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Low Back Pain and Musculoskeletal Symptoms Among Kansas Farmers

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Background *Farming continues to rank as one of the most dangerous occupations in the United States. The purpose of this study was to determine the prevalence of low back pain and other musculoskeletal disorders (MSDs) among the farmers and to examine the factors associated with occupational back pain. Farmers in a predominately corn and soybean growing region of Kansas served as the study sample.*
Methods *Questionnaires were mailed out to 499 active farmers of a Farmers' Co-operative in Southeast Kansas. The self-administered questionnaire was used to determine the prevalence of self-reported symptoms of back pain and other MSDs and to determine the strength of associations between back pain and work factors.*
Results *The participation rate was 57.2%. The low back was the anatomical area with the highest prevalence of self-reported work-related pain (37.5%), followed by the shoulders (25.9%), knees (23.6%), and neck (22.4%). Close to 60% of the farmers reported that they experienced farm work-related MSD symptoms in at least one of the nine body areas in the previous year. Nearly one quarter of the farmers reported seeing a physician for their low back symptoms, and one in five farmers had to modify their work habits due to low back symptoms during the previous year.*
Conclusions *Low back pain and other musculoskeletal conditions are a significant problem for Kansas farmers. This group of Kansas farmers experienced low back pain at a much higher rate than the general working population and higher than other groups of farmers previously studied.* Am. J. Ind. Med. 49: 547–556, 2006. *© 2006 Wiley-Liss, Inc.*

KEY WORDS: low back pain; musculoskeletal disorders; farmers; agriculture

INTRODUCTION

Agriculture is among the most hazardous occupations in which injury to workers is an important contributor to mortality and morbidity [McCurdy and Carroll, 2000; Hwang et al., 2001]. Although there are many epidemiologic studies reporting on acute injuries in agricultural populations [Lewis et al., 1998; Meyers, 1998; Lyman et al., 1999], few studies have investigated the relationships between cumulative exposure to physical stress and musculoskeletal disorders (MSDs). Because of the high physical strain associated with farming tasks, MSDs are common among farmers and agricultural workers [Nevala-Puranen et al., 1993, 1996; Nevala-Puranen and Sorensen, 1997; Sorainen et al., 1998; Xiang et al., 1999]. Low back disorders are perhaps the most common MSD among farmers and agricultural workers [Xiang et al., 1999; Park et al., 2001].

Physical risk factors such as heavy lifting and forceful movements, bending and twisting, static postures, and whole body vibration, are common in farming tasks and have been associated with low back disorders [Bernard, 1997]. The

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specific type of MSD and area of the body affected are dependent upon the type of agricultural task performed. In a study of fruit harvesting, for example, seasonal farm workers were required to work with both arms raised over shoulder height while reaching and picking. Agricultural tasks that involved reaching overhead were considered a risk factor for shoulder disorders [Fulmer et al., 2002]. Whole-body vibration from tractor use has been associated with the risk of low back disorders [Sorainen et al., 1998]. Farmers involved with animal production showed a significant positive relationship with the risk of developing hip joint osteoarthritis [Thelin et al., 2004]. Repetitive hand activities involved with manual milking tasks among sheep farmers have been associated with hand and wrist disorders such as carpal tunnel syndrome [Rosecrance et al., 2001]. Thus, interventions aimed at reducing workplace injuries in the agricultural sector must be targeted to the specific type of agriculture.

The vast majority of studies that have focused on the prevalence of work-related MSDs and their association with occupational tasks have been performed in the manufacturing sector as outlined in comprehensive literature reviews by the National Institute for Occupational Safety and Health (NIOSH), [Bernard, 1997] and the National Research Council [NRC, 2001]. Data from the Bureau of Labor Statistics provides an indication of the extent and cause of many work-related disorders in occupational sectors [BLS, 2005]; however, the survey excludes farming operations with fewer than 11 employees. Thus, there is limited data reflecting injuries from agricultural operations in the U.S. where the majority of farms have fewer then 11 employees and there are relatively few studies reporting the causes and nature of these disorders among agricultural workers.

