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Musculoskeletal Injury, Functional Disability, and Health-Related Quality of Life in Aging Mexican Immigrant Farmworkers

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Abstract Migrant and seasonal farmworkers are at high risk for musculoskeletal and other occupational injuries. Although persons aged 40–80 years account for 40 % of all US farmworkers and as many as 50 % in certain regions, little is known about their occupational health issues. The current study examined work-related persistent musculoskeletal injuries (PMIs) and their association with clinical and functional indicators of disability and health-related quality of life (HRQOL) in 177 middle-aged and elderly US–Mexico border farmworkers. At interview, 68 % reported current PMI pain; 51 % had pain at multiple sites. PMI pain was associated with increased shoulder, knee, and lower extremity dysfunction and reduced HRQOL scores. However, fewer than 25 % of injured participants received any conventional medical treatment. The study results indicated that work-related PMIs, especially multiple PMIs, caused significant functional impairment, disability, and poorer HRQOL, adversely affecting the ability of the aging farmworkers to perform work, self-care, and other daily activities.

Keywords Occupational health · Musculoskeletal injuries · Functional disability · Health-related quality of life · Aging · Migrant and seasonal farmworkers · Hispanic immigrants

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Introduction

Approximately 1.1–3 million migrant and seasonal farmworkers, most of whom are Mexican immigrants [1, 2], labor on US farms planting, cultivating, and harvesting specialty food and fiber crops vital to the economy [3]. Farmworkers are at-risk for occupational injuries caused by toxic pesticides, chemicals, harsh environmental conditions (e.g., dust inhalation, sunburn, dehydration, heat stroke) and other exposures (e.g., pathogenic microorganisms, farm machinery and transportation accidents) [1, 4–9]. Farm work also involves the frequent lifting and carrying of heavy, unbalanced loads, prolonged kneeling, bending, stooping, twisting, repetitive hand tasks, and other physical stressors. These exposures can increase farmworker risk for musculoskeletal sprain and strain injuries resulting in significant physical pain and disability [1, 4–11].

National Agricultural Workers Survey (NAWS) published data indicates that average farmworker age has been increasing since 2000 [12]. Individuals aged ≥40 years accounted for 40 % of farmworkers surveyed by the NAWS from 2005 to 2009 [12]. However, the proportion is even higher in certain regions such as the US Southwest where more than half of crop workers were 40–80 years [9, 12–15].

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Farmworkers suffer from a high prevalence of work-related musculoskeletal injuries [1, 16–22]. However, little is known about the effect of injuries on functional disability and health-related quality of life in aging farmworkers. This is an important occupational health issue since functional capacity is affected by age-related changes in body composition including reduced lean body mass, increased fat mass, and possibly, decreased muscle quality [23, 24]. Musculoskeletal capacity decreases as much as 25 % between the ages of 30–65 years with the most rapid period of decline starting at around 45 [24]. Age-related declines in physical capacity can increase the risk for musculoskeletal injuries, especially severe ones, and prolong recovery time [23–26]. These declines are greatest among workers in high-demand manual occupations [24, 26].

Pain caused by osteoarthritis, herniated discs, and other musculoskeletal conditions has been linked to poorer health-related quality of life (HRQOL) in aging workers employed in physical demanding jobs across diverse occupations [27–30]. However, to the best of our knowledge, the impact of work-related musculoskeletal injury pain on physical and mental HRQOL has not yet been investigated in the aging farmworker population. Examination of HRQOL can provide useful insights into the burden of injury-related disabilities and help to guide future occupational health and safety interventions for the aging farm labor force.

The present study examined the prevalence and burden of work-related persistent musculoskeletal injury (PMI) pain in middle-aged and elderly Mexican immigrant farmworkers living on the US–Mexico border. We hypothesized that PMI pain, especially at multiple body sites, would be associated with increased functional impairment, disability and poorer physical and mental HRQOL in the aging farmworker group.

Methods and Materials

Study Site and Participants

A convenience sample of farmworkers was recruited from an El Paso, Texas, farmworker center during April, 2009–July, 2010. The center is a major hiring site for Far West Texas and Southeast New Mexico farms that produce food (e.g., chiles, onions) and fiber crops (i.e., cotton). All farmworkers located on-site by the study team were eligible to participate in the study if they had performed paid farm work during the previous 12-months and were aged 40 years or older. Of the 183 who were asked to participate, six declined. The study protocol was approved by the UTEP Institutional Review Board. Participants went through the informed consent process prior to the start of data collection in their preferred language, i.e., Spanish or English. They were compensated with a $20 cash payment and free blood pressure, cholesterol, and anthropometric screenings. Test results were individually interpreted for participants. Persons identified with health conditions requiring medical follow-up were given referrals to free/low cost local health care providers.

