Workplace Safety Interventions for Commercial Fishermen of the Gulf

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ABSTRACT

Commercial fishing continues to have one of the highest rates of occupational fatalities compared with other work sectors in the United States. Attitudes/beliefs among Vietnamese shrimp fishermen of the Gulf of Mexico may influence behaviors that are risk factors for fatal and nonfatal injuries. The study employs a community trial with quasi-experimental pretest/posttest intervention design. An advisory group made up of key stakeholders including representatives from the US Coast Guard was assembled. A survey was designed using the Theory of Planned Behavior as the theoretical framework. Three community groups at port sites along the Texas/Louisiana Gulf Coasts were identified. Focus groups were convened at each site to select priority areas for risk intervention using training and awareness measures. Initial and follow-up surveys were administered pre-/post-interventions for each of the three community groups (2008, n = 217 completed surveys; 2012, n = 206 completed surveys). The follow-up survey was condensed and “intent to act” questions were added for the priority concerns identified (noise-induced hearing loss, machinery/winches, and fatigue). Statistically significant changes (P ranging from .000 to .042) were observed in selective attitude/belief responses for hearing/noise and fatigue. Intent to action or to adopt the intervention was high among all three groups of shrimp fishermen (hearing conservation, 82.4%; machinery/winch safety, 94.6%; fatigue awareness, 95.3%). Simple, yet culturally appropriate training and awareness measures in the form of visual and written safety messages favorably influence attitudes, beliefs, and behavioral intent related to priority risk factors identified by Vietnamese commercial shrimp fishermen along the Texas and Louisiana Gulf Coasts.

KEYWORDS

Gulf Coast; interventions; shrimp fishermen; Vietnamese; workplace safety behaviors

Introduction

Commercial fishing continues to be one of the most dangerous occupations in the United States. Casualties that occur in these jobs are often the result of a combination of human factors, machinery and equipment, and the environmental elements at sea. There has been a gradual decline in the annual number of commercial fishing deaths over the last two decades, but much of this progress has been regionally focused, such as in Alaska. Although the historically high rates of work-related fatalities in Alaska might be related, in part, to extreme northern environmental conditions, the fact that some Nordic countries with similar industrial make-up and extreme environmental conditions had notably lower occupational fatality rates suggested the existence of other contributing factors.

The progress that has occurred in Alaska has been attributed to a comprehensive and concerted effort in establishing surveillance systems to assess occupational hazards and collaboration with partners to develop and evaluate interventions. Despite progress, the US occupational fatality rate in the commercial fishing industry remains among the highest in the nation, 23 times higher in 2013 than the rate for all US workers. During the period 2000–2009, vessel disasters and falls overboard continued to be the main incidents contributing to this mortality. In this same time period, of total deaths with known fishery type, the largest percentage (47%) occurred while fishing for shellfish, and, among these, the highest number of deaths from falls overboard occurred in the Gulf of Mexico shrimp fishery.
Understandably and reasonably, given that vessel disasters and falls overboard account for the majority of deaths across the United States, much attention has been given to event/post-event factors such as personal flotation devices, immersion suits, life rafts, and electronic positioning beacons to reduce fatalities.\textsuperscript{1,4,5,8} Further, regulatory efforts beginning with the Commercial Fishing Vessel Safety Act of 1988 and, more recently, the Coast Guard Authorization Act of 2010 have provided for a variety of preparedness requirements in the event of an incident, including vessel dockside examinations and training for workers.\textsuperscript{9} However, the availability and proper use of these event/post-event tools is still influenced by behavioral decision-making factors.

Less is actually known of the variables related to occupational morbidity and nonfatal injuries in commercial fishing both in quantity and severity.\textsuperscript{10} On-deck dangers have been recognized as an important cause of fatal and nonfatal workplace injuries among Alaskan commercial fisherman, concluding the need for additional attention to worker safety on deck, particularly around deck machinery.\textsuperscript{11,12} In the absence of a more complete understanding of the severity of these on-deck incidents, it can be difficult to separate factors that may contribute to both nonfatal and fatal events.

