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Assessing Health and Safety Concerns and Psychological Stressors Among Agricultural Workers in the US Midwest

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Abstract

Problem statement: There is limited research exploring agricultural workers' own perspectives on the relative importance of the hazards and stressors they experience. There is also lack of evidence on whether this reporting differs by method of elicitation. Finally, there exists very little research on how to improve mail survey response rates among agricultural workers.

Objectives: We examined health and safety concerns and psychological stressors among Midwestern farmers. We assessed whether these reports varied by survey mode (mail survey versus in-person survey). The efficacy of two different types of incentives to enhance mail survey response rates among agricultural workers was also investigated.

Methods: In 2018, a needs assessment survey was developed and mailed to a random sample of farm owner-operators in Iowa, Ohio and Missouri, with randomly assigned prepaid or promised monetary incentives. In-person surveys were conducted among farm owner-operators and hired workers at three regional farm shows in Iowa, Minnesota and Nebraska. Mail survey response rates were compared by incentive type. Content analysis was used to generate themes associated

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with health and safety concerns and psychological stressors, which were then ranked by frequency counts. Chi-square tests were used to analyze variation in the distribution of these themes by survey mode.

Findings: The response rate for the $1 prepaid incentive was double that of the $10 promised incentive. Content analysis identified 13 health and safety concerns and eight psychological stressors. Chemicals, equipment/tools and health outcomes were the most frequently noted health and safety concerns. Finances, climate/weather, and farm workload and management were the most frequently noted psychological stressors. Although there was considerable overlap in survey responses across mail and in-person respondents, important differences by sample and survey mode characteristics were observed.

Significance: The results can support a variety of stakeholders in prioritizing and developing interventions and educational resources to address health and safety concerns and psychological stressors among Midwestern farmers. Our findings also contribute to the evidence base on primary data collection methods for agricultural workers.

Keywords

Farmers; Health and safety; Needs assessment; Stressors; Survey incentives

Background

Agriculture is one of the most hazardous industries in the United States. According to the US Bureau of Labor Statistics (BLS), the fatal occupational injury rate in agriculture is seven times the pooled fatality rate of all other industries in the country (BLS, 2018). Contemporary farm environments regularly expose workers to unique combinations of physical, biological and chemical risks. These exposures are associated with respiratory diseases (Greskevitch et al., 2008; Hoppin et al., 2014), hearing loss (Gomez et al., 2001), livestock-related infectious diseases (Rautiainen and Reynolds, 2002), acute and chronic poisoning (Damalas and Koutroubas, 2016), skin disorders (Feldman et al., 2009; Vallejos et al., 2008), and musculoskeletal injuries (Weigel et al., 2014; Fethke et al., 2014). There is also a growing recognition of psychological hazards associated with working in agriculture. When compared with other populations, farmers report higher levels of depression and anxiety (Sanne et al., 2004) and have an increased risk of suicide (Ringgenberg et al., 2018). Substance abuse is another emergent concern: in a survey conducted by American Farm Bureau (Thornton and Jerome, 2017), 74% of farmers and farmworkers reported having been “directly impacted” by the opioid crisis, compared with 45% of other rural adults.

Existing research on health and safety risks in farming has mainly focused on the prevalence of specific diseases among the agricultural population. There has been limited work examining agricultural workers’ own perspectives on the relative importance of the hazards and stressors they experience. Although a few studies have investigated perceived needs among farm workers in the US, these have primarily focused on a small number of counties, narrow sub-groups of farmers (such as beginning, small-scale or migrant farmers) and, in some cases, exclusively on labor and safety needs (Dill et al., 2012; Sullivan, 2011; Kearney

et al., 2014; Anthony, Williams and Avery, 2008; Byler et al., 2013; Goodwin and Gouldthorpe, 2013; de Castro et al., 2014).

