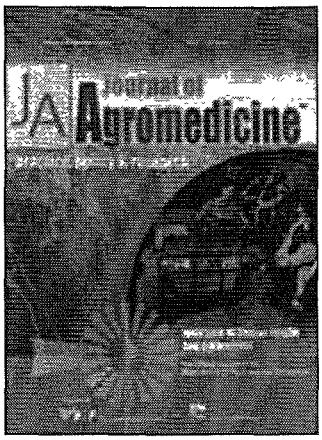

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Risk Factors for Musculoskeletal Symptoms Among Crawfish Farmers in Louisiana—A Pilot Study

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Risk Factors for Musculoskeletal Symptoms Among Crawfish Farmers in Louisiana—A Pilot Study

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ABSTRACT. The prevalence of musculoskeletal symptoms (MSS) among crawfish farmers is unknown. The purpose of this study was to assess the prevalence of MSS in nine body regions among crawfish farmers, and to examine associations between MSS and crawfish farm work activities. Questionnaires were mailed to randomly selected crawfish farmers in the State of Louisiana, USA. Site-specific MSS, demographics, and crawfish farm work information was obtained from the previous six months. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated with logistic regression adjusting for potential confounders. Among the participants (N = 184), shoulder MSS were reported most frequently (62%). Wrist/hand and low back MSS were significantly associated with tractor use (OR_{adj} = 2.89; 95% CI = 1.28–6.56) and (OR_{adj} = 2.41; 95% CI = 1.03–5.67), respectively. Also, upper back MSS were associated with the number of years working on a crawfish farm (OR_{adj} = 3.07; 95% CI = 1.17–8.04). Shoulder and low back MSS were common. Tractor use may increase the risk of wrist/hand and low back MSS. Future studies need accurately assess exposures to physical risk factors for MSS so ergonomic interventions can be developed.

KEYWORDS. Aquaculture, ergonomics, musculoskeletal, occupational

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INTRODUCTION

Musculoskeletal disorders (MSDs) are painful, often disabling and costly.[1] Some information exists on the prevalence of various work-related MSDs and musculoskeletal symptoms (MSS) among agricultural and fishing industry workers.[2,3] However, little information is available about the prevalence and associated risk factors for MSS or MSDs among aquaculture workers. Furthermore, aquaculture work may include many of the hazards that are present in the agricultural and fishing industries.[4,5]

Aquaculture is the farming of aquatic animals or plants. The aquaculture industry is expanding as the value of aquaculture products sold in the United States has increased by nearly $14 million US dollars from 1998 to 2005.[6] This increase is evident particularly in the Gulf Coast States. For example, the state of Louisiana has nearly doubled aquaculture products sold from 1998 to 2005 to just over $1 billion US dollars in 2005.[6] Crawfish farming contributes to a large proportion of the aquaculture products produced in Louisiana where 90% of the crawfish are produced in the United States.[7] During the 2006–2007 season, approximately 1300 Louisiana crawfish farmers produced an estimated 109,165,127 pounds of crawfish for a total farm value of $84,602,973 US.[8]

Crawfish are raised in flooded rice fields containing about 15 to 20 inches of freshwater. The crawfish are deposited or emerge in the pond around July. The crawfish are allowed to grow, and the harvesting period begins in November and ends in late April of the following calendar year. The crawfish are typically harvested using a boat and baited traps; however, sometimes farmers walk among the crawfish traps to harvest the crawfish. During boat harvesting, foot controls allow for hands-free steering while the boat is underway. The boat is guided along a row of traps in the crawfish pond. Then the crawfish farmers reach down with their right arm, grab a trap, and empty the crawfish trap onto a sorting table while the boat is moving. The crawfish farmer then places a piece of bait in the trap, and returns the trap back into the water and immediately picks up the next trap, which is emptied and re-baited. This sequence is repeated throughout the pond. The work cycle (pick up trap, empty trap, re-bait trap, and place trap in the water again) likely occurs in less than 30 seconds, which meets a definition of repetitive work.[9] Repetitive work is a risk factor for carpal tunnel syndrome (CTS).[10] Additionally, the force required to lift a crawfish trap may be substantial as traps weights are estimated at 10 pounds, and awkward wrist and shoulder postures may be present. Therefore, crawfish farmers may be at risk for MSS and MSDs. Currently, no information is available on the prevalence of MSDs or MSS among crawfish farmers. The purpose of this study was to identify risk factors for prevalent MSS among crawfish farmers in Louisiana.