Considering a traditional tiered approach to occupational health and safety intervention design, engineering measures, administrative and work practice controls, and personal protective equipment (PPE) are typically employed. The emergency-stop or E-stop system, used to stop a winch in the event of entanglement or other emergency, serves as an example of an engineering measure installed on commercial fishing vessels.\textsuperscript{13} The E-stop, when engaged, locks the winch in place, thereby limiting the extent of an entanglement. Retrofit kits have become commercially available;\textsuperscript{14} however, engineering measures may be expensive and impractical in some settings, particularly if hydraulic systems are dated and require more extensive replacement of a winch system in order to retrofit an E-stop (personal communication to author A.C. from C. Woodward). Administrative and work practice controls as well as use of PPE may also be hampered by behavioral obstacles and cost.

Risk factors for occupational morbidity and mortality vary by fishery. During 2000–2009, falls overboard caused 53% of the fatalities among shrimp fishermen in the Gulf of Mexico, with 22% caused by on-board injuries.\textsuperscript{15} During 2000–2011, 10% of the commercial fishing fatalities across the United States were due to on-board injuries such as machinery entanglements, occurring most often in the Gulf of Mexico.\textsuperscript{16} Of the 35 work-related injuries (8 of which were fatal) occurring in this time frame among the southern shrimp fleet and involving winches, 74% were in the Gulf of Mexico and nearly 50% off the coasts of Texas and Louisiana.

In this setting, the high cost of some engineering solutions might prevent their adoption. Crew members are to be discouraged from working alone on deck (a significant risk factor), combined with training to include procedures for stopping the winch in the event of an emergency and administering first aid for severe injuries.

There is considerable knowledge regarding measures that can be taken to improve safety on commercial fishing vessels.\textsuperscript{17} Yet, the application of these measures are largely a function of risk perception among fishermen and the education they receive to ready them for sea. In spite of high injury and fatality rates among commercial fishermen, safe work is often not given a high priority by these workers.\textsuperscript{18} The traditional concern by small fishing vessel enterprises over the added cost of safety is one explanation that has been offered. However, behavioral and psychological factors are also at play. Studies of commercial fishing have revealed that attitudes of fatalism and risk acceptance, along with risk perception, social norms, and cultural patterns, have negatively influenced the adoption of safe work practices. Additionally, adopting safety practices as well as altering behaviors may be a function of cultural factors unique to fishermen in select geographic areas such as the Vietnamese shrimpers of the Gulf Coast.\textsuperscript{19–21}

The current study focuses on the predominantly Vietnamese shrimp fishery of the Texas and Louisiana Gulf Coasts with the following objectives: (1) to characterize selective workplace factors
and behaviors that may contribute to morbidity and mortality among Gulf Coast shrimp fishermen (shrimpers) and (2) to utilize a community-based approach to planning, implementing, and evaluating prevention and education/awareness measures directed at priority workplace factors and behaviors as identified by stakeholders. The study employs a community trial with quasi-experimental pretest/posttest intervention design to address the question of whether simple, yet culturally appropriate training and awareness measures in the form of visual and written safety messages favorably influence attitudes, beliefs, and behavioral intent related to priority risk factors identified by Vietnamese commercial shrimp fishermen along the Texas and Louisiana Gulf Coasts.

Methods

The project team worked collaboratively with the United States Coast Guard (USCG) Marine Safety Unit in the Eighth District along with other partners such as Louisiana Agricultural Extension and the Area Health Education Center program. A project advisory group was established composed of representation from these groups as well as from the Vietnamese communities in target locations, including volunteers with marine industry and/or commercial fishing experience, otherwise recognized as opinion leaders. Support and participation from trusted members of the Vietnamese communities, USCG, and commercial fishing industry were essential to recruitment and participation in project activities.

Survey development and focus groups

A survey tool was developed building upon a prior questionnaire administered to Vietnamese fishermen at the Port of Galveston. Questions related to age, race/ethnicity, gender, language, school completion (demographic factors), role and duration in commercial fishing, usual crew size, physical demand and riskiness of job, ability to perform emergency procedures and familiarity with vessel policies, safety training, and average work days/ work hours (work-specific factors) were retained. Similarly styled questions were added concerning sleep/fatigue, hearing problems, work-related respiratory risks, and smoking.