There is also wide variation in the methods used to elicit these concerns. Some studies have used in-person methods such as focus groups, interviews and telephone surveys (Sullivan, 2011; Anthony, Williams and Avery, 2008; Goodwin and Gouldthorpe, 2013; Kearney et al., 2014; de Castro et al., 2014), others have explored farmer needs via mail and web surveys (Dill et al., 2012; Lizer and Petrea, 2007; Byler et al., 2013). In light of previous findings on the salience of cultural attitudes toward health and health care access among rural residents (Spleen et al., 2014), it is unclear if the mode of eliciting these concerns leads to variation in the nature of identified needs. Although mail surveys are generally better able to ensure anonymity, these surveys have historically displayed lower response rates for all demographic groups, including farmers (Mangione, 2014; Pennings, Irwin and Good, 2002; Church, 1993). Several studies have demonstrated that the provision of prepaid (or up-front) monetary incentives is a crucial factor in improving response rates for mail surveys (relative to no incentives or promised/delayed incentives), with larger incentives leading to higher response rates (Jobber, Saunders and Mitchell, 2004; Pennings, Irwin and Good, 2002; Edwards et al., 2002; Singer et al., 1999; Church, 1993; James and Bolstein, 1992). However, this method can add significant cost to a project. At the same time, there have been few systematic attempts at examining differences in response rates by the size of monetary incentives included in prepaid and promised designs. Further, agricultural workers (especially farm owner-operators) typically operate on a different time scale than those in other industries – they take out a loan at the beginning of the year and wait for their "paycheck" until after harvest. Thus, relative to other populations, they may view a larger promised payment more favorably than a smaller prepaid incentive. To our knowledge, no previous study has examined the effect of prepaid and promised incentives (of varying monetary values) on mail survey response rates specifically among agricultural workers.

In this paper, we report the results of a needs assessment survey among agricultural workers in multiple Midwestern states, examining differences between two survey modes: mail and in-person methods. For mail survey respondents, we also compared the effectiveness of prepaid versus promised incentives in enhancing farm workers' willingness to participate in the study. We assessed open-ended survey responses using content analysis methods and ranked main categories of health and safety concerns and psychological stressors among surveyed farm workers. We also analyzed the distribution of these concerns by survey mode to examine whether concerns and stressors varied by method of elicitation.

Methods

Survey Instrument

A survey was developed to assess safety and health concerns of agricultural workers in the Midwestern US. Several agricultural health and safety specialists provided input on conceptualizing and developing survey questions. The final instrument contained two open-ended questions on health and safety concerns and psychological stressors: "What is your greatest health and safety concern on the farm?" and "Over the past year, what has caused you the most stress?" For health and safety concerns, respondents were asked to provide at

least three concerns ranked in order of importance. The survey also asked individuals to describe resources and current coping strategies to help address identified concerns and psychological stressors. Other questions included queries on past-year injuries, age, gender, location, years in farming, produce type, farming status, and social media use. The survey was pilot tested in-person by 10 agricultural workers in the region. Based on their feedback, some questions were modified and new questions were added. The final survey is available from the authors.

Sample

For the purposes of this study, an agricultural worker is defined a person who ever worked on a farm in at least a part-time capacity. This includes farm owner-operators and hired workers. During June-September 2018, the survey was administered to a sample of farm owner-operators via a mail method using a list of farm owner-operator addresses from a private vendor, and to a mixture of farm owner-operators and hired workers via an in-person method. This approach allowed the researchers to accomplish dual goals of comprehensively capturing health and safety concerns and stressors experienced by a wide range of agricultural workers while also investigating differences in responses between two types of survey modes.

For the mail survey, a list of residential addresses for 2,590 farm owners and/or operators residing in Iowa, Missouri and Ohio was purchased from a private vendor. This list was not restricted by farm size or commodity type. The surveys were mailed in two batches to account for farming seasonality. In Batch 1, surveys were mailed to 1,920 farm owner-operators during June and July 2018. We empirically tested response rates for two forms of monetary incentives in Batch 1: 1) a $1 prepaid incentive in the form of a one-dollar bill inserted within the mailing, and 2) a $10 promised incentive in the form of a check to be sent to the respondent upon receiving completed response to the survey request, where the details of this incentive were described in bold font in the cover letter attached to the survey. A total of 960 surveys were mailed under each incentive arm. Within each incentive arm, a total of 320 surveys were mailed in each of the three states. Thus, for Batch 1, in each state, half the respondents were randomized to receive the prepaid incentive and the other half received the promised incentive. A second and final batch of surveys was mailed to 670 additional farm owner-operators in the same three states in September 2018. In this batch, all surveyed individuals received a prepaid incentive of $1 within the mailing (i.e., there was only one incentive arm). In Batch 2, a total of 223 surveys were mailed in Iowa and Missouri and 224 surveys were mailed in Ohio.