Although previous studies have assessed MSDs among farmers in specific agricultural regions, few studies have investigated farmers that primarily produce row crops such as corn and soybeans. In East Central Kansas, farmers concentrate on growing corn, soybeans, wheat, and sorghum and are involved in a variety of livestock production. The purpose of this study was to determine the prevalence of low back pain and other MSDs among Kansas farmers and to examine the risk factors that are associated with work-related MSDs in this population.

MATERIALS AND METHODS

Study Population

The study population consisted of 499 farmers who were active members of a Southeastern Kansas farming cooperative. Active members of the Cooperative were mailed a questionnaire to assess MSD symptoms, farm and non-farm activities, and general demographics. The names of the study participants were obtained from the Cooperative's Executive Board. All materials used in the study were reviewed and approved by the Executive Board of the Cooperative and by the Institutional Review Board of the University.

Questionnaire

The first section of the questionnaire addressed the participant's farming operation. The study definition of a farm was ''a place that sells $1000 or more in agricultural products in a year'' [USDA, 2002]. Participants were asked whether they were the principal operator or owner of a farm, and whether or not they did physical work on a farm. Other questions addressed the years spent farming and living in that area, and whether or not the participant also held a job outside the farm. Farmers were asked how many acres of wheat, corn, soybeans, and grain sorghum they typically planted, as well as how many cattle, swine, sheep, goats, and chickens they had in production. These questions were used to determine current farming status. If a person responded that they did no physical work on a farm but then described how many acres of crops and numbers of animals they produced, they were included in the analysis as active farmers. Persons responding that they did no physical work on a farm without an obvious contradiction in another part of the questionnaire were excluded on the basis that the person was not currently an active farmer. Only active farmers were included in the final analyses.

The second portion of the questionnaire addressed demographic data such as age, gender, height, and weight, as well as general health characteristics.

The third section of the questionnaire addressed health issues. Participants were asked whether they had experienced any injury on the farm in the last 12 months that caused them to miss half a day of work or more or for which they required medical attention. This questionnaire item was adapted from other surveys assessing health outcomes among farmers [Lewis et al., 1998; Hwang et al., 2001]. If the participant indicated that they had an injury resulting in missed work, they were prompted to describe any injury and the circumstances surrounding it. Also in this section, the period prevalence of farm work-related MSD symptoms was addressed for the 12 months preceding the survey. This portion of the questionnaire was a modification of the Standardized Nordic Questionnaire [Kuorinka et al., 1987] and consisted of questions referring to nine anatomical areas: neck, upper back, low back, shoulders, elbows, wrist/hand, hips, knees, and feet. These questions have been used extensively to determine worker symptoms in various study populations [Baron et al., 1996; Cook et al., 1996; Goldsheyder et al., 2002; Rosecrance et al., 2002; Merlino et al., 2003]. Subjects answered ''yes'' or ''no'' to the following question: ''During the last 12 months have you had a farm-related ache, pain, discomfort, etc. lasting one week or more in . . . '' followed by the list of nine areas of the body. Because

farmers must work according to weather patterns and crop growth cycles, they frequently work while injured or hurt. Due to this specific circumstance, they were asked if they were forced to modify their work habits due to the condition as opposed to being asked if they were forced to miss work. The final set of questions in this series inquired if they saw a physician for the condition.

The third section also contained a list of 11 different job factors to assess the participants' perception of occupational risk factors and their potential contribution to MSDs. Subjects were asked to indicate on a scale of 0–10 (0 = no problem, 10 = major problem) how much of a problem each factor was for them in terms of their health at work. Examples of the job factors that were rated include: ''Vibration from driving heavy equipment,'' ''Carrying, lifting, or moving heavy materials,'' ''Relocating, maneuvering, or feeding animals,'' and ''Working when injured or hurt.''

The fourth portion of the questionnaire addressed farm work and tasks performed by seasons to assess seasonal variation of work habits. Seasons were defined for the respondents as follows: spring = March, April, May; summer = June, July, August; fall = September, October, November; winter = December, January, February. Participants were asked to indicate the number of hours per day and the number of days per week they spent doing farm work per season, as well as the three following specific activities: operating heavy equipment, machine repair, and lifting or carrying materials or equipment weighing over 50 pounds.