Additional questions for the survey tool were designed to emphasize a number of potential outcomes associated with recognized risk factors in commercial fishing. These included traumatic injuries associated with machinery and equipment, falls overboard, back injuries, falls aboard vessel, traumatic eye injuries and ocular exposure to ultraviolet radiation, hearing loss, breathing hazards, skin cancer, and injuries related to fatigue. The Theory of Planned Behavior (TPB) was used as a framework. Therefore, groups of questions assessed behavioral, normative, and control beliefs as well as intention for each of these priority injury/illness risk areas associated with the commercial fishing trades, using a 6-point scale. For each outcome category, one to two questions to assess each of the belief types were developed based upon potentially contributing factors. For example, questions to assess normative beliefs were designed for the potential influence of the opinions of family members versus vessel captains. For each category of risk, as, for example, machinery, there were approximately six questions formulated. There were slightly more than 100 total questions in the survey, including demographic questions.

The questions were assessed for face and content validity and adjusted for a ninth grade (or less) reading level. The questions were subsequently translated into Vietnamese by individuals with Vietnamese as their primary language who also had experience and/or a working knowledge of marine safety in the United States. The tool was reviewed on multiple occasions by this group of translators until consensus was reached in areas of discrepancy. Informed consents along with the surveys and testing (blood pressure by automated cuff, spirometry, and pure-tone audiometry, the latter to be reported elsewhere) were administered by trained personnel with the translation assistance of these same individuals in the latter half of 2008. Survey administration for the individual participant took approximately 45 minutes to 1 hour. The study protocol, survey tools, and informed consent were approved by the institutional review board at The University of Texas Health Science Center at Tyler.
Following administration and analysis of the initial surveys and testing (n = 217 completed surveys), a focus group, participatory approach was utilized to identify a single, but distinct focus strategy for implementation at each of three geographically separate sites along the Texas/Louisiana Gulf Coast. Focus groups of Vietnamese commercial fishermen were convened during the summer months of 2009 at each of three port locations (Houston/Kemah, Texas, n = 19; Belle Chasse, Louisiana, n = 16; and Abbeville, Louisiana, n = 9). With the assistance of a moderator using a structured approach to facilitate the process, each focus group independently selected an area for developing/disseminating an intervention targeted at a priority occupational safety and health concern as outlined above. Houston/Kemah chose hearing/noise conservation, Belle Chasse chose machinery safety (with special attention to winches), and Abbeville selected fatigue awareness as their intervention topics. Distinct and nonoverlapping intervention strategies were used for each of the three geographic groups.

Follow-up surveys were completed in each of the intervention groups in 2012 (n = 206). For these data collection events, the original survey was shortened to include only those groups of questions related to the three priority injury/illness risk areas selected by the focus groups. Further, a single “intent to act” question was added for each of the priority safety and health concerns identified (hearing/noise, machinery/winches, and fatigue), for a total of approximately 40 questions.

Sample selection, recruitment, data collection, and statistical analysis

A reliable enumeration of the commercial fishermen operating on vessels along the Gulf Coast is not available. Most vessels are privately owned, with crews of three or fewer including the owner/captain. Deckhands may move from vessel to vessel in a given port location, move between port locations, or work other jobs outside of the shrimp harvesting season. There is also some variability between states as to when the coastal waters are open for fishing off their shoreline. Vessels are licensed by each state for operation, but not individual fishermen. Therefore, the community trial design was best suited to study of this workforce.

With input from the USCG, three geographically separate locations along the Texas and Louisiana coasts were identified for purposes of this study: two port locations for Louisiana (Abbeville west of New Orleans and Belle Chasse near New Orleans) and one for Texas (Houston and nearby Kemah). The three locations were selected given their recognized concentration of Vietnamese shrimp fishermen. Previous study at the port of Galveston revealed a high concentration of Asian shrimp fishermen (>80%), mostly Vietnamese. These fishermen were considered highly likely to participate as part of the Houston/Kemah group. The three survey locations were, therefore, in Abbeville, Belle Chasse, and Houston/Kemah. Figure 1 is a map of the United States Gulf Coast indicating the distinct and separate locations of the commercial fishermen sampled in Texas (Houston/Kemah) and Louisiana (Abbeville and Belle Chasse).