In addition to mail surveys, and across the same time period, a purposive sample of a broad range of agricultural workers was recruited at farm shows to complete the surveys in-person. Farms shows are public events exhibiting equipment, animals, and sports and recreation associated with agriculture and animal husbandry. These shows typically host “Safety and Health Tents” where advocates provide outreach to farmers on preventing injury and illness on the farm. At three farm shows (*Minnesota Farm Fest*, Minnesota; *Farm Progress Show*, Iowa; and *Husker Harvest Days*, Nebraska), study staff first asked show participants whether they ever worked on a farm in at least a part-time capacity. If they responded “yes,” they

were invited to complete a paper copy of the same needs assessment survey sent in the mail. Participants who accepted this invitation then completed the survey and handed it back to the study staff. In the event a participant turned in an incomplete survey, study staff queried the participant whether they intentionally meant to skip the unanswered question(s) or if the question(s) was unclear. In case of the latter, clarification was provided by the staff, following which the participant had the opportunity to change their answer(s). In such cases, the staff reiterated that completing all questions was voluntary. Each respondent who completed the survey at a farm show was compensated with either a blank eight-GB flash drive or a pair of cold-weather gloves.

Analytical Strategy

For mail survey respondents, response rates were compared by state. For Batch 1, response rates were also compared by type of monetary incentive. Descriptive statistics were used to characterize the combined sample of mail and in-person survey respondents. Qualitative directed content analysis (Hsieh and Shannon, 2005) was used to code themes in the open-ended responses for the two questions on self-identified health and safety concerns and psychological stressors. Quantitative descriptive analyses were used to compare the distribution of the coded themes by survey mode. These steps are described as follows.

Step 1: Qualitative coding of open-ended question responses—The content analysis coding team was comprised of three researchers with backgrounds in program evaluation, health policy, and agricultural health and safety. The team used an iterative coding process to produce taxonomies of coded themes from survey responses. To begin, potential themes were deductively borrowed from existing literature on agricultural health and safety concerns as well as from results of a previous needs assessment analysis performed by the authors in 2014. This approach provided a generic frame to begin coding of the survey data. Using initial themes, team members independently reviewed the same randomly selected sample of 50 responses to the two open-ended questions and assigned descriptive labels to each response.

Using the constant comparison method, these labels were then sorted into emergent categories based on how various labels related to each other. Emergent categories were then organized and grouped into meaningful clusters or themes. Each team member independently coded responses and then the full team of three members met to check for agreement on these emergent categories and themes. At this stage, team members also decided if additional categories or themes were required to be designated. After coding and comparing the first sample of 50 responses, the team engaged in an iterative process of coding additional sets of randomly selected open-ended responses for both questions.

In the next step, preliminary categories and themes for both questions were discussed with three additional researchers (with backgrounds in agricultural safety, industrial hygiene and occupational medicine). Based on these discussions, the core team members again reviewed and sorted responses into identified topics to generate confirmed categories and themes. The full group of researchers met again to discuss and concur with final themes and the clustering of categories within each theme. Using this process, the researchers engaged in

approximately six rounds of coding samples of data and subsequent team discussions before ultimately reaching almost total consensus on the coding. Through this process, 13 themes associated with health and safety concerns and eight themes associated with psychological stressors were identified. A cluster of emergent categories comprising each theme was also identified.

Step 2: Quantitative analysis of coded themes—The coded health and safety concerns and psychological stressors were examined using Stata 15 (StataCorp LLC, College Station, TX). For both constructs, each emergent category derived from the content analysis was assigned a numerical value. Because respondents could note concerns and stressors aligning with multiple emergent categories, and because no respondent noted more than four discrete categories, four variables were created denoting these categories. (Note four variables were created for health and safety emergent categories and an additional four were created for psychological stressor emergent categories). Based on these coded categories, binary variables were created for the 13 health and safety concerns themes and eight psychological stressor themes, and respondents were assigned values (0=no, 1=yes) for each theme.

Because a respondent could report multiple themes under both constructs, two continuous variables were constructed that counted the total number of health and safety concerns and psychological stressors provided by each respondent. Continuous years in farming was categorized into three levels of farming experience: beginning (<10 years), experienced (10–30 years) and established (> 30 years).

Descriptive statistics were used to examine sample characteristics. Frequency tabulations of coded clusters of health and safety concerns and psychological stressors were analyzed. Chi-square statistics were used to determine significant associations between coded clusters and survey mode. An independent samples *t*-test was conducted to examine whether the average number of health and safety concerns and psychological stressors differed by survey mode.

Results

Table 1 presents the number of mail and in-person surveys received. It also describes the mail survey response rate by type of incentive and location. Of the 2,590 surveys mailed, 338 completed surveys were returned. The response rate for Batch 1 was approximately 12%. Those who received a prepaid incentive of $1 were twice as likely to return a completed survey than those who received a promised incentive of $10 (16% versus 8%). Despite being mailed close to harvest time in the region, the response rate for Batch 2 (where all individuals received a prepaid incentive of $1 in the mailing) was very similar to those receiving the $1 incentive in Batch 1.

