



## Identification of Food Safety Education Needs for Military Veteran Farmers

### ABSTRACT

Most military veteran farmers engage in small-scale farming. They struggle to balance making a profit and handling food safety regulatory requirements. This study evaluated veteran farmers' food safety attitudes, knowledge, and practices and identified future food safety educational programming needs for this niche audience group. A total of 78 Indiana military veteran farmers completed the Web-based survey. Most veteran farmers who grew fruits and vegetables self-reported that they did not follow recommended on-farm food safety practices such as water testing, wildlife management, and farm food safety plan development because they lacked the knowledge to adopt these practices. Two major barriers to food safety education were identified: a lack of time to learn and an overwhelming amount of information. Veteran farmers preferred to receive food safety information through electronic newsletters and in-person workshops, and they preferred to attend educational events in person with small groups of veteran farmers or attend one-on-one mentoring sessions. This research represents a pilot

study to assess the needs and barriers of military veteran farmers in food safety education. These findings provide preliminary guidance for educators and government agencies in the development of food safety education programs for military veteran farmers.

### INTRODUCTION

Foodborne illness has gained increasing attention as a major public health issue in the United States. The Centers for Disease Control and Prevention estimates that approximately 48 million Americans contract foodborne illnesses annually, including 128,000 hospitalizations and 3,000 deaths (31). In response to consistent food safety concerns, the Food Safety Modernization Act (FSMA) was signed into law in 2011 to create a new food safety system to reduce foodborne illnesses (42).

As an essential segment in the food system, farmers share the responsibilities of ensuring food safety in the supply chain. However, increasing regulatory requirements generate many challenges for farmers that limit their ability to implement food safety practices, including high compliance

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costs, lack of labor, lack of time, and extensive documentation processes and audits (4, 15, 22). Because many retailers and foodservice buyers require farmers to provide certification confirming their adoption of on-farm food safety practices (4, 37), small-scale farmers are particularly struggling to both make a profit and meet these regulatory requirements (6, 11). Moreover, to increase profits, farmers have been involved in producing value-added food products (2, 12). Those further processing activities trigger additional regulatory requirements for operations that prepare foods for human consumption. To reduce the compliance-cost burdens for small-scale farmers or producers (such as licensing and inspections), the cottage food law was passed in Indiana. Similar to those in many other states, this law exempts those who produce low-risk food products in home kitchens and sell their products at farmers' markets or roadside stands from the additional regulatory requirements. However, these producers must still meet certain requirements, such as labeling and packaging requirements. Limited studies have investigated farmers' understanding of the cottage food law.

More than 7,000 farms are operated by military veterans in Indiana. Most of these are small-scale farms with less than 180 acres and, approximately 75% of the farms have agriculture product sales of less than \$50,000 (41). Military veterans may experience physical or psychological trauma after returning from deployment. Farming has been reported to both improve veterans' mental health and provide opportunities for veterans to adjust to civilian life (34, 44). The number of education programs for veteran farmers has grown since 2007 (10); these programs help to address veteran farmers' needs regarding farming techniques, regulations, and sustainability. However, none of the programs focused on food safety, and the effectiveness of those programs has rarely been evaluated.

Proper food safety education can strengthen farmers' food safety knowledge and enhance the implementation of food safety practices. Various education intervention formats have been evaluated among farmers, including in-person workshops (23, 38) and videos (20). However, few studies investigated veteran farmers' unique preferences on food safety education. Therefore, the objectives of this study were to assess veteran farmers' food safety attitudes, knowledge, and practices and to identify their barriers to and needs in food safety education.

## MATERIALS AND METHODS

### Needs assessment survey development and distribution

A needs assessment survey was developed to evaluate military veteran farmers' food safety attitudes, knowledge, and practices and to identify their needs for future food safety education. The survey included knowledge questions regarding Indiana cottage food law adapted from online quizzes from the North Central Region Center (24); knowledge questions developed by the authors based on the FSMA produce safety rule (PSR) (43) and poultry- and

egg-handling food safety guidelines; on-farm food safety practice questions adapted from a previous study (1); food safety attitude questions; future food safety education needs questions; and military background questions. The developed survey questions were reviewed by two food safety experts for content validity. Four veteran farmers were recruited via the Farmer Veteran Coalition Chapter of Indiana (FVC-I) email list to participate in a 2h focus group to pilot test the survey at the Marion County Extension Office in Indianapolis. The focus group was audio-recorded with the permission of participants. The survey was refined based on the feedback of the focus group participants. The final needs assessment survey contained 89 questions that took an average of 15 min to complete.