Multimodal efforts were made at each of the three geographic sites to recruit eligible study participants currently working in shrimp fishing operations. These multimodal methods included engagement of key local partners to publicly announce the survey activities and place postings (in English and Vietnamese) both dockside and in other venues frequently attended by the fishermen (church, marine supply, community center, etc.), beginning at least 2 weeks in advance of a study data collection event. Additionally, health and safety screening and training not directly related to the survey behavioral questions or interventions (e.g., blood pressure, navigation signaling, and Mayday simulation) were offered to encourage participation along with nominal incentives. All commercial fishermen (shrimp is the major fishery at these locations) over the age of 21, who identified themselves as actively engaged in fishing operations and who volunteered participation were included in the surveys/testing even if they were not Vietnamese. Women were included if they played an active work role in fishing operations. There were rare exclusions of women volunteers who said they were attending the surveys on their fisherman husband’s behalf.
Surveys and testing were administered following informed consent and using an assigned subject number for each participant in order to maintain confidentiality of responses and data. Paper surveys were administered predominantly in Vietnamese (participants could select Vietnamese or English). This was accomplished using trained personnel, with assistance from trusted translators as previously noted. Surveys were reviewed for complete responses as they were submitted. Data cleaning involved review of any unclearly marked responses and multiple marked responses where not appropriate. Final complete surveys were entered into a Microsoft Access database constructed for this purpose. Statistical analysis was completed using IBM SPSS Statistics version 19 (IBM, Armonk, NY).

Initially, survey data were analyzed to estimate the prevalence of demographic factors and work-specific factors (previously identified) in order to (1) examine the distribution of potential confounding variables across the three survey locations and (2) complete the descriptive and formative assessment of risk factors and development of possible strategies for prevention and education among the focus groups. Next, for each of the three priority intervention areas (hearing/noise, machinery/winch safety, and fatigue), comparison of pre-/post-intervention group question response means was conducted using a two-tailed t test with an alpha = .05 and several assumptions: the three geographically separate groups were independently sampled, scaled question responses were treated as continuous variables, and sampling distributions of differences in means for each group question were normally distributed based upon sample size (>30) and the central limit theorem, with sample variances also approaching population variances in the source populations and assumed to be equal.

Statistically significant results were then interpreted relative to intermediate impact, that is, the degree to which changes in attitudes/beliefs might influence outcomes such as noise-induced hearing loss, machinery/winch injuries, and fatigue-related on-board incidents.

Distinct and nonoverlapping intervention strategies were used for each of the three geographic groups. Selection of different priority injury/illness categories for each group reduced the risk of introducing information bias, which could alter the results.

Finally, the single “intent to act” question was added only to the follow-up survey for each of the priority safety and health concerns identified during the focus groups. Since responses to these questions could not be evaluated using a pre-/post-intervention approach, the prevalence of “intent to act” within each of the three intervention groups was estimated and described.
Results

Figure 2 demonstrates schematically the organization of this community trial. Group sample size for each port location ranged from $n = 63$ to $n = 92$.

**Intervention development and deployment for community trial**

The project advisory group includes USCG Marine Safety Unit representatives, along with project investigators and other community stakeholders with expertise in marine safety. This group met to select an intervention approach that could be customized for each of the three prioritized target strategies identified by the focus groups. Selection of interventions considered the traditional hierarchy of workplace safety approaches such as engineering controls, administrative and work practice controls, and use of PPE. Practicality of the intervention in terms of cost and ease of dissemination/application was also considered. It was determined that safety messaging using easily and often universally recognized images/colors, along with written messages that were cautionary in nature, and culturally, linguistically (translated into Vietnamese), and literacy appropriate, would be adopted. The images and written messages were

![Figure 2. Schematic for quasi-experimental community trial with focus group selected areas for intervention development and deployment. Group sample size for each port location ranged from $n = 63$ to $n = 92.](image-url)
placed on durable and reflective signage for use in the marine environment. Images were also placed on bright t-shirts that are sought after by the Vietnamese fishermen. Figure 3A includes sign images adopted for each of the three interventions accompanied by written safety messages (in English). Figure 3B provides an actual example of the signage (in Vietnamese) for hearing protection while working in the high noise area of the engine room.