Data Collection

The bilingual study team administered the interviews and clinical, functional, and anthropometric assessments. Participants were offered the opportunity to be interviewed in either Spanish or English. An abbreviated version of the California Agricultural Worker Health Survey (CAWHS) [31] was used to collect information on participant characteristics including age, sex, education, marital status, birthplace, current residence, migration and occupation history, and acculturation indicators (e.g., language, literacy, years in US). The CAWHS also was used to collect data on participant health complaints for the past 12-month period.

Body Mass Index (BMI)

Participant body weight (kg) and standing height (cm) were measured according to a standard protocol [32]. These measurements were used to calculate BMI and classify overweight and obesity using CDC reference standards [33].

Work-Related Musculoskeletal Injury

The abbreviated CAWHS was used to question participants about any farm work-related persistent musculoskeletal injuries (PMIs) that they had experienced during the previous 12-months. Specifically, they were questioned in detail about any musculoskeletal strain or sprain injuries which had persisted for $\geq$1 week, the type and body sites affected, whether they still had pain at the same injury site, and the length of time the pain had persisted. They also were questioned about whether they had received treatment for their injuries, and if so, if this had involved self-treatment or that from a conventional medical or complementary and alternative medicine (CAM) practitioner.

Physical Pain, Disability, and Functionality Indicators

The Western Ontario and McMaster Universities Knee Osteoarthritis Index (WOMAC). was used to examine self-reported knee pain, stiffness, and physical dysfunction [34]. The instrument has 24 questions, rated on a 0–4 scale.

Three subscale scores were used to calculate the global scaled score (range 0–96). Higher scores indicate greater symptoms or physical disability.

The shoulder pain and disability index (SPADI) examined reported pain and disability due to shoulder pathology [35]. The SPADI contains 13 items divided into pain (5 questions) and disability (8 questions) sub-scales. Subscale scores were weighted and summed from 0 to 100 with higher scores indicating greater pain and dysfunction.

The short physical performance battery (SPPB) was used to assess lower extremity functioning [36]. The SPPB is based on performance on three objective tests: balance, strength, and walking. Each performance measure was assigned a score ranging from zero (inability to complete the test) to four (highest performance level). The test scores were summed to produce a summary score (range 0–12). Lower scores reflected poorer function and mobility.

Health-Related Quality of Life

The medical outcome short form (SF-36) was used to assess HRQOL. This instrument is reported to be a valid HRQOL measure for aging persons of Mexican descent [37]. It produces an 8-scale profile of functional health/well-being and physical (PCS) and mental health (MCS) composite scores [38]. The four physical health domains include physical functioning (extent to which an individual's health interferes with physical activities), role-physical (problems with work or other daily activities as a result of physical health), bodily pain (extent of bodily pain and related limitations), and general health (general health self-evaluation). The four mental health domains include vitality (participant perception of their degree of fatigue or energy), social functioning (extent to which health interferes with normal social activities), role-emotional (problems with work or other activities as a result of emotional problems) and mental health (general mood, psychological well-being, or distress). Domain and composite scores range from 0 to 100 with lower values indicating poorer quality of life. The Cronbach alpha for the eight SF-36 physical and mental health domains in our study ranged from 0.88 (vitality) to 0.90 (social functioning) suggesting good internal consistency.

Data Analysis

Descriptive data are presented as number (%) or mean ± SD. Multiple linear regression (MLR) was used to analyze the association of current work-related PMIs with WOMAC, SPADI, and SPPB scores, adjusting for age and sex. Likewise, MLR examined the current PMIs (individual and multiple) with the eight SF-36 domains and the physical (PCS) and mental (MCS) composite scores. Subsequently, three MLR models were constructed to investigate the association of current PMI number with PCS and MCS. Model 1 examined the unadjusted association of current PMI number with PCS and MCS. Model 2 investigated the association of PMI number with PCS and MCS, adjusting for participant age, sex, and education. Model 3 included all variables from Model 2 plus health-related covariates (i.e., diabetes, cardiovascular disease, body mass index, PMI treatment). The models were tested for assumptions of linearity, normality, collinearity, and goodness of fit.

Results

Participant Characteristics

Table 1 displays the characteristics of the 177 study participants whose ages ranged from 40 to 82 years. Compared to the NAWS 2007–2009 participants [39], the study farmworkers were more likely to be Mexican immigrants (96 % vs. 69 %) who had worked for more time in US agriculture (29 vs. 13 years). Although 76 % of participants were in a legal/common law union, only 53 % lived with their families. They also reported fewer average years of schooling compared to NAWS participants (5th vs. 8th grade) and more indicated having had little-to-no English speaking ability (97 % vs. 62 %). Low Spanish literacy was common among the El Paso participants with 40 % indicating they had little-to-no reading proficiency in their native language.

Health Complaints

Figure 1 displays the health complaints reported by participants for the last 12 months. The three most frequently reported were eye/vision, dental and gastrointestinal conditions. However, as the figure indicates, diabetes, cardiovascular disease, and emotional/psychological problems also were common. The anthropometric assessments also identified a high prevalence of overweight (