In addition to the mail survey method, 202 surveys were completed in-person at three farm shows. While a majority of respondents at each farm show belonged to the state in which the event was held, a few individuals noted farming elsewhere. At *Minnesota Farm Fest*, four individuals in the sample stated that they farmed in states other than Minnesota: Iowa (N=1) and South Dakota (3). At *Farm Progress Show*, six individuals in the sample stated that they

farmed in states other than Iowa: Illinois (N=1), Indiana (1), Nebraska (1), Minnesota (2) and Michigan (1). At *Husker Harvest Days*, nine individuals in the sample stated that they farmed in states other than Nebraska: North Dakota (N=2), South Dakota (2), Kansas (4) and Colorado (1). Overall, the two survey approaches produced a study sample size of 540 agricultural workers.

Sample characteristics of mail and in-person survey participants are provided in Table 2. Overall, the mean age of agricultural workers in our sample was 59 years and about 10% of the respondents were female. Compared to in-person participants, mail survey respondents were on average 13 years older and were more likely to be male. Although 82% of mail survey respondents were farm owner-operators, only 52% of in-person respondents reported holding the same title. With regard to farming tenure, a greater percent of mail survey respondents (59%) were “experienced” relative to in-person respondents (45%). The mail respondents also reported “managing others on the farm” more frequently than in-person respondents (14% versus 5%). In contrast, a greater proportion of in-person respondents were “beginning” farmers and were more likely to work on the farm in part-time status. In general, a majority of the sample was engaged in grain and livestock farming. Overall, 15% of the full sample reported being injured in the previous year.

Health and Safety Concerns Themes

Of the 540 survey participants, 121 (22%) provided no response to the open-ended question on health and safety concerns. A majority of these missing responses were attributable to mail survey respondents. In particular, 223 (66%) mail survey respondents provided complete (i.e., not blank) answers to this question as compared to 196 (97%) in-person respondents. The data used in the content analysis for this construct was provided by 419 survey participants.

The qualitative coding process yielded 13 themes of health and safety concerns. A full description of these themes is presented in Table 3, including the emergent categories clustered under each theme. The survey permitted a respondent to describe concerns aligning with more than one theme (for instance, a respondent could report concerns under “chemicals” as well as “equipment/tools”). Thus, a total of 1,012 concerns were identified, yielding an average of 2.41 (SD = 0.86) concerns per respondent. The average (SD) number of health and safety concerns among mail survey respondents and among in-person respondents were 2.45 (0.92) and 2.37 (0.80). The difference was not statistically significant ($t = 0.96$; $df = 417$; $p = 0.34$).

Further, a respondent could report multiple emergent categories within a single theme. For example, a respondent could note “safety in handling chemicals” and “pesticide drift,” as two discrete emergent categories clustered under the same theme, “chemicals.” The frequency count of themes does not double-count individuals if their responses addressed multiple emergent categories within the same theme.

As shown in Table 3, concerns associated with farm chemicals and equipment/tools were the two most frequently coded health and safety concerns across all respondents (42% each). These were followed by health outcomes (36%), general farm safety (26%), livestock issues

(18%), roadway and tractor safety (17%), confined space safety (15%) and farm management (13%). The remaining themes (environment, falls and mobility, children on the farm, general health and aging) were noted by 10% or fewer respondents.

Next, the researchers examined whether the distribution of health and safety concerns varied by method of elicitation. For each of the 13 themes, a Chi-square test was performed to determine if type of survey mode (mail or in-person) was associated with the report of a particular health and safety concern. In general, there was considerable overlap among mail and in-person respondents on the most frequently identified health and safety concerns on the farm. There were few statistically significant differences in the choice of health and safety concerns by survey mode. In particular, relative to in-person respondents, a greater percent of mail survey respondents noted chemicals (47% vs. 37%; p=0.04), general health (10% vs. 2%; p=0.00), and aging (4% vs. 1%; p=0.03) as a concern. In contrast, relative to mail show respondents, a greater percent of in-person respondents noted general farm safety (31% vs. 22%; p=0.02), confined space entry (19% vs. 11%; p=0.02), and children on the farm (10% vs. 5%; p=0.04) as a concern. Within each group, concerns associated with chemicals, equipment/tools, and health outcomes remained the top three concerns.