Two rounds of survey data were collected using Qualtrics (Provo, UT). The first round of survey data was collected between January and March 2019, and the second round of survey data was collected between February to April 2021. A recruitment flyer was distributed to Indiana veteran farmers via the FVC-I email list and was posted on FVC-I's social media account. Only Indiana military veteran farmers who were 18 years and older were included in this study. The data of second-round survey participants who completed the survey in 2019 were excluded from further data analysis. This research protocol (1810021180) was approved by the Institutional Review Board at Purdue University.

### Data analysis

Web-based survey data were exported from Qualtrics and was imported into IBM SPSS Statistics (version 26, SPSS Inc., Chicago, IL) for further data analysis. A related-samples Wilcoxon-signed rank test was used to determine whether the differences in attitude toward different food safety statements were statistically significant and whether the differences in the comfort level for veteran farmers to attend various events were statistically significant. The statistical difference was determined at the statistical level of 0.05.

## RESULTS AND DISCUSSION

### Demographic characteristics

Seventy-eight Indiana military veteran farmers completed the Web-based needs assessment survey. *Table 1* presents participants' demographic characteristics and farming backgrounds. Most survey participants were male (82%), married (72%), aged 39 and above (71%), and Caucasian (82%), with a bachelor's degree and above (60%). Because of the difficulties of recruiting survey participants, the distribution of age and product grown by the participants did not mirror data from the 2017 U.S. Census of Agriculture (41), which reported more than 30% Indiana veteran farmers were older than 74 years old and 80% grew oilseed, grain, hay, and beef cattle, whereas in the present study, only 3% of participants were older than 74 years old and they primarily grew vegetables, fruits, eggs, and poultry.

**TABLE 1. Demographic characteristics and farming backgrounds of participants**

Characteristic of participants ( <i>n</i> = 78)	Survey, % ( <i>n</i> )
<b>Gender</b>	
Female	15 (12)
Male	82 (64)
Prefer not to answer	3 (2)
<b>Age (yr)</b>	
24–38	29 (23)
39–53	51 (40)
54–74	17 (13)
Above 74	3 (2)
<b>Education level</b>	
High school/GED	18 (14)
Associate's degree	21 (16)
Bachelor's degree	32 (25)
Post-bachelor's degree	28 (22)
Prefer not to answer	1 (1)
<b>Ethnicity</b>	
Caucasian	82 (64)
Hispanic	4 (3)
African American	1 (1)
<b>Other</b>	
Marital status	
Married	72 (56)
Single	20 (16)
Prefer not to answer	8 (6)
<b>Farming experience (yr)</b>	
I am thinking of farming but have not started	32 (25)
Less than 1 yr	9 (7)
1–3 yr	22 (17)
4–6 yr	17 (13)
7–9 yr	3 (3)
10 yr or more	17 (13)
<b>Farm type (check all that apply) (<i>n</i> = 53)<sup>1</sup></b>	
Conventional	40 (21)
Organic practices, not certified	72 (38)
Certified organic	4 (2)

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**TABLE 1. Demographic characteristics and farming backgrounds of participants (cont.)**