The final section of the questionnaire addressed low back symptoms by asking questions modeled after other epidemiologic questionnaires of low back disorders [Xiang et al., 1999; Park et al., 2001]. Participants were asked if at any time during the past 12 months they experienced back pain every day for a week or more. Persons were coded as having back pain for the purpose of analysis if they answered ''yes'' to this question as opposed to the Nordic format question since this question encompassed all areas of the back. If their answer was ''no,'' they were instructed to skip to the last question of the questionnaire. If they responded ''yes,'' they were asked further questions about the back pain, including whether repeated activities or a single accident brought on the pain, and where these activities took place. They were also asked to indicate the season during which most of their back pain occurred and prompted to list or describe the farming tasks that were most difficult when they were experiencing back pain.

Questionnaire Administration

The first mailing of the questionnaire was conducted at the beginning of January and consisted of a cover letter describing the project, the four-page self-administered questionnaire, and a stamped envelope to return the questionnaire. The potential participants were given the option of returning a blank questionnaire if they did not wish to participate. The letter also stated that those who returned a completed questionnaire would be entered into a drawing for five $100 cash prizes, to be held in March. Reminder postcards were sent in mid January to those who had not yet responded. A second mailing of the same letter, questionnaire and return envelope was sent to the non-respondents at the end of January. The questionnaires in the initial mailing had unique identifiers corresponding to a name on a master list of the potential participants. The identifiers allowed for tracking so that the reminder postcard and second mailing would be targeted to only non-respondents. To assess selection bias, farm cooperative personnel provided the following information for non-respondents: age, if non-respondent was active in farming, type of farming (grain crops vs. livestock), and if non-respondents were involved in off-farm employment. The anonymous non-respondent data were based on a membership profile database maintained by the Cooperative. The non-respondent data were reviewed and updated by the Executive Board of the Cooperative before it was provided to the investigators.

Data Analysis

Questionnaire data were entered into a Microsoft Access file (Microsoft Corporation, 2003). Percentiles or means and medians were calculated as appropriate for demographics, job factors, farm assets, and seasonal activities. Twelve-month period prevalence rates for each of the nine body sites and the back pain question were determined by dividing the number of ''yes'' responses to each site by the total number of participants. Chi square tests and *t*-tests compared covariates between ''yes'' and ''no'' respondents for the back pain question and demographic, job factors, seasonal activities, and farm assets. Questionnaire items related to job factors were dichotomized as 0–5 (no problem/some problem) or 6–10 (moderate/major problem) for bivariate and multivariate analyses. The demographic, job factor, farm assets, and seasonal factors variables were modeled univariately with low back pain. All univariate variables (at $P < 0.10$ significance level) were modeled multivariately for associations with prevalent low back pain. Odds ratios and 95% confidence intervals were estimated by stepwise logistic regression for multivariate modeling. All data were analyzed with Statistical Analysis Software for PC V8.0 [SAS, 2000].

RESULTS

Response Rate

Of the 499 potential participants, 319 (64%) returned a questionnaire or a letter explaining their current work status. The distribution of the potential respondents and participant

cohort is illustrated in Figure 1. Non-respondents (n = 180) were classified as those who did not return a questionnaire or send any correspondence. Of the 319 respondents, 53 questionnaires were either blank (n = 20) or the answers indicated that the respondent was no longer actively farming (n = 33). Because the investigation pertained only to those currently farming, the 33 retired farmers were excluded from the data analysis, resulting in a cohort of 266 active farmers. Thus, the participation rate of active farmers was 57.2% (266/465).

Non-Respondents

Of the non-respondents (n = 180), one died before the study period began and personal data was unknown on four others. Thus, limited data was available on 175 of the 180 non-respondents. The non-respondents were significantly younger and farmed fewer acres and raised fewer livestock than the respondents (Table I).

Respondents

The representative participant in this cohort was a male (97.7%) approximately 58 years of age who had been farming for 36 years (Table II). He was principal operator or owner of the farm, and lived on the farm property. Most of the participants planted and harvested several 100 acres of various crops, with almost half (48.6%) farming over 500 acres (Fig. 2). Many farms in this area were large, with the mean total acres planted being 881. The median number of acres planted was 540. Soybeans were the most common crop grown, in terms of the number of farms producing them and by the number of acres planted (Table III). Wheat and corn were also commonly grown crops in this region. The mean acreage of soybeans planted was 436 while the median was 273. Over two-thirds of the farms in this sample produced beef cattle, with the mean head per farm at almost 200. Although only 12 farmers raised hogs, the mean number of hogs raised on theses farms was 2,400.