METHODS

Study Sample

Crawfish farmers from the state of Louisiana were recruited to participate in this cross-sectional study. Potential participants were identified from a list of crawfish farm owner/operators ($N = 1180$) maintained by the Louisiana State University Agricultural Research Center (LSUARC).

Data Collection Instruments

Participants were asked to complete two self-administered questionnaires: (1) a participant and farm demographic questionnaire and (2) the Modified Nordic questionnaire.[11]

Participant and Farm Demographic Questionnaire

The participant demographic information included age, gender, height, weight, and smoking status. The questionnaire also collected information about crawfish farm activities over the previous season (i.e., November 2007 to April 2008); including hours-per-day performing crawfish farm activities (e.g., harvesting crawfish). Participants were also asked to report the pounds of crawfish produced on the farm. Additionally, information was collected on

years worked on a crawfish farm, off-farm employment including the hours per week and weeks per year working, and information on other occupations.

Modified Nordic Questionnaire

The Modified Nordic Questionnaire was used to collect 6-month period prevalences of MSS of the (1) wrist/hand, (2) elbow, (3) shoulder, (4) neck, (5) upper back, (6) low back, (7) hip, (8) knee, and (9) feet.[11] This questionnaire has been previously used and has demonstrated good test-retest reliability.[2,12,13] Participants were also asked (yes, no) if they saw a physician (MD, DO, or DC) for their MSS. Participants were also asked about lost work time due to MSS, and whether MSS were due to a traumatic injury. The previous 6 months (November 2007 to April 2008) were chosen as the recall period as this time frame corresponds with the recent crawfish harvesting season.

Procedures

Questionnaires were mailed by the LSUARC to each farm with a prepaid return envelope in mid-May 2008. A cover letter included a request that the questionnaire be completed by the farm worker who performed the majority of the crawfish harvesting operations. Reminder postcards were sent 2 weeks after the initial mailing and 4 weeks after the initial mailing a second questionnaire was sent to nonresponders. Six weeks after the initial mailing, additional reminder post cards were mailed to nonresponders. In order to enhance participation, the participants were entered into a drawing for five $50 gift cards. The Institutional Review Board at the University of Texas Health Science Center at Tyler approved all procedures for this study.

Statistical Analysis

The crawfish farm activities examined in this study were years working on a crawfish farm, and information about study participant's work on the crawfish farm during the 2007/2008 crawfish harvesting season. Specifically, the percentage of crawfish produced on the farm that was harvested by the participant, hours spent harvesting crawfish utilizing a motorized boat, hours spent manually harvesting (i.e., walking among crawfish traps), hours spent loading/unloading, hours spent cutting bait, and hours driving a tractor. Body mass index (BMI) was also calculated as weight (kg) divided by height squared (m^2).

Most of the crawfish farm activity variables were categorized into quartiles based on the distribution within the study sample. Some variables were categorized into tertiles or dichotomized due to small cell numbers, where zero values become the reference category and the exposure categorized by the median value. Collinearity was assessed among continuous variables prior to categorization with Pearson correlation analyses. Means and percentiles were calculated for the demographic, crawfish farm activity variables, and site specific MSS.

Associations between (1) demographic variables and (2) crawfish farm work variables and the nine MSS outcomes (wrist/hand, elbow, shoulder, neck, upper back, low back, hip, knee, and feet MSS) were initially examined individually with logistic regression models, which included age and gender. Demographic or crawfish farm work variables were entered simultaneously into a final multivariable logistic regression model for the specific MSS outcome if one or more categories were associated with a MSS outcome with a probability of $\leq .15$. Observations between MSS outcome and exposure variables were reported as statistically significant with a probability of $\leq .05$. Statistical analyses were conducted using SPSS Version 18 (SPSS, Chicago, IL).

RESULTS

Subjects

Of the 1180 questionnaires that were mailed, 184 (15.6%) crawfish farmers completed and returned questionnaires, 65 (5.5%) farmers refused, 748 (63.4%) did not respond, 155 (13.1%) no longer worked on a crawfish farm, and 28 (2.4%) were returned as undeliverable, resulting in 18% participation [184/(1180 – 155 – 28)].