Characteristic of participants ( <i>n</i> = 78)	Survey, % ( <i>n</i> )
<b>Products grown/raised (check all that apply) (<i>n</i> = 53)<sup>1</sup></b>	
Eggs	53 (28)
Vegetables	47 (25)
Fruits	38 (20)
Poultry	36 (19)
Goats and sheep	19 (10)
Hogs	17 (9)
Corn	15 (8)
Beef cattle	13 (7)
Others	38 (20)
<b>Products plan to grow/raise (check all that apply) (<i>n</i> = 25)<sup>2</sup></b>	
Vegetables	64 (16)
Eggs	56 (14)
Fruits	48 (12)
Poultry	32 (8)
Bees	24 (6)
Beef cattle	16 (4)
Goats and sheep	12 (3)
Others	28 (7)
<b>Annual sale of fruits and vegetables (<i>n</i> = 33)<sup>3</sup></b>	
Less than \$25,000	82 (27)
\$25,001–\$250,000	6 (2)
Prefer not to answer	12 (4)
<b>Prior food safety training experience (<i>n</i> = 53)<sup>1</sup></b>	
Yes	30 (16)
No	70 (37)

<sup>1</sup>Answered by farmers with farming experience (*n* = 53).

<sup>2</sup>Answered by farmers who plan to farm (*n* = 25).

<sup>3</sup>Answered by current fruit and vegetable farmers (*n* = 33).

Most participants (68%) had at least 1 year of farming experiences. Among those who were farming, 72% of participants reported that they were following noncertified organic practices and 40% of them were running a conventional farm. Eggs, vegetables, fruits, and poultry were the major products that were grown or raised by the participants who were farming; these were also identified as the major products to be grown or raised by participants who were planning to farm. More than 80% of participants who grew fruits and vegetables ran a very small-scale farm with \$25,000 or less in annual produce sales. In the present study,

only 30% of participants who were farming reported that they had prior food safety training experience.

#### Attitude toward food safety

Veteran farmers were aware of the importance of food safety. *Table 2* presents the mean scores of participants' attitudes toward food safety. Participants mostly believed that it was essential to obtain food safety information from reputable sources ( $M = 4.79$ , standard deviation [SD] = 0.52). Many participants agreed that they needed to be knowledgeable about food safety ( $M = 4.39$ , SD = 0.81)

**TABLE 2. Participants' attitudes toward food safety and their self-reported comfort level for attending in-person events**

Statement	Survey (mean score ± SD)
<b>Attitude toward food safety (strongly disagree = 1, strongly agree = 5)</b>	<i>n</i> = 77
Getting information from reputable sources is important to you.	4.79 ± 0.52 <sup>a</sup>
Being knowledgeable in food safety is important to you.	4.39 ± 0.81 <sup>b</sup>
Food safety on your farm is a top priority for you.	4.13 ± 0.94 <sup>c</sup>
Outside inspections or third-party audits are an important aspect of food safety.	3.75 ± 0.91 <sup>d</sup>
<b>Self-reported comfort level (extremely uncomfortable = 1, extremely comfortable = 5)</b>	<i>n</i> = 75
Having one-on-one mentoring session	4.28 ± 0.94 <sup>a</sup>
Meeting with smaller groups of veteran farmers	4.23 ± 0.97 <sup>a</sup>
Meeting with smaller groups of nonveteran farmers	3.72 ± 1.12 <sup>b</sup>
Attending events with large crowds	3.11 ± 1.25 <sup>c</sup>

Note: Superscript <sup>a,b,c</sup> and <sup>d</sup> indicate that the difference between the mean scores on the statements is statistically significant at the significant level of 0.05.

and that food safety was a top priority on their farm ( $M = 4.13$ ,  $SD = 0.94$ ). This finding aligns with a study conducted among small- and medium-scale produce growers. Most participants of the study perceived that food safety was important to their farms, as well as to their customers (28).

Veteran farmers were slightly agreed that outside inspections or third-party audits were important to maintain food safety ( $M = 3.75$ ,  $SD = 0.91$ ). Previous studies indicated that most farmers did not trust third-party auditors to keep food safe (28) and only a small number had received third-party audits (3, 23). Many buyers, such as retailers and processors, require third-party audits, which increase the costs and workloads of the farmers to meet all audit criteria (4). Most veteran farmers in the United States are very small-scale farmers (41) who are already struggling to make a profit. They sell most of their products through direct-to-consumer channels, such as farmers' markets and roadside stands that do not require third-party audits (19). Thus, they are less likely to use and consider using third-party audits (3).