The majority of hours, on a weekly basis, performing farm work were in the summer (61 hr) with the fewest in the winter (33 hr) (Table IV). The majority of work time in all seasons was spent operating heavy equipment (tractors, combines, etc. . . .). The time spent lifting or carrying over 50 lbs was consistent throughout the seasons. Almost one-third of the farmers (N = 86) reported doing paid work off the farm. These farmers reported working off the farm for almost 35 hr per week. Unfortunately, we were unable to determine time working off the farm by season.

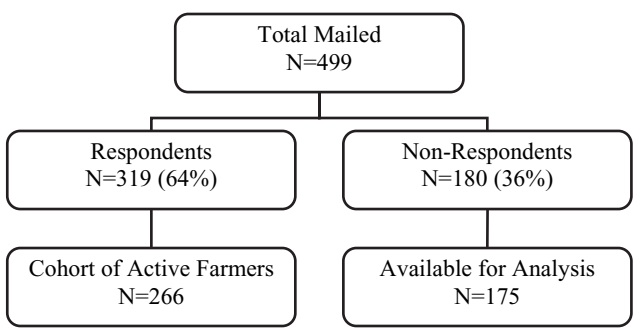

FIGURE 1. Distribution of respondents and non-respondents in study.

TABLE I. Demographics for Non-Respondents and Respondents

	Non-respondents N = 175	Respondents N = 266	*P*-value
Age (mean ± SD)	52.0 ± 12.1	57.7 ± 13.1	$P < 0.0001$
Plants crops	86 (49.1%)	237 (89.1%)	$P < 0.0001$
Raises animals	93 (53.1%)	191 (71.8%)	$P < 0.0001$
Off-farm job	47 (26.9%)	86 (32.3%)	$P = 0.22$

Low Back Pain and MSD Symptoms

Over a quarter (27.7%) of the respondents visited an emergency room within the last 5 years for a farm-related injury. Forty-two (15.9%) of the farmers reported a farm-related injury in the last 12 months that required them to miss half a day of work or more or caused them to seek medical attention. Of the 42 experiencing an injury, 28.6% reported the low back as an area injured.

The 12-month period prevalence of MSD symptoms was highest for the low back (37.5%), followed by the shoulders (25.9%), knees (23.6%), and neck (22.4%) (Table V). Nearly 60% of the farmers in the sample reported that they experienced farm work-related MSD symptoms during the last 12 months in at least one of the nine body areas. Almost one quarter of the farmers reported seeing a physician for their low back symptoms, and one in five farmers had to modify their work habits due to low back symptoms during the previous year. After low back symptoms, farmers were

TABLE II. Demographics of Participating Farmers

	Mean	SD
Age	57.7	13.1
Height (in)	70.1	2.6
Weight (lbs)	198.5	38.7
BMI	28.1	4.0
Duration farmer	35.7	15.7
Duration lived on farm	45.5	19.3
Duration lived in Kansas	52.2	16.0
	Number	**Percent**
Principal operator	256	96.6
Live on farm property	235	89.4
Male gender	258	97.7

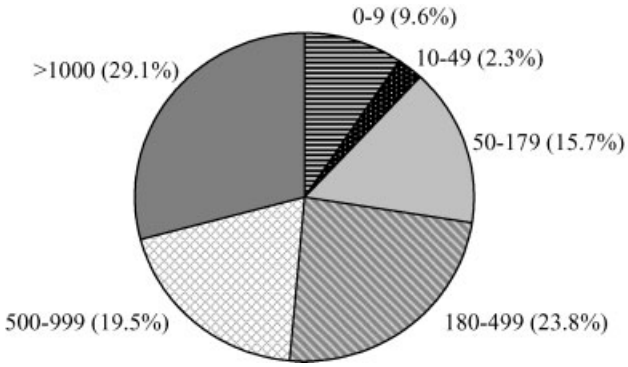

FIGURE 2. Farm size by total acres planted and percent of farmers represented by the respective farm size.

more likely to modify their work habits due to knee symptoms (11.6%) and shoulder symptoms (10.4%). They were most likely (after low back symptoms) to visit a physician for shoulder symptoms (13.5%) followed by neck symptoms (13.5%).