For themes where statistically significant differences were noted, we examined the count of disaggregated categories by survey mode (see “Emergent Categories” in Table 3). For chemicals, mail survey respondents (as compared to in-person respondents) were more likely to note concerns associated with “health effects of using chemicals.” For general health, only mail survey respondents noted concerns associated with access to care and affordability of health insurance. For general farm safety, a greater number of in-person respondents reported “PPE [personal protective equipment] safety equipment” and “Non-PPE safety equipment” relative to mail survey respondents. Though there was no statistically significant difference between mail and in-person respondents in the likelihood of reporting the health outcomes concern, the disaggregated categories in Table 3 shows that mail survey respondents were more likely to note categories associated with “stress” and “behavioral health/depression” within this theme. Conversely, in-person respondents were more likely to note concerns associated with “respiratory issues.”

Psychological Stressors Themes

Complete responses to the open-ended question on psychological stressors were provided by 501 survey respondents (93%). Response rates were similar between the mail survey (92%) and the in-person respondents (94%).

The qualitative coding process identified eight themes of stressors. A complete listing of these themes is presented in Table 4, including the associated emergent categories comprising each theme. A total of 574 stressors were identified across respondents, yielding an average (SD) of 1.15 (0.48) stressors per respondent. Overall, the average (SD) number of stressors among mail survey respondents and among in-person respondents were 1.21 (0.52) and 1.05 (0.40) respectively and this difference was statistically significant (t = 3.62; df = 499; $p < 0.001$).

As depicted in Table 4, financial stressors were the most frequently reported psychological stressors (45%) among all surveyed agricultural workers. Within this theme, “markets/commodity prices” was the most frequently noted emergent category. Climate/weather was the second most frequently noted stressor (22%), followed by stressors grouped under the general theme of farm workload and management (16%). The remaining stressor themes (family/personal, farm-specific activities and equipment, health and safety, regulations and politics, and aging) were reported by fewer than 10% of respondents. Even though the open-ended questions queried about stressors broadly, most stressor themes were associated with farm-related issues.

For each of the eight themes, a Chi-square test was performed to determine if type of survey mode was associated with the report of a particular stressor. Similar to the health and safety concerns analysis, there was considerable overlap among key stressors irrespective of the survey mode. Statistically significant differences between survey modality were noted for the following stressor themes: climate/weather, workload and management, family/personal, and regulations and politics. Specifically, relative to in-person respondents, a greater percent of mail survey respondents reported climate/weather (27% vs. 13%; $p<0.001$) and regulations and politics (9% vs. 1%; $p<0.001$) as a stressor. On the other hand, relative to mail survey respondents, in-person respondents were more likely to note stressors associated with workload and management (23% vs. 12%; $p<0.001$) and family/personal themes (13% vs. 5%; $p<0.001$). Though only 6% of all respondents reported stressors associated with the theme of regulations and politics, it is important to note that almost all of these were exclusively provided by mail survey respondents (see “Emergent Categories” in Table 4). With regard to workload and management, stress associated with nature of agricultural work (workload, physical intensity and working in isolation) was more extensively reported by in-person survey respondents whereas mail survey respondents appeared to experience greater stress on account of shortage of trained labor and maintenance of employee relationships. Within family/personal stressor theme, only in-person respondents noted children/childcare. For both groups, stressors associated with financial, climate/weather, and workload and management comprised the top-three themes. For in-person respondents, the family/personal stressor theme replaced workload and management in the top-three stressor themes.

Discussion

Using two survey modes, this study explored responses of agricultural workers in the Midwestern region to two open-ended survey questions on (i) health and safety concerns on the farm and (ii) the nature of psychological stressors experienced in the past year.

The response rate for the mail survey ranged from 8% to 16% depending upon the type of monetary compensation provided to the survey population. Specifically, the response rate among those who received a prepaid one-dollar incentive was double the response rate than those who received a promised $10 incentive. Although systematic reviews examining response rate enhancing strategies have generally also found prepaid monetary incentives to be more effective than promised incentives (Edwards et al., 2007), it remains unclear if this relationship is moderated by the monetary value of the incentives. The results of this study contribute to the evidence base by finding that despite the lower monetary value ($1 versus

$10), the provision of a moderate prepaid incentive was associated with a higher response rate. Further, this study is also the first to examine the relationship between form of monetary compensation and mail survey response rate among the agricultural population. We find that the effectiveness of prepaid incentives (relative to promised incentives) can be generalized to farm owner-operators in the US Midwest as well.