Most veteran farmers with farming experiences did not perceive food safety as a problem on their farms (81%, data not presented in the tables). Farmers believed that contamination mostly occurred at consumers' homes instead of on the farm (14). However, many sources can contribute to the contamination of agricultural commodities, including humans, soil, water, animals, and equipment and tools. Contamination can happen on the farm at any time: from growing to harvesting, packaging, and transportation. Many foodborne illness outbreaks have been linked to raw agricultural commodities traced back to farms. For example,

a romaine lettuce *Escherichia coli* outbreak was traced to agricultural water contamination on a farm (7). More education can help to raise veteran farmers' food safety risk perceptions.

#### Self-reported food safety practices

Most veteran farmers who grew fruits and vegetables failed to follow the recommended on-farm food safety practices (Table 3). The microbial quality of agricultural water is a critical component in ensuring produce safety because it can potentially carry pathogens and contaminate produce throughout production to postharvest handling (43). In the present study, only 24% of participants self-reported that they would collect water samples for safety testing such as a microbial test. Among those who did not test water samples, 46% reported that they did not know how to do so, whereas 30% perceived it was not necessary. Two possible reasons for this result were (i) the produce farms of most participants were exempted from the FSMA PSR, so they were less likely to be aware of the importance of water testing and might lack such knowledge, and (ii) very small-scale farmers tend to rely on natural rainwater during production (3) and commonly use municipal water on their farms (32), so water testing is not necessary for them. When asked whether they would take actions when their field was contaminated with dirty water, 94% of participants answered "no," with 61% indicating that they did not know how to take actions and 33% perceiving that it was not necessary. The common action reported by the participants that would take action (6%) was contacting authorized agencies such as the U.S. Environmental Protection Agency for instructions on the next step.

**TABLE 3. Self-reported food safety practices of fruits and vegetable growers**

Statement of participants ( <i>n</i> = 33)	Survey, % ( <i>n</i> )
<b>Collect water samples for safety testing (like microbial test)</b>	
Yes	24 (8)
No, I don't think it's necessary	30 (10)
No, I don't know how to do it	46 (15)
<b>Have actions when field is contaminated with dirty water</b>	
Yes	6 (2)
No, I don't think it's necessary	33 (11)
No, I don't know how to do it	61 (20)
<b>Have actions to prevent wild animals from entering the field</b>	
Yes	27 (9)
No, I don't think it's necessary	43 (14)
No, I don't know how to do it	30 (10)
<b>Use soil amendments</b>	
Yes	70 (23)
No	21 (7)
I do not know	9 (3)
<b>Soil amendments used<sup>2</sup></b>	
Physical materials, such as irrigation and wetting agents	0
Biological materials, such as manure, preconsumer vegetative waste, and yard trimmings	82 (19)
Chemical materials, such as chemical and synthetic fertilizers	9 (2)
Others	9 (2)
<b>Sanitize harvest containers before harvest</b>	
Yes	36 (12)
No	49 (16)
I do not know	15 (5)
<b>Have farm food safety plan</b>	
Yes	15 (5)
No	85 (28)
<b>Planning to make a food safety plan<sup>1</sup></b>	
I am planning on making one	32 (9)
I am working on creating one	7 (2)
I do not plan on making one, because I don't know how to make one	36 (10)
I do not plan on making one, because I don't think it's necessary	11 (3)
Others	14 (4)
<b>Intention to make a food safety plan after knowing how to make it<sup>1</sup></b>	
Yes	82 (23)
No	14 (4)
Prefer not to answer	4 (1)

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**TABLE 3. Self-reported food safety practices of fruits and vegetable growers (cont.)**