An alternative questionnaire item to assess low back pain prevalence included the question ''At any time during the past 12 months, did you have back pain every day for a week or more?'' Of the 253 respondents to this question, a total of 92 (36.4%) had experienced an episode of back pain lasting for a week or more. There was good agreement between the two back pain case definitions as demonstrated by a kappa coefficient of 0.66 [Fleiss, 1981].

In 88.0% of the cases, the respondents back pain was brought on by repeated activities such as lifting, pushing, pulling, bending, twisting, or reaching (Table VI). A single accident or injury such as slipping, falling, twisting, lifting something, or being in a car accident was reported as a cause in 43.5% of the low back pain cases. In either situation (repeated activities or a single accident), the location of the activity was most likely to be at work on the farm. The majority of low back pain was experienced during the summer months. Participants were asked an open-ended question regarding which tasks they considered most difficult when they were experiencing back pain. Of the back pain cases (N = 92), 37.0% listed lifting/carrying as a task they found difficult, and 25.1% of the cases listed riding on or operating equipment as being difficult (Table VII).

The job factors rated most problematic in contributing to work-related pain and injury were lifting heavy materials (defined in the questionnaire as ''carrying, lifting, or moving heavy materials'') (Table VIII). ''Working in the same position for long periods of time'' and ''bending or twisting the back in an awkward way'' were the second and third highest rated job factors, respectively, contributing to

TABLE III. Crop and Livestock Production

	# Farms with product	Mean acres or head	SD	Median
Soybeans	220	436	499	273
Wheat	202	185	221	110
Corn	145	283	331	200
Milo (sorghum)	156	138	123	100
Other plant	64	202	340	70
Any/all crops	237	881	985	540
Beef cattle	179	197	310	100
Hogs	12	2,376	7,152	37
Dairy cattle	12	279	273	290
Sheep	4	182	232	100
Goats	6	30	48	4
Chickens	13	26	21	25
Other animals	18	319	695	10

TABLE IV. Farm Work by Seasons

	Spring	Summer	Fall	Winter
Farm work				
Hr/day	9.4	9.8	9.3	5.5
Days/week	5.9	6.0	5.9	5.0
Hr/week	52.3	61.1	57.4	32.9
Operating heavy Equipment				
Hr/day	7.0	7.4	7.1	2.5
Days/week	4.7	4.9	4.7	3.2
Hr/week	36.8	40.6	38.7	10.9
Machine repair				
Hr/day	1.6	1.7	1.6	1.4
Days/week	2.3	2.2	2.6	1.4
Hr/week	4.5	4.9	4.7	3.6
Lifting/carrying over 50 pounds				
Hr/day	1.7	1.6	1.4	1.4
Days/week	3.6	3.3	3.1	3.2
Hr/week	7.7	6.7	6.3	6.7

TABLE V. Frequency of Prevalent Musculoskeletal Symptoms, Modified Work Habits Those That Saw a Physician Due to Symptoms

	Symptoms N (%)	Modified work habits N (%)	Saw physician N (%)
Neck	58 (22.4)	21 (8.1)	35 (13.5)
Upper back	43 (16.7)	19 (7.4)	32 (12.4)
Lower back	97 (37.5)	50 (19.3)	59 (22.8)
Shoulders	66 (25.9)	27 (10.4)	35 (13.5)
Elbows	15 (5.8)	5 (1.9)	5 (1.9)
Wrists/hands	31 (12.0)	10 (3.9)	11 (4.3)
Hips/thighs	27 (10.4)	16 (6.2)	15 (5.8)
Knees	61 (23.6)	30 (11.6)	21 (8.1)
Feet	39 (15.1)	14 (5.4)	17 (6.6)

TABLE VI. Number and Percentage of Back Pain During Preceding 12 Months by Selected Characteristics

