proper hand washing and proper food storage; youth were more willing to implement poultry and egg safety practices at home; and youth indicated they would share these practices with their family members.

These findings are important because the Theory of Planned Behavior suggests favorable attitudes and reported intentions often lead to desired targeted behavior (Ajzen, 1991), and Rogers' (2003) Diffusion of Innovation Theory touts the essential nature of awareness and knowledge. Therefore, it is reasonable to believe youth who participated in this study will implement poultry and egg safety practices learned now, and as they grow into adulthood. It is also reasonable to believe that a complete curriculum with lesson plans, videos, activities, and assessments would have an even greater impact than a one-hour workshop format. A complete curriculum developed for PEEP should include the following messages: prevent cross contamination at home by cleaning and hand washing; correctly store poultry and eggs at home; use thermometers correctly and adhere to recommended internal cooked temperatures for poultry and eggs; don't trust visual cues when checking for doneness of egg dishes; don't eat runny or undercooked eggs; separate poultry and other foods in shopping carts and bags at the grocery store; and use of plastic meat bags provided at the meat section for poultry products.

The following recommendations for further action and research were born from this study. Education in and about safe handling and use of poultry and poultry products should not only continue, but be improved upon and expanded. Educational materials to educate youth regarding themes should be further developed with the best of what is known about the principles of teaching and learning. Educational materials should also be developed for various age levels. This study should be replicated when more formal lesson plans and educational resources are finalized. Follow-up studies should utilize random selection and ensure that students have been exposed to respective lesson plans that were developed for each theme/subtheme. Participants and youth like them in replication studies should be studied with longitudinal and observational research to determine if their reported "planned behavior" is enacted. Parents and other members of the family and community in which youth live and move should be studied as well to determine changes in their knowledge, attitude, perception, intention, and ultimately behavior. Educators should be made aware of the science and be trained in content and the educational materials available that will help students with safe handling and use of poultry and poultry products.

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