Statement of participants ( <i>n</i> = 33)	Survey, % ( <i>n</i> )
<b>Have third-party food safety inspections</b>	
Yes	6 (2)
No	94 (31)
<b>Keep written records for policies and procedures</b>	
Yes	18 (6)
No	79 (26)
I do not know	3 (1)
<b>Keep written records for water treatment methods</b>	
Yes	9 (3)
No	91 (30)
<b>Keep written records for water treatment monitoring results</b>	
Yes	9 (3)
No	91 (30)
<b>Keep written records for water testing results</b>	
Yes	21 (7)
No	79 (26)
<b>Keep written records for soil amendment application dates</b>	
Yes	21 (7)
No	73 (24)
I do not know	6 (2)
<b>Keep written records for soil amendment testing results</b>	
Yes	15 (5)
No	82 (27)
I do not know	3 (1)
<b>Keep written records for crop harvest dates</b>	
Yes	36 (12)
No	64 (21)
<b>Keep written records for crop testing results</b>	
Yes	12 (4)
No	88 (29)
<b>Keep written records for flooding</b>	
Yes	6 (2)
No	91 (30)
I do not know	3 (1)
<b>Keep written records for evidence of wild animals in the field</b>	
Yes	6 (2)
No	91 (30)
I do not know	3 (1)

<sup>1</sup>Answered by growers who did not have food safety plan (*n* = 28).

<sup>2</sup>Answered by growers who used soil amendments (*n* = 23).

Many participants self-reported that they did not take actions to prevent wild animals from entering the production field (73%). Among these participants, many believed it was not necessary to limit the access of wild animals. However, wild animals pose food safety risks to the farm because they may carry human pathogens and spread it onto the produce as they move around in the field. Therefore, it is critical to raise participants' awareness of controlling the wild animals from entering the field to prevent cross-contamination. Of participants who took actions (27%), the most common approach used to prevent wild animals was fencing. However, one concern from small-scale farmers is the cost of performing such preventive action. Ivey et al. (14) reported that 35% of growers perceived it was essential to prevent animals from entering the field by using barriers, but only 8% of them believed this preventive action was financially feasible. Additional financial support may be needed to facilitate veteran farmers in overcoming this challenge.

Most participants reported using soil amendments (70%) on their farms. This result aligns with the finding of a national survey among produce growers in the United States conducted by Adalja and Lichtenberg (1) that 66 to 67% of the farms that were classified as exempted or very small scale under the FSMA PSR used soil amendments. In the present study, most of those who used soil amendments indicated that they used biological materials (82%). However, further studies are needed to investigate whether they used biological soil amendments of animal origin and whether they would treat their soil amendments to ensure food safety.

As for harvest container sanitation, only 36% of participants indicated that they sanitized harvest containers before harvest. This percentage was lower than the finding in Hultberg et al.'s study (13), in which 84% of the small-scale vegetable growers in Minnesota sanitized their harvest containers before use.

Most participants did not have a farm food safety plan and did not maintain written records for food safety practices. In the present study, 85% of participants reported that they did not have a farm food safety plan. Among those without a food safety plan, 82% of them intended to create one for their farm if they knew how to make it. Only 6% of participants had third-party food safety inspections. A few participants maintained written records (6 to 36%). The main items that participants recorded were crop harvest dates (36%), water testing results (21%), and soil amendment application dates (21%). This trend is similar to the one reported in Adalja and Lichtenberg's study (1): that most PSR-exempted and very small-scale farms maintained the written records of crop harvest dates (72 to 74%), soil amendment application dates (43%), and water testing results (24 to 33%).

Although most of veteran farmers who grew fruits and vegetables had very small-scale farms that were exempted from FSMA PSR, it was still recommended that they adopt on-farm food safety practices to ensure the safety of their

products. In the present study, many participants indicated that they did not perform certain practices such as water testing, wildlife management, and food safety plan development because they did not know how to do so. Limited knowledge has been identified as one of the main barriers to adopting new farm practices (22, 30). In addition, a big portion of the participants perceived it was not necessary to perform these food safety practices, which might increase the risks of cross-contamination on produce. These findings suggest that there is an opportunity to develop and deliver effective food safety education to veteran farmers to enhance their food safety knowledge, risk perceptions, and practices.