Characteristic	Number	Percent
Back pain every day for a week or more		
Yes	92	36.4
No	161	63.6
Cause of back pain[a]		
Repeated activities	81	88.0
Single accident/injury	40	43.4
Location when back pain brought on by repeated activities		
At work on farm	65	80.2
At work off farm	7	8.6
At home, recreation site, etc	8	9.9
No answer	1	1.2
Location when back pain from single accident or injury		
At work on farm	31	77.5
Not at work on farm	8	20.0
No answer	1	2.5
Season when most of back pain occurs		
Spring	7	7.6
Summer	17	18.5
Fall	12	13.0
Winter	13	14.1
All seasons	21	22.8
Combination of seasons	18	19.6
No answer	4	4.4

[a]Categories not exclusive, that is, . . . both causes of back pain episodes could be chosen by a single participant.

work-related injury. The job factor rated least problematic was vibration from heavy equipment.

Association Between MSDs and Occupational and Non-Occupational Variables

The associations between prevalent back symptoms (every day for a week or more) and demographic variables and job factors are outlined in Table IX. There was a significant inverse trend ($P = 0.01$) for the association of back pain with age when categorizing age by quartile. The job factors of ''carrying, lifting, or moving heavy materials'' (OR = 2.74; 95% CI = 1.36–5.49), ''working when injured or hurt'' (OR = 2.57; 95% CI = 1.24–5.31), and ''working overhead'' (OR = 2.55; 95% CI = 1.25–5.19) were significantly associated with prevalent back pain when adjusting for other variables in the model.

Factors associated with musculoskeletal symptoms in the shoulder and neck are presented in Table X. There was a strong association with shoulder pain and the job factor of ''working with animals'' (OR = 5.20; 95% CI = 2.11–12.79). The strongest association for neck pain was found with the job factor of ''carrying, lifting, or moving heavy materials'' (OR = 4.46; 95% CI = 1.74–11.47).

TABLE VII. Most Difficult Tasks for Farmers (N = 92) With Back Pain

Farm task	Number	Percent
Lifting/carrying	34	37.0
Riding/operating equipment	24	25.1
Feeding animals, handling hay	17	18.5
Bending, stooping	15	15.3
Walking, sitting, standing (not in equipment)	8	8.7
Climbing, maneuvering	7	7.6
Machinery maintenance	4	4.3

TABLE VIII. Job Factors Contributing to Pain Symptoms Among Farmers (0–10 Scale)

	Mean	SD	Median
Heavy equipment vibration	2.57	2.39	2
Machine repair	3.19	2.48	3
Lift heavy materials	4.79	3.01	5
Maneuver/relocate animals	2.80	2.83	2
Work in awkward/cramped position	4.03	2.85	4
Work in same position for long time	4.41	2.97	4
Bend/twist back awkwardly	4.28	3.00	4
Work overhead	3.79	2.84	3
Work in inclement conditions	4.05	2.82	4
Work when injured or hurt	4.13	3.08	4
Insufficient breaks during workday	3.00	2.69	2

DISCUSSION

Low Back Pain

This sample of Kansas farmers experienced a slightly higher prevalence (36.4%) of low back pain than reported in studies of farmers in other parts of the United States. For the purposes of the present study, the case definition of low back pain was a ''yes'' response to ''At any time during the past 12 months, did you have back pain every day for a week or more?'' Using the same questionnaire item, Park et al. [2001], in their analysis of Iowa farmers, reported back pain prevalence at 31.0%, while Xiang et al. [1999] reported low back pain prevalence of 28.6% among the male farmers in Colorado. Using 1988 Occupational Health Supplement data from the National Health Interview Survey, Guo et al. [1999] reported that males working in the production of crops and livestock had a 12-month period prevalence of back pain of

TABLE IX. Association of Back Pain With Demographic and Occupational Factors

			Univariate		Adjusted[a]	
	Cases	Non-cases	OR	95% CI	OR	95% CI
Age quartile						
18–48.3	32	34	1.00	Referent	1.00	Referent
48.4–56.8	28	36	0.83	0.41–1.65	0.73	0.32–1.61
56.9–67.1	19	43	0.47	0.23–0.97	0.33	0.14–0.78
≥67.2	12	48	0.27	0.12–0.59	0.17	0.07–0.44
P-trend				0.0004		0.01
Age, mean (SD)	53.2 (12.0)	59.5 (12.9)				
Lift materials						
≤5	32	126	1.00	Referent	1.00	Referent
>5	60	39	6.06	3.42–10.06	2.74	1.36–5.49
Working overhead						
≤5	53	136	1.00	Referent	1.00	Referent
>5	39	29	3.45	1.94–6.14	2.55	1.25–5.19
Working when injured						
≤5	43	136	1.00	Referent	1.00	Referent
>5	49	29	5.34	3.01–9.48	2.57	1.24–5.31

[a]Adjusted for each of the variables listed.