Qualitative coding methods identified 13 themes of health and safety concerns on the farm and eight themes of psychological stressors. Chemicals, equipment/tools and health outcomes were the most frequently reported health and safety concerns among agricultural workers in this region. With regard to psychological stressors, financial issues were the most frequently reported theme across all respondents. Although commodity prices were potentially a constant stressor among agricultural workers, it is important to place this finding in the context of recent economic issues related to tariff conflicts between U.S and China. In part, as a consequence of this conflict, the per-bushel commodity prices for soybeans dropped 10% during the survey period in comparison to prices in 2017. Thus, it is possible that this downturn in particular was associated with a high frequency of “financial” concerns reported by this sample.

After financial concerns, participants identified climate/weather conditions as the next important stressor. With the exception of localized flashfloods, neither Iowa nor Missouri experienced substantial flooding during this survey period. However, the Ohio River flooded in February 2018. We examined drought data from the National Integrated Drought Information System (2019) during the survey period and found that although drought affected 3% of Ohio and 23% of Iowa, approximately 60% of Missouri was affected by drought (with 55–63% of land reported to be “abnormally dry” and about 7–17% in “moderate drought” stage). Survey responses aligned with severity differences. Though about 22% of Ohio farmers and 20% of Iowa farmers noted climate/weather conditions as a psychological stressor, about 40% of Missouri farmers noted this stressor.

Despite significant differences in the sample characteristics across mail and in-person survey respondents, there was considerable overlap in the distribution of health and safety concerns and psychological stressors across both groups. Most remaining differences in themes across mail and in-person respondents could be attributed to two aspects: sample characteristics and survey mode characteristics, discussed below.

A greater proportion of mail survey respondents were older, were farm owner-operators, and were also more likely to report concerns associated with emergent categories such as health exposure of chemicals, cost of health care access, shortage of labor, and aging. In contrast, in-person respondents, who were relatively younger and less experienced, were more likely to report concerns associated with children on the farm and childcare, workload and the physically intense nature of farming.

Differences across groups for certain themes and categories may also relate to unique features of each survey mode. For instance, it is possible that mail survey respondents more frequently noted health and safety concerns under the “stress” and “behavioral health/ depression” due to a greater degree of anonymity and time available when completing a mail

survey. We also found that for both health and safety concerns and psychological stressors, mail survey respondents reported a greater number of discrete themes on average, though the result was only statistically significant for psychological stressors. It is possible that in-person respondents were influenced by health and safety material on display at various farm show booths. Specifically, educational information on safety equipment (including respirators and hearing protection) and confined space entry was on display at all three farm shows, which may have increased the likelihood of identifying them as potential concerns.

The results of this study align with previously reported US farmer surveys. For instance, a cross-sectional analysis of 128 farmers in Eastern North Carolina also identified concerns relating to the weather, problems with machinery, market prices for crops/livestock, and health care costs as “very stressful” factors among farmers (Kearney et al., 2014). Similarly, a study investigating health and safety concerns among Hmong farmers found that handling and operating heavy machinery, heat and cold stress, and respiratory exposures were priority concerns noted by study participants (de Castro et al., 2014). This present study contributes to the literature by highlighting additional concerns and stressors experienced by this population, including those associated with chemicals, a variety of health outcomes (including behavioral health and depression) as well as family and personal factors. Further, it allowed for an in-depth examination of each of these broad themes through the analysis of associated emergent categories.

This study differs from previous investigations in that it provided respondents an open-ended field to note their concerns instead of a pre-determined list of options. Though this approach facilitated capturing rich qualitative data, it also may have led to a lower response rate if the survey question itself was confusing and participants required assistance when answering this question. One way to enhance question clarity in future studies is to use two separate questions on “health” and “safety” concerns (instead of one combined question). Future studies can use this evidence-based list of farmer concerns as preset options for closed-ended questions in their survey design. Finally, by conducting surveys at farm shows in addition to the mail method, the researchers were able to access to multiple subgroups of agricultural workers (e.g., hired workers, beginning and female farmers) that are difficult to access via a mail method or found in low frequencies among random samples of agricultural workers.

Although every attempt was made to design the study to maximize the generalizability of our findings, a variety of factors limit our ability to extrapolate findings across regions with similar agricultural operations. First, participants were limited to only a few states. Second, because mail survey response rates were below 20%, the concerns of those farm owner-operators who did not to respond to the survey may differ from participants in ways unknown to the researchers. However, similarities in responses seen between mailed an in-person surveys, even though the characteristics of participants differed, provides some validity that many of the findings on concerns and stressors are relevant across the Midwest. Another potential study limitation is the possibility that respondents interpreted the question on psychological stressors differently. While the intent of the question was to query the respondent on all possible stressors, the actual phrasing of the question may have led some respondents to note only one specific cause of stress (especially because the following

question asks them to then rate the level of stress caused by “this” stressor). Thus, the results on average number of stressors among agricultural workers should be interpreted with caution. Finally, we were also unable to disaggregate migrant/seasonal workers from resident, year-round workers.