### **Future food safety education needs for military veteran farmers**

Veteran farmers' current on-farm food safety knowledge was evaluated. Participants who grew fruits and vegetables and had heard of FSMA were asked questions about FSMA PSR. Participants had knowledge about sources and risks of cross-contamination on produce, but they lacked knowledge about the food safety regulations. Only 7% of participants knew that rarely consumed raw produce commodities were not covered by the FSMA PSR, and only 15% knew produce that was not a raw agricultural commodity was exempted. A lack of understanding of what produce had been covered by the regulations could lead to the confusion about the regulations among farmers. In addition, veteran farmers did not know about the labeling requirements for exempted farms, with only 48% of participants aware that exempted farms should include the name and address of their farm on the label for their produce. Even though most participants in the present study owned farms that were exempted from the FSMA PSR, they may still be subject to the labeling requirements (43). Without knowing these requirements, veteran farmers were at a higher risk of violating the regulations. In addition, veteran farmers lacked knowledge about the resources that were available to them. Only 48% of participants knew that the U.S. Food and Drug Administration offered a free food safety plan builder to assist farmers in developing their own food safety plan. These findings suggest that veteran farmers had a good grasp of the basic concepts of the cross-contamination but needed more information regarding the interpretation of the regulations and additional navigation on the available resources.

Veteran farmers who raised poultry and eggs answered the knowledge questions on poultry and egg handling. They had knowledge regarding cleaning and sanitation on poultry farms, but they had limited knowledge about temperature control during poultry processing. For example, only 34% of participants knew that the poultry carcasses should be chilled to 40°F before packing. Reducing the temperature of the poultry carcasses after processing is critical to limit the growth of spoilage microorganisms and prevent the growth of pathogenic microorganisms (16). A lack of knowledge



about temperature control in poultry processing increases the concern of causing foodborne illness in consumers. This result shows that when developing future education materials for veteran farmers who raise poultry and eggs, the concept of temperature control should be emphasized.

To better develop food safety education programs for veteran farmers, their barriers and needs to food safety education were identified. *Table 4* presents recommendations for the development of future food safety education programs.

Veteran farmers were asked their needs in food safety information. They perceived a critical need for information on soil amendments (55%), agricultural water (54%), and postharvest handling and sanitation (50%). A recent review on produce growers' food safety education also showed that agricultural water and soil amendment topics were not well understood among growers (8); thus, educators and researchers should pay additional attention to these topics in the development of future education programs for veteran farmers.

### Barriers to food safety education

The top two barriers to food safety education among Indiana veteran farmers were (i) lack of time (45%) and (ii) an overwhelming amount of information (32%). Time is commonly identified as one of the major barriers for farmers to learn and adopt new practices because of intense farm production and lack of labor (8, 15, 25, 32, 38). Veteran farmers also perceived the current education information as overwhelming. There were two possible reasons. First, many veteran farmers run small-scale farms (41), and they face the twin challenges of making a profit and sustaining their businesses. Food safety was just one of many challenges. Therefore, they perceived food safety information as burdensome rather than helpful. Second, the one-size-fits-all model does not work well for veteran farmers. Most food safety education resources for farmers are generalized and standardized. However, some recommended practices are not applicable because of different farm situations, especially for small-scale veteran farmers who have diversified farms. This complaint revealed the demand for developing audience-targeted education materials for veteran farmers based on their farm scale and farm type.

### Preferred information delivery formats

The top two preferred delivery formats were electronic newsletters (59%) and in-person workshops (55%). Electronic newsletters are environmentally friendly and easy to use. Previous studies also revealed that Web-based handouts, such as electronic newsletters, are one of the preferred information delivery formats among farmers (26, 35). Veteran farmers appreciate how newsletters can be accessed at any time and at any location, allowing them to learn at their own pace. In-person workshops provide opportunities for veteran farmers to interact with their peers