16.2%, while they had previously found [Guo et al., 1995] that the general working population had a prevalence of 17.6% for back pain.

The vast majority of farmers in the present sample lived on their farm property, essentially living at work, so they may be more likely than the general population to report back pain as work-related. However, when given the opportunity to distinguish the location of the activities associated with back pain, the majority of farmers in the present study indicated that they were working on the farm when performing activities that caused their back pain. Of the back pain cases in the current study, 43.4% reported that their episode was due at least in part to a single accident or injury, and 77.5% of those reported that they experienced the accident or injury while at work on the farm. This is consistent to the findings among Colorado farmers of which 33.8% reported their back pain was due to an accident or acute injury, with 76.5% of those accidents taking place while the farmer was at work on the farm [Xiang et al., 1999]. In regards to repeated activities, of the back pain cases in the current study, 88.0% reported that at least part of their pain was due to activities such as lifting or pushing repeatedly, with 80.2% of those stating that the activities took place while at work on the farm. These findings are also consistent with Colorado farmers in which 66.2% of the back pain cases were related to repeated activities, with 91.5% of the activities taking place while the farmer was at work on the farm [Xiang et al., 1999].

TABLE X. Association of Shoulder and Neck Pain With Demographic and Occupational Factors

	Adjusted[a]	
Anatomical area	OR	95% CI
Shoulder		
Corn	1.00	1.00–1.00
Injury	2.15	0.91–5.04
Hr/year repair	1.01	0.99–1.02
Lift materials	1.99	0.93–4.28
Working with animals	5.20	2.11–12.79
Neck		
Total acres	1.00	1.00–1.00
Hr/year repair	1.02	1.01–1.04
Lift materials	4.46	1.74–11.47
Working when hurt	2.24	0.91–5.48

[a]Adjusted for all other factors in the model.

Job Factors

Many of the risk factors previously associated with back pain in occupational settings [Bernard, 1997] were also reported by this farming population. There was a strong association between low back pain among Kansas farmers and three job factors: (1) carrying, lifting, or moving heavy

materials, (2) working overhead, and (3) working when injured or hurt. Farmers rating any of these factors as a five or greater (on a 0–10 scale) were more than twice as likely to experience an episode of back pain in the previous 12 months than those rating these job factors less than five. Lifting materials has been strongly associated with back pain in other studies [Bernard, 1997].

Specific job factors were also associated with shoulder and neck pain. Shoulder pain was strongly associated with the job factor working with animals, while neck pain was strongly associated with lifting and carrying heavy materials. Shoulder pain was univariately associated with having sustained an injury, while neck pain was univariately associated with working when injured or hurt. Farmers may be more likely than workers in other occupational sectors [office, manufacturing, service sectors] to work when injured or hurt. Working while injured or hurt however, has also been reported to be problematic for construction workers [Goldsheyder et al., 2002; Merlino et al., 2003]. Several factors may account for farmers working while injured or hurt including being self-employed, limited availability of others to perform the necessary work tasks, seasonal and weather related constraints, and lack of workers' compensation insurance by small farming operations. As one farmer with low back pain stated on his questionnaire, ''the costs are too high to have somebody else to do the work for you but the work has to be done.''