TABLE 1. Demographic and Crawfish Farming Information (N = 184)

Characteristics	Number (%) or mean (*SD*)
Demographic characteristics	
Age (years)	51 (13.8)
Gender (male)	169 (92%)
Body mass index (kg/m^2) (N = 170)	29 (5.3)
Current smokers (N = 182)	19 (10%)
Ever smokers (N = 182)	34 (19%)
Handedness (right) (N = 183)	170 (93%)
Ethnicity Non Hispanic (N = 177)	173 (98%)
Crawfish operation characteristics (2007–2008)	
Years worked in crawfish production	15 (10.3)
Position in operation (N = 182). Owner	102 (56%)
Position in operation (N = 182). Fisherman	24 (13%)
Other occupation (N = 182)	139 (76 4%)
Diagnosed with muscle or joint pain (N = 138)	30 (21 7%)
Total crawfish harvest in (lbs)	39,409 (66,737)
Percentage personally harvested	65 (39)
Traps harvested per farm per week (N = 165)	2693 (4071)
Harvesting traps (hours)	188 (302)
Walking traps (hours)	16 6 (56 7)
Loading/unloading traps (hours)	42 4 (84 4)
Cutting bait (hours)	32 7 (82.5)
Driving tractor (hours)	91 4 (224 8)

Information on participant demographics is presented in Table 1. The mean age of the crawfish farmers was 51 years (*SD* 14), 92% were male, 100% were Caucasian, with 2.2% indicating Hispanic ethnicity. Additionally, 56% of the participants were farm owners and worked an average of 15 years (*SD* 10) on a crawfish farm.

Crawfish Farm Activities

Information on crawfish farm activities is presented in Table 1. On average, participants harvested crawfish 188 hours per year (*SD* 302). The mean number of traps harvested per farm per week was 2693 (*SD* 4071), of these 65% were personally harvested by the study participants. Seventy-six percent of the participants also had another occupation.

Musculoskeletal Symptoms

Musculoskeletal symptoms were common. The highest 6-month period (November to April) prevalence of MSS was observed for shoulder MSS (62%), which was closely followed by low back MSS (61%) (Table 2). The greatest proportion of participants who sought health care due to their MSS was among those who experienced low back MSS (23%) and 16% had missed work due to low back MSS (data not shown). Across all body sites (wrist/hand, elbow, neck, shoulder, upper back, low back, knee, hip, and feet), participants reported that 1% to 6% of MSS were due to a traumatic injury, with the highest frequency for low back MSS.

TABLE 2. Six-Month Prevalence of Musculoskeletal Symptoms by Body Site

Body site (N = 184)	Frequency	%
Neck	88	48
Shoulder	114	62
Elbow	72	39
Wrist/hand	86	47
Upper back	46	25
Lower back	112	61
Hip/thigh	39	21
Knee	51	28
Feet	44	24
Any site	165	90

Associations Between Crawfish Farm Activities and MSS

Statistically significant associations between crawfish farm activities and site specific MSS are presented in Table 3.

Wrist/hand

A statistically significant increase in risk of wrist/hand MSS (adjusted odds ratio [OR_{adj}] = 2.89; 95% confidence interval [CI] = 1.28–6.56) was observed among participants who reported between 1 and 40 hours of tractor driving over the 2007–2008 crawfish season after controlling for potential confounders (age, gender, BMI).

Upper Back

A statistically significant increase in risk of upper back MSS (OR_{adj} = 3.07; 95% CI = 1.17–8.04) was observed among participants

TABLE 3. Crawfish Farming Activities Associated With Prevalent Musculoskeletal Symptoms