and experts. This aligns with the findings of Ivey et al.'s study (14) that farmers preferred to communicate via in-person formats. In the present study, 88% of participants indicated that the preferred format for in-person workshops was the combination of lecture and hands-on demonstration. Compared with in-person workshops, online workshops allow veteran farmers to participate regardless of their physical location and availability to travel. However, online workshops were less preferred than in-person workshops among veteran farmers. There could be several reasons for this preference. First, unlike newsletters or recorded videos, the online workshops are not self-paced. Second, veteran farmers need to overcome many technical challenges, including internet bandwidth and software accessibility. Slow internet speed is a common challenge among farmers in the United States, especially those in rural areas (40). Third, online workshops cannot provide the same kind of experiential learning and peer-to-peer interactions for veteran farmers as in-person workshops. Some previous studies showed that experiential learning enhances learners' learning motivation and increases their knowledge retention (5, 17, 36). Peer-to-peer interactions allow learners to gain new knowledge and modify their existing thoughts and knowledge by asking and answering questions or debating with one another (18). These reasons also explain the different preferred time lengths of online and in-person workshops. Without experiential learning and peer-to-peer interactions, veteran farmers did not want to spend more than 1 h on online workshops, whereas they preferred in-person workshops to be 2 to 4 h.

Both physical and psychological factors, such as depression, anxiety, and posttraumatic stress disorder, increase the difficulty for military veterans to transition back to civilian life and participate in normal social activities (21, 39). Therefore, veteran farmers' preference for attending events should be considered when developing food safety educational interventions for this population. In the present study, more participants felt comfortable attending events in person (74%) than online (55%). When attending in-person events, most participants (58%) stated they could attend without a companion, whereas many (42%) preferred to be accompanied by their spouse. *Table 2* presents participants' self-reported comfort level for attending in-person events. They significantly felt more comfortable having a one-on-one mentoring session or meeting with smaller groups of veteran farmers than meeting with smaller groups of nonveteran farmers ( $P < 0.05$ ). They were least comfortable attending events with large crowds ( $P < 0.05$ ). This is common among people with other challenges. Feng et al. (9) found that vulnerable populations such as pregnant women and people with diabetes had better learning outcomes when they learned materials with a group of people like themselves.

**TABLE 4. Recommendations for future food safety education programs (n = 78)**

Statement of participants (n = 78)	Survey, % (n)
<b>Barriers limiting the learning of food safety (check all that apply)</b>	
Lack of time to learn	45 (35)
Overwhelming amount of information	32 (25)
Lack of education materials	26 (20)
I do not feel like the information applies to me	21 (16)
Too expensive to learn	17 (13)
I do not see food safety as a problem on my farm/business	15 (12)
The information does not appeal to me	10 (8)
The information is too complicated for me	6 (5)
<b>Preferred delivery formats (check all that apply)</b>	
Newsletters (electronic or by email)	59 (46)
In-person workshops	55 (43)
Online workshops or seminars	37 (29)
Newsletters by mail	27 (21)
<b>Preferred length for in-person workshops (n = 43)<sup>1</sup></b>	
30–45 min	14 (6)
1 h	19 (8)
2–4 h	56 (24)
Other	12 (5)
<b>Preferred format for in-person workshops (n = 43)<sup>1</sup></b>	
Combination of lecture and demonstration	88 (38)
Hands-on demonstration	12 (5)
Lecture	0
<b>Preferred length for online workshops (n = 29)<sup>2</sup></b>	
30–45 min	45 (13)
1 h	41 (12)
2–4 h	7 (2)
Other	7 (2)
<b>Preferred topics (check all that apply)</b>	
Soil amendments	55 (43)
Agriculture water	54 (42)
Postharvest handling and sanitation	50 (39)
Regulation and food safety guidelines	49 (38)
Meat processing/butchering food safety	45 (35)
Wildlife, domesticated animals, and land use	37 (29)
How to develop a farm food safety plan	37 (29)
Value-added produce	32 (25)
Worker health, hygiene, and training	19 (15)
Others	10 (8)

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**TABLE 4. Recommendations for future food safety education programs (n = 78) (cont.)**