Each port site received signage and t-shirts with their respective priority message. These were delivered as part of a community training session emphasizing more usual safety measures for commercial fishing (similar to survey administration) along with the specific target priority message. The latter priority message was uniquely disseminated to its targeted site so as not to “contaminate” the remaining two community groups. Additional dissemination of materials was conducted dockside and in other venues frequented by commercial fishermen at their respective port locations over the ensuing months. These repeated efforts took place between the spring of 2010 and the spring of 2011, engaging Vietnamese opinion leaders in intervention diffusion efforts.23

In the case of the Houston/Kemah site, distribution of a pair of earmuffs as PPE was also accomplished. The fishermen in this location received an inexpensive hanger device for engine room door placement so that a single pair of earmuffs could be shared by all crew members who enter the engine room where noise levels are highest aboard vessel. Accompanied by signage, this was a ready reminder to fishermen of the importance of hearing protection. For the remaining two priority areas (machinery/winch safety, fatigue), placement of signage was encouraged in a readily visible

Figure 3. (A) Sign images and written safety messages (in English) adopted for each of the three interventions: hearing/noise, machinery/winch safety, and fatigue. (B) Actual hearing signage (in Vietnamese) and personal protective equipment (PPE) placed aboard a Houston/Kemah shrimp vessel at the entry to the engine room.
location nearby the winch. Figure 3B again illustrates actual hearing signage (in Vietnamese) placed aboard a shrimp vessel (Houston/Kemah) at the entry to the engine room, accompanied by PPE.

**Initial and follow-up survey analysis**

Comparison of demographic factors and other work-specific factors between the initial and follow-up surveys demonstrated considerable similarity between the participants at the beginning of the project (2008), and those who completed the survey in 2012 after interventions were diffused\(^23\) in the community (Table 1, see supplemental material; \(n = 217\) completed surveys in 2008 and \(n = 206\) completed surveys in 2012). Of particular note is the preponderance of Asian fishermen, approximately 95% or greater, during both surveys. Most were over the age of 40 (>90%), and most were owners/captains (>80%). Also of interest is a self-reported history of limited hearing difficulties in both groups at approximately 10% or less.

In addition, there is comparability between voluntary participants in the three community groups (Table 1). Overall, the same demographic factors are individually comparable to all three groups combined as well as to each other. There appeared to be a modestly smaller proportion of men during the initial survey at Belle Chasse, as well as a somewhat higher proportion of deckhands (in 2008) and Hispanics (in both 2008 and 2012). Of particular interest is the strikingly greater number of self-reported days worked per season and hours worked per day at Abbeville. This may well explain the selection of fatigue as a risk factor for intervention by this group.

All belief/attitude questions common to both the initial and follow-up surveys are reported (Table 2, see supplemental material). The relevant questions that demonstrate statistically significant improvement (\(P \leq .05\)) at the intervention location are indicated with a (+) in the Intervention Location column. Improvement is defined as a strengthened level of agreement with the statement (post-intervention mean greater than pre-intervention mean). The questions are grouped by both intervention and corresponding location of deployment. A significant increase (\(P \leq .05\)) in Pre I versus Post I survey question means (I = Intervention) at a location other than that of the intervention dissemination is signified by the symbol $. There is concordance for pre-/post-improvement in question responses relevant to the location of the corresponding intervention, specifically for fatigue (Abbeville) and hearing/noise (Houston/Kemah). This is less notable at Belle Chasse where the machinery/winch safety intervention was deployed.

Post-only “intent to action” questions on the follow-up survey also suggested the intermediate impact of the interventions selected by and disseminated to each group of fishermen, as illustrated in Table 3 (see supplemental material). The fatigue intervention at Abbeville and the hearing/noise intervention at Houston/Kemah appeared to have the greatest impact on intent, as would be expected. However, strong intent in response to machinery/winch safety questions was unexpectedly greater at Abbeville than at Belle Chasse, the latter being the location of dissemination.