Non-Occupational Factors

Age has been associated with back pain in previous studies [Bernard, 1997; Dempsey et al., 1997; Xiang et al., 1999; Park et al., 2001], but the direction of the association has been inconsistent. In the current study, there was a significant inverse trend for the association of age with low back pain. Xiang et al. [1999] suggested that a pattern of decreased back pain in older age groups might be due to the ''healthy worker effect,'' where younger workers who experience difficulty or pain due to work habits select themselves out of the population by leaving the occupation. Park et al. [2001] also suggested that older farmers in Iowa may perform less physical labor leaving the difficult high force tasks to younger workers. In addition, older experienced farmers may have learned to modify their work habits to avoid pain, discomfort, and injury. Additionally, farmers may not acknowledge symptoms as being significant until they are unable to perform specific tasks. A recurring theme reported by the respondents was ''back pain is just part of the job.'' Four areas of the body (neck, low back, shoulders, and knees) were identified by over 20% of the farmers as areas in which they experienced work-related pain. However, only low back pain caused more than 15% of the respondents to either modify their work habits or consult a physician.

Prevention Strategies

General farm work was found to be related to higher risk for back injury. The data in the present study indicates that heavy lifting, working when injured, and lifting overhead were associated with low back pain. Specific tasks that appear to be problematic include feeding animals, handling hay, and operating equipment. Thus, prevention strategies should be targeted in these problematic areas. For example, tractors could be retrofitted with additional steps and handles to ascend and descend safely into and out of the tractor cab. Better designed and spaced steps and handles may help prevent slips and falls and reduce the risk of injury. To minimize the risk of injury when lifting bags of grain seed, smaller packaging into lighter bags with handles may lower the risk of low back injury. Handling hay bales was a common safety concern for farmers in the present study. Improved mechanization and design of the bundling and handling processes could reduce the risk associated with manually lifting and throwing bales into the truck or feeding area. With improved recognition of the hazards associated with farming operations, engineering solutions can be developed and targeted for the farming tasks at highest risk of injury.

To help prevent injuries and illnesses related to farm work, NIOSH developed the publication Simple Solutions: Ergonomics for Farm Workers [Baron et al., 2001] which illustrates ergonomic interventions aimed at specific types of agriculture. It is clear from the NIOSH publication that agricultural tasks vary depending on the type of farming and to some extent the geographical region. Although the majority of ergonomic prevention strategies involve similar principles, the interventions are specific to the agricultural task. Interventions for workers harvesting berries would likely be very different than those for farmers harvesting wheat. Although the NIOSH publication addresses a variety of solutions for various agricultural sectors, it does not address the type of agricultural operations most common to Kansas or the US heartland that involve grain and livestock production. Additional effort should be focused on developing and disseminating solutions relevant to tasks common to the majority of agricultural operations in the Midwest and Mountain States. These operations would include populations involved in dairy production, grain production, and animal handling. Disseminating solutions involving dairy, grain, and animal handling operations would benefit a large segment of US agriculture.

CONCLUSIONS

The cross-sectional design was limited to establishing associations rather than causation between low back pain and other MSD symptoms and risk factors. The limited sample of farmers responding to the questionnaire presents a possible

selection bias and limits the generalizability of results. Although the response rate of 64% was greater than expected for this population, the conclusions should be limited to the demographic subset of respondents. There were no medical screenings or exposure assessments to validate MSD symptoms or risk factor exposure. Other factors previously associated with low back pain were not included on the questionnaire, including smoking status [Dempsey et al., 1997] and depressive symptoms [Stallones et al., 1995; Dempsey et al., 1997; Xiang et al., 1999]. The questionnaire items used to determine a 12-month period prevalence were dependent on self-reports during a 1-year period. Previous studies have demonstrated that memory decay of adverse health events is not uncommon among farmers even after just 2 months [Hwang et al., 2001; Jenkins et al., 2002]. Thus, loss of recall of symptoms is a possible limitation in the present study.

This was the first study of low back pain and MSD symptoms and associated risk factors among Kansas farmers. Close to 60% of the farmers reported that they experienced farm work-related MSD symptoms. Nearly one quarter of the farmers reported seeing a physician for their low back symptoms, and one in five farmers had to modify their work habits due to low back symptoms during the previous year. Back pain and other musculoskeletal conditions are problematic for Kansas farmers. This study population experienced back pain at a much higher rate than the general working population, and higher than other groups of farmers previously studied. The majority of the back pain experienced by farmers in the current study was caused by activities or accidents at work on the farm, representing a unique set of circumstances requiring additional study. Additional research is needed in the prevention of low back disorders among farmers involved in grain and livestock production.

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