Statement of participants (n = 78)	Survey, % (n)
<b>Feeling more comfortable attending events online</b>	
Yes	55 (43)
No	40 (31)
Not answered	5 (4)
<b>Feeling more comfortable attending events in person</b>	
Yes	74 (58)
No	21 (16)
Not answered	5 (4)
<b>Preferred companion when attending events (check all that apply)</b>	
I am okay if I am unaccompanied	58 (45)
A spouse	42 (33)
A friend	24 (19)
A family member	24 (19)
<b>Experience with the county extension office</b>	
Received advice from the county extension office	39 (30)
Did not received advice from the county extension office	61 (48)
<b>Topics consulted at the county extension office (check all that apply) (n = 30)<sup>3</sup></b>	
Law and regulation	50 (15)
Marketing	40 (12)
Pesticide use	40 (12)
Food safety	40 (12)
Others	37 (11)
<b>Reasons for not seeking advice from the county extension office (n = 48)<sup>4</sup></b>	
I'm not familiar with the extension system	37 (18)
I haven't had a question for them yet	19 (9)
I contacted the office but didn't receive useful advice	15 (7)
The office is too far from me	4 (2)
I don't know how to contact them	2 (1)
I don't have time/My schedule does not comply with their hours	4 (2)
Others	19 (9)
<b>Preferred food safety delivery formats from food safety educators (check all that apply)</b>	
On-farm visits	51 (40)
Video extension presentations	46 (36)
Extension publications for reading	31 (24)
Online discussion sessions	27 (21)
Others	6 (5)

<sup>1</sup>Answered by participants who selected in-person workshops (n = 43).

<sup>2</sup>Answered by participants who selected online workshops (n = 29).

<sup>3</sup>Answered by participants who received advice from the county extension office (n = 30).

<sup>4</sup>Answered by participants who did not received advice from the county extension office (n = 48).

## Recommendations for extension educators

Extension educators have a firm understanding of farmers' barriers to implementing food safety practices because they work closely with farmers (22). They help to fill the knowledge gap between farmers and complex regulations. In Pires et al.'s study (27), the extension agency was the preferred source of information among certified organic farmers. In the present study, 39% of participants received advice from the county extension agencies, and half of them consulted on topics related to law and regulations. Of those who did not seek advice (61%), most (37%) claimed that they were unfamiliar with the extension system, which limited their access to farming-related resources. Poor connection between the veteran farmers and the extension system suggests a need for educators to promote extension programs to reach a broader audience.

Most participants expected food safety educators to provide on-farm visits (51%) and offer more video-based extension presentations (46%). Previous studies showed that farmers preferred to learn from bite-size videos that focus only on one topic in every video (29, 33). Videos can be used to visualize and simplify the information, which helps to enhance veteran farmers' understanding of complicated on-farm food safety topics.

## Limitations

Veteran farmers are a niche audience group for food safety education. Obtaining a large sample size has been a challenge. Survey participants were only recruited online via an email list and social media post. Veteran farmers who had limited access to the internet might not be exposed to the survey. In addition, this study surveyed military veteran farmers in Indiana. Because of the geographical limitation, the findings of this study may not be generalizable to the larger population of veteran farmers nationally. Future studies can consider collecting data from military veteran farmers

nationwide and recruiting participants using a combination of online and offline (e.g., mailing or in-person veteran farmer events) approaches to minimize bias.

## CONCLUSIONS

This study assessed Indiana military veteran farmers' food safety attitudes, knowledge, and practices and identified future food safety educational programming needs for this niche audience group. The results showed that military veteran farmers were aware of the importance of food safety; however, their food safety knowledge and practices were limited. Food safety regulation navigation, including exemptions and covered products, should be emphasized in future education programs. Two major barriers perceived by veteran farmers to receiving food safety education were limited time and an overwhelming amount of information. Electronic newsletters and in-person workshops were the preferred food safety education formats. For in-person events, veteran farmers preferred to attend one-on-one mentoring sessions or meet with small groups of veteran farmers. These findings provide guidance for the development of future audience-targeted food safety education programs for military veteran farmers and other small-scale niche farmer groups.

## ACKNOWLEDGMENTS

We thank Cindy Chastain, Edward Sheldon, and Sara Creech from the Farmer Veteran Coalition Chapter of Indiana for recruiting participants and organizing the monthly learning circles and in-person workshops. This project was supported by U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture 2018-70020-28851, Hatch S1077-1016049 and 2020-70020-33029, USDA Agricultural Marketing Service Local Food Promotion Program AM180100XXXXG124, and Indiana State Department of Agriculture A337-19-SCBG-18-006.

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