Conclusion

The results of this study can support a variety of stakeholders, including extension agents, producer groups, and occupational health advocacy groups, in prioritizing and developing interventions and educational resources to address health and safety concerns and psychological stressors among agricultural workers in the region. In addition, we also expect our findings to contribute to the methodological evidence base on primary data collection techniques for agricultural workers in particular and rural residents in general.

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Highlights

- Chemicals, equipment/tools and health outcomes were the greatest perceived health and safety concerns among surveyed agricultural workers.
- Finances, climate/weather, and farm workload and management were the greatest perceived psychological stressors among surveyed agricultural workers.
- Among mail survey respondents, response rates for prepaid monetary incentives were double that of promised monetary incentives.
- There was considerable overlap in the pattern of survey response across mail and in-person respondents.
- In-person data collection facilitated access to underrepresented groups of agricultural workers.

Table 1:

Completed Mail and In-Person Surveys

Mail Surveys		
	Batch 1	**Batch 2**
	June-July 2018	September 2018
Total surveys mailed	1,920	670
Overall Response Rate	12% (N=228)	16% (N=110)
Response Rate by Incentive		
$1 prepaid incentive with survey ***(batch 1 denominator = 960; batch 2 denominator=670)***	16% (N=151)	16% (N=110)
$10 promised incentive after survey receipt ***(batch 1 denominator = 960)***	8% (N=77)	N/A
Response Rate by State		
Iowa ***(batch 1 denominator = 640; batch 2 denominator=223)***	16% (N=105)	20% (N=45)
Missouri ***(batch 1 denominator = 640; batch 2 denominator=223)***	10% (**N=64**)	13% (N=29)
Ohio ***(batch 1 denominator = 640; batch 2 denominator=224)***	9% (**N=59**)	16% (N=36)
In-person Surveys		
	Number of Surveys Completed	
Minnesota Farm Fest (MN)	80	
Farm Progress Show (IA)	37	
Husker Harvest Days (NE)	85	
Study Sample Size	540 (Mail: 338; In-person: 202)	

Table 2:

Sample Characteristics

	Overall	Mail Respondent	In-person Respondent
Age (SD)	59 (15)	64 (13)	51 (16)
Female (%)	10	3	20
Farm owner-operator (%)	71	82	52
Past-year Injury (%)	15	14	16
Farming Experience (%):			
Beginning	8	3	16
Experienced	54	59	45
Established	38	38	39
Type of Produce (%):			
Dairy	6	6	6
Livestock	54	53	55
Forage	27	33	17
Poultry	6	3	9
Grain	78	78	79
Farming Status:			
Full-time	60	64	55
Part-time	29	27	32
Manage others on farm	11	14	5
Have an off-farm job	25	24	27
N	540	338	202

Table 3:

Content Analysis of Health and Safety Concerns among Agricultural Workers

Themes	N[A]	%[B]	Emergent Categories[C]
1. Chemicals	178	42	Safety in handling (M:57 ; I:43), Effect of chemicals on health (M:11 ; I:3), Pesticide drift (M:5 ; I:1), How to use and store farm chemicals (M:4 ; I:1), “Chemicals” (M:31 ; I:26)
2. Equipment/Tools	175	42	Entanglement/rotating shaft hazards (M:15 ; I:27), Operating machinery (M:18 ; I:8), Injury from equipment (M:10 ; I:5), Equipment maintenance/old or faulty equipment (M:8 ; I:6), ATVs/ Snowmobiles (M:1 ; I:8), “Equipment” (M:52 ; I:35)
3. Health Outcomes	149	36	Respiratory issues (M:42 ; I:59); Noise and hearing loss(M:11 ; I:15); Stress(M:16 ; I:1); Cancer(M:9; I:1); Behavioral health/Depression(M: 6; I:1); Pain(M:2 ; I:3); Other chronic conditions (M:5 ; I:1); Acute Illnesses (M:1 ; I:5)
4. General Farm Safety	109	26	Farm accidents (M:26 ; I:27), Carelessness/distractions (M: 10; I:6), Trespassers and wild animals (M:7 ; I:3), Electrical concerns (M:3 ; I:7), PPE safety equipment (M:3 ; I:18), Non-PPE safety equipment (M:3 ; I:10),
5. Livestock	76	18	Safety while working with livestock (M:40 ; I:27), Animal health and transfer of animal illnesses to humans (M:4 ; I:4)
6. Roadway and Tractor Safety	71	17	Sharing the road with other drivers (M:12 ; I:11), Driving with machinery/overweight loads/loose bales (M:18 ; I:7), Old infrastructure (M:3 ; I:3), Lighting and marking of farm vehicles (M:0 ; I:6), Tractor run overs/rollovers (M:6 ; I:14)
7. Confined Space Safety	61	15	Physical tasks in grain bins (M:9 ; I:7), Grain loading and unloading (M:1 ; I:5), Grain bin equipment (M:1 ; I:4), Entrapment in grain bin (M:1 ; I:3), Manure pit safety (M:4 ; I:3), “Confined spaces” (M: 10; I:21)
8. Farm Management	53	13	Lack of experienced and reliable workers/need for training (M:7 ; I:10), Work load/physical intensity/ isolation (M:10 ; I:2), Emergency preparedness (M:2 ; I:3), Regulations (M:4 ; I:2), Information and awareness, Financial issues (M:15 ; I:4)
9. Environment	40	10	Pollution (M:6 ; I:4), Heat exposure (M:6 ; I:8), Water: flooding, lack of (M:2 ; I:3), Weather (M:8 ; I:3), Falling trees (M:1 ; I:0)
10. Falls and mobility	34	8	Non-grain bin related falls and slips, heavy lifting, “mobility” “cleaning gutters,” “ladders” (M:21 ; I:13)
11. Children on the farm	31	7	“child safety,” “small children on the farm,” “grandchildren around equipment” (M:11 ; I:21)
12. General health	26	6	“health” (M:5 ; I:4), Access to care/affordability of health insurance (M:17 ; I:0)
13. Aging	9	2	“my age,” “aging,” “age-related clumsiness” (M:8 ; I:1)

A. Indicates the frequency count of a particular theme.

B. Indicates proportion of respondents who reported concerns associated with the theme.

C. The frequency counts of each emergent category within a theme are also provided in parenthesis and disaggregated by number of mail (M) and in-person (I) respondents.

Table 4:

Content Analysis of Psychological Stressors among Agricultural Workers

Themes	N[A]	%[B]	Emergent Categories[C]
1. Financial	224	45	Markets/Commodity prices (M:106 ; I:55), Input cost (M:17 ; I:3), Health insurance cost (M:10 ; I:1), Maintenance cost (M:3 ; I:1), Production risks (M:2 , I:1), Product knowledge (M:1, I:0), “Financial,” “lack of income”, “unable to pay bills” (M:37 ; I:19)
2. Climate/ Weather	109	22	Drought/lack of rain (M:14 ; I:5), Flood/ too much rain (M:3 ; I:2), “Climate/weather,” “snow storms,” “cold,” heat” (M:70 ; I:18)
3.Workload and management	80	16	Work load/physical intensity/isolation (M:13 ; I:25); Time management (M:12 ; I:14); Shortage of labor/employee relationships (M:12 ; I:3); Communication (M:4 ; I:4)
4. Family/Personal	42	8	Children/childcare (M:0 ; I:10), Transition/succession (M:6; I:2), Health of family members (M:3 ; I:5), Death of family members (M:4 ; I:1), “Family,” “Personal,” “Pets” (M:4 ; I:8)
5. Farm specific activities and equipment	42	8	Livestock (M:15 ; I:5), Equipment (safety, operation, breakdown, aging, failure) (M:7 ; I:6), Chemicals (M:5; I:0), Grain bins (M:1, I:3)
6. Health and safety	38	8	Farm-related health & safety (M:9 ; I:6), Chronic diseases and pain (M:4 ; I:1), Mental health (M:2 ; I:1), “My health,” “Safety, “Get tired quickly,” “No energy” (M:11 ; I:4)
7. Regulations and Politics	29	6	New administration & policies (trade, tariffs, farm bill) (M:17 ; I:1), Regulations/compliance (M:6 ; I:0), Health insurance policies (M:1 ; I:0), “Politics,” “Policy” (M:6 ; I:1)
8. Aging	10	2	Aging parents/siblings (M:2 ; I:1), “Aging,” “I am too old,” “my aging body” (M:7 ; I:0)

A. Indicates the frequency count of a particular theme.

B. Indicates proportion of respondents who reported concerns associated with the theme.

C. The frequency counts of each emergent category within a theme are also provided in parenthesis and disaggregated by number of mail (M) and in-person (I) respondent