**Discussion**

This study employs a community trial with quasi-experimental pretest/posttest intervention design to address the question of whether simple, yet culturally appropriate training and awareness measures in the form of visual and written safety messages favorably influence attitudes, beliefs, and behavioral intent related to priority risk factors identified by Vietnamese commercial shrimp fishermen along the Texas and Louisiana Gulf Coasts.

In the context of a community trial, a community may represent any number of defined units,\(^24\) in this instance, a commercial fishing community with vessel landings predominantly taking place at a geographic port or dock location. Although community trials may suffer, in comparison with clinical trials, with respect to controlling participant entrance to the study, shifts in the composition of the study population, delivering the intervention, and monitoring outcomes, they can be useful in evaluating the impact of behavior change or other modifiable risks.
In the current study, the initial survey of 2008 suggested that Vietnamese commercial shrimp fishermen in this region perceive their work to be somewhat to very risky (>70%). The follow-up survey confirmed that the shrimp fishermen of the Gulf Coast work longer hours and more days with less sleep during the open fishing season.

All three community groups demonstrated favorable benefit from the interventions, with strong intent to adopt safety measures. Statistically significant changes were noted in related belief responses following introduction of priority risk factor interventions among commercial shrimp fishermen at two of the three geographically separate locations (Houston/Kemah and Abbeville). These changes over time appear related to and surround the period of disseminating an intervention focused on a unique concern selected by each of these groups. Specifically, using the Theory of Planned Behavior\textsuperscript{22} to construct a survey administered before and after the dissemination of interventions for community selected priority concerns, there were detectable favorable changes in two of the groups (hearing/noise and fatigue).

The nature of these changes to include behavioral beliefs, normative beliefs, and control beliefs was more extensive for hearing/noise (Houston/Kemah area) and fatigue (Abbeville) than for machinery/winch safety (Belle Chasse). For hearing/noise, all three belief areas changed significantly, as was the case for fatigue. The latter may, in part, have been influenced by the greater number of days and longer work hours undertaken by the Abbeville fishermen during the active fishing season. Improvement of control beliefs in Houston/Kemah may be a function of use of PPE as part of this intervention (accessible earmuffs) as a tangible method for controlling noise exposure and hearing loss while working in the engine room. For both hearing/noise and fatigue, the nature of the cautionary safety images may have successfully conveyed to the fishermen the importance of the opinions of others they respect (normative beliefs). The absence of statistically significant changes in most of the belief categories for machinery/winch safety in Belle Chasse may reflect the varied nature and scale of dangerous machinery situations aboard vessel. Although the fishermen at Belle Chasse may intend to be more careful, they may construe accidents that occur with machinery as being outside of their immediate control.

The intermediate impact of the interventions and their corresponding influence on intention to action for all three groups was considered to be strong, although this conclusion is largely predicated upon the post-only component (follow-up survey) of this community trial. More than 84% of respondents in Houston/Kemah indicated that the safety information helped them and they intended to wear hearing protection. Over 95% of survey respondents in Abbeville said that the project was helpful and they intended to get enough sleep while working aboard vessel. Similarly, nearly 95% of respondents at Belle Chasse indicated that safety information helped them and that they would be more careful around machinery/winches aboard vessel.

An important strength of this study design is the use of a prospective, quasi-experimental community trial to manipulate a study factor in the form of an intervention that allows evaluation of intermediate impact on attitudes and beliefs. These, in turn, have the potential to culminate in action(s) that can reduce risk. An additional strength is the application of an actual and unique intervention to each of the three community groups. This has the potential to reduce the impact of the Hawthorne effect in which a change is purported due to singling out a group to receive an intervention (similar to a placebo effect).\textsuperscript{24}

Several challenges presented themselves during the course of this study, including hurricanes and hurricane recovery and economic factors such as the rising cost of diesel fuel. An additional challenge was identification of optimal times to conduct data collection and community reinforcement of the selected intervention messages through dockside dissemination efforts and a repeat community training initiative at each of the three sites. This was largely due to variability of scheduling around the busy fishing season. This challenge was significantly compounded for a period of several months by the Deepwater Horizon explosion (April 20, 2010) and oil spill in the Gulf of Mexico.