	Experience symptoms		Age-gender adjusted OR	95% CI	Adjusted* OR	95% CI
	Yes	No				
Wrist/hand symptoms	86	98				
Harvesting traps (hours/season)						
0	18	16	1 00	—	1.00	—
1–172	44	55	0.53	0.23–1.23	0 40	0.16–1 03
≥173	24	27	0.56	0 22–1 41	0.48	0.17–1 33
Trend test			p = 50		p = 61	
Tractor driving (hours/season)						
0	42	57	1 00	—	1 00	—
1–40	27	16	2.16	1.02–4 56	2 89	1 28–6 56
≥41	17	25	0 93	0.43–1 98	1 00	0 45–2 22
Trend test			p = 76		p = .78	
Upper back symptoms	46	138				
Years working on crawfish farm						
≤6	8	43	1 00	—	1 00	—
7–15	19	35	2 78	1 10–7 01	3 07	1 17–8 04
16–20	8	25	1 70	0.56–5.09	1.81	0 58–5 66
≥21	10	34	1.41	0 51–3 95	1 46	0 49–4 30
Trend test			p = .24		p = 21	
Loading or unloading boats (hours/year)						
0	13	58	1 00	—	1 00	—
1–20	16	41	1 81	0.78–4 23	1 72	0.73–4.06
≥21	17	39	1 95	0 84–4 55	1.74	0 72–4.22
Trend test			p = 25		p = 15	
Low back symptoms	112	72				
Loading or unloading boats (hours/year)						
0	37	34	1.00	—	1.00	—
1–20	41	16	2 70	1 22–5.97	1 87	0.85–4 08
≥21	34	22	1 34	0.64–2 79	1 05	0.48–2 27
Trend test			p = 48		p = 60	
Tractor driving (hours/season)						
0	52	47	1 00	—	1 00	—
1–40	29	14	1 64	0 76–3.53	1 54	0.70–3 40
≥41	31	11	2.43	1 05–5.61	2.41	1 03–5 67
Trend test			p = 11		p = .07	

*Adjusted for all remaining variables in the model

who reported between 7 and 15 years of working on a crawfish farm after controlling for potential confounders (age, gender).

Low Back

A statistically significant increase in risk of low back MSS (OR_{adj} = 2.41; 95% CI = 1.03–5.67) was observed among participants who reported ≥41 hours of operating a tractor over the 2007–2008 crawfish season after controlling for potential confounders (age, gender).

DISCUSSION

Musculoskeletal Symptoms

Shoulder and low back MSS were reported frequently by the crawfish farmers who participated in this study. Across all body sites evaluated, the shoulder was the most common location for MSS (62%). The prevalences of MSS for all body sites among crawfish farmers in the current study were higher than what has been reported among aquaculture and fisheries workers. Specifically, commercial fishermen

indicated that 48% of fishing related musculoskeletal injuries were to the back and 26% to the shoulder.[14] Seventy percent of these musculoskeletal injuries were caused by hauling in fishing nets and traps, or moving heavy objects. A subsequent longitudinal study among the same group of commercial fishermen reported that 83% experienced MSS in the previous 12 months.[3] The low back and the upper extremity were areas of the body where MSS were most frequently reported (i.e., 52% low back, 41% hands/wrists, 27% forearm/elbow, and 25% shoulder). These reports are similar to what was found among crawfish farmers in the current study. Furthermore, 66% of the commercial fishermen participating used a trap to catch crustaceans (i.e., lobsters or crabs). This type of fishing is similar to the type of work performed by crawfish farmers.[7] Therefore, crawfish farmers may suffer from similar rates of MSS.

Associations Between Crawfish Operation Activities and MSS

One of the primary objectives of this study was to examine associations between crawfish farm work characteristics, such as hours harvesting crawfish and prevalent MSS of the wrist/hand, elbow, shoulder, neck, upper back, low back, hip, knee, and feet.

We expected harvesting crawfish farmers would experience prevalent shoulder symptoms to be associated with shoulder MSS, as physical risk factors for shoulder MSS appear to be present in anecdotal observations of the crawfish harvesting task. Specifically, shoulder abduction greater that 60 degrees and repetition appear to be present during a significant portion of this harvesting task which has been associated with shoulder MSDs.[10] However, a statistically significant association between shoulder MSS and crawfish harvesting was not observed.

However, other statistically significant associations ($p \leq .05$) were observed between MSS and crawfish farm work activities. Upper back MSS were significantly associated with years working on a crawfish farm ($OR_{adj} = 3.07$; 95% CI = 1.17–8.04). This association was statistically significant even after controlling for age in the analyses. Therefore, there may be other work factors not measured in this study that place crawfish farmers at risk for MSS of the upper back. The number of years working in aquaculture has not been previously identified as a risk factor for MSS; however, previous work had identified years working on a farm as being associated with prevalent MSS.[2]

Tractor use was significantly associated with wrist/hand MSS ($OR_{adj} = 2.89$; 95% CI = 1.28–6.56) and low back MSS ($OR_{adj} = 2.41$; 95% CI = 1.03–5.67). Exposure to vibration during tractor work has been suggested as a possible risk factor for MSS.[15] Given that wrist/hand and low back MSS have previously been associated with tractor use,[15,16] these observations may be of importance. However, further evaluation of tractor use is needed as work utilizing a tractor was defined differently across these studies.