The study also has several limitations. Despite efforts toward a community-based approach to
select an intervention and maximize participation of Vietnamese fishermen within each community group, the study still suffers from an inability to randomize community participants to study conditions. Given that different participants are likely to have been involved in the surveys of 2008 and 2012, similarities in age, gender, race/ethnicity, language, school completion, role/duration in commercial fishing, and hours worked help to reduce confounding influences of these factors on responses to attitude/belief and “intent to act” questions.

Although several individuals completing the initial survey participated in the follow-up, it proved difficult to match surveys due to similarities in participant names and inconsistent retention by study subjects of unique identifying cards provided with the first survey. Additionally, there may have been migration among the communities of fishermen and inability to ensure that the same fishermen were participants at both pre- and post-intervention surveys. A paired analysis of surveys could not be performed for these reasons. As a result, the proportion of individuals from a given community who participated in both the pre- and post-intervention surveys could not be ascertained, also limiting the ability to know, with any certainty, the extent to which the intervention was delivered.

Given the 4-year period between administration of initial and follow-up surveys, there may also have been loss of effect due to a shift in study population composition surrounding the interventions deployed between 2010 and 2011. This might be construed as strengthening the statistically favorable findings that were, in fact, identified. Although a distinct and nonoverlapping focus strategy/intervention was applied to each of the three groups separated by geographic distance, the commercial fishermen of the Gulf Coast are known to conduct their landings at various ports other than their home location. This could have resulted in cross-contamination of the groups with the interventions, i.e., less rigid control of the “exposure.” Moreover, an intervention effect might have occurred in any single community group as a result of the overall message of health and safety delivered in the context of training. However, careful efforts were made to ensure that all three groups received comparable awareness training except for the unique intervention received by each.

Additional weaknesses include reduced external validity and generalizability of the findings due to self-selection of the intervention. However, in this particular study, a number of common potential confounders were shown to be comparably prevalent between the initial and follow-up surveys (see Table 1). Differing opinion leaders within the separate communities may have emphasized different interventions to varying degrees (e.g., use of hearing protection for noise exposure may have received greater emphasis in Houston/Kemah than machinery/winch safety received in Belle Chasse). Finally, the matter of sustainability is always a concern, and the present study does not examine the actual or persistent adoption of behaviors over the long term as with use of hearing protection. Moreover, what measures should or could be taken to ensure widespread dissemination of interventions throughout the regional commercial fishing community? Perhaps the USCG has a valuable role to play in this regard.

Another incidental, yet important finding during this study was that >50% of participants during the initial survey were noted to fall into the category of stage 1 or greater hypertension (based upon a single sitting automated blood pressure measurement). In many cases, participants were unaware of elevated blood pressure or poor control of hypertension and received education as to its significance and need for potential lifestyle change and follow-up for appropriate medical intervention.

Considering the findings of the current study and scale of the problem of winch injuries among shrimp fishermen along the Gulf Coast, future efforts would be reasonable to determine if there are work practice behaviors that could significantly influence the frequency and severity of these injuries.

Conclusions

Participatory methods are considered important preventive tools in the public health arena to determine and test effective strategies for reducing risk factors leading to illness, injury, and even
death, in a culturally appropriate way, and for translating these research findings into practice (r2p). This study has demonstrated how support and participation from trusted members of the Vietnamese communities, USCG, and commercial fishing industry were essential to recruitment and participation in project activities, development of practical interventions, and their dissemination to the target communities. It addressed the question of whether simple, yet culturally appropriate training and awareness measures in the form of visual and written safety messages favorably influence attitudes, beliefs, and behavioral intent. It has also confirmed the intermediate impact of community input to carrying out research activities in a vulnerable population such as the Vietnamese commercial shrimp fishermen. Further, this project addressed multiple priority areas as defined by the National Institute for Occupational Safety and Health (NIOSH) under its National Occupational Research Agenda (NORA), and its associated Agriculture, Forestry, and Fisheries Strategic Plan.\textsuperscript{25}

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