A statistically significant increase in wrist/hand MSS was observed for the lower 50th percentile of tractor use. However, increased wrist/hand MSS were not observed among individuals who reported greater than 40 hours of tractor use over the 6-month recall period. The reason for the lack of consistency with wrist/hand MSS and hours of tractor use was unclear as significant work task variability may be present among categories of exposure. Further research evaluating exposure to physical risk factors for MSS among crawfish farmer work tasks is warranted.

Limitations

An explanation for the lack of associations between crawfish farm work activities and MSS may be that the exposures examined in this study have little or no effect on risk of the MSS as determined with the Modified Nordic Questionnaire. However, previous research suggests that work in farming and therefore work in aquaculture is associated with physical exposures known in other industries to increase the risk of MSS. Several methodological limitations may have attenuated associations observed between crawfish farming activities and MSS.

It is possible that the study sample was not representative of the population of crawfish famers. Participation in the current study was low (18%), and respondents may have differed from nonparticipants in crawfish farm exposures or MSS. Additional information about nonparticipants and nonresponders was difficult to obtain. Additional information may be gathered about the demographics of the population of crawfish farmers at agricultural events in Louisiana. However, the mean age (51 years) and gender (8% female) reported by the participants in this study were similar to demographic data reported available for farmers in the State of Louisiana (57 years and 12% female).[17] Also, the mean BMI calculated for participants in this study was similar to the mean BMI reported previously among similar farmers.[2] Based on these limited comparisons, demographic characteristics of the participating crawfish farmers were similar to those available from other sources in the state of Louisiana. However, this additional information does not confirm that statistically significant associations among participants were similar to statistically significant associations among nonparticipants. Furthermore, participants may still differ from nonparticipants with respect to reported MSS, exposure to physical risk factors, and the association between prevalent MSS and reported exposure.

Another concern with the selection of the study sample was our request (as described above) that the questionnaire be completed by "the crawfish farm worker who performed the majority of the crawfish harvesting operations." It may be that crawfish farmers who were most adversely affected by the crawfish harvesting tasks were no longer performing the majority of the crawfish harvesting operations and did not, therefore, complete the questionnaires. Consequently, the most susceptible and most heavily exposed crawfish farmers may not be fully represented in the study sample.

Another limitation may be that many of these crawfish farmers also have other occupations (76.4%), therefore, an additional occupation may affect the MSS reported by the study participants as the prevalent MSS may have been due exposure encountered at this other occupation. However, many of the crawfish farmers are also rice farmers. Therefore, the exposures quantified in this study may apply to both occupations. This point may add validity to the statistically significant associations of low back and wrist hand MSS with tractor use, as tractors are likely used in both occupations. Furthermore, the questionnaire assessed total tractor use over the previous 6-month period, not only tractor use specifically for crawfish farming. Thus, the likelihood of the confounding of tractor use due to other occupational exposures is low. Also, this study relied on self-report of exposure. Imprecision of the estimate of exposure to crawfish farming activities may have attenuated observed associations with MSS.[18]

Lastly, the information collected in this study was cross-sectional by design. In cross-sectional studies such as this, a temporal relationship between the exposure variables and MSS cannot be established. For example, if previous work as a crawfish farmer, such as harvesting crawfish, resulted in substantial shoulder MSS, highly symptomatic individuals may have reduced the amount of crawfish harvesting they personally perform. The MSS from the harvesting work may remain, therefore attenuating the exposure effect association. Given these study limitations, the associations we have reported should be generalized with caution.

CONCLUSIONS

In this study, a higher prevalence of shoulder MSS was reported among crawfish farmers, than what has been reported among other aquaculture and agricultural workers in previous investigations. The results of this study suggest that the risk of developing wrist/hand and low back MSS may be increased due to tractor use.

Future studies that incorporate a prospective cohort design, additional incentives to increase participation rates, precise measurement of exposure to physical risk factors, potential confounders, and MSS may provide a better understanding of how work on a crawfish farm may contribute to MSS. Furthermore, intervention research is needed to evaluate opportunities on the crawfish farm to reduce exposure to physical risk factors for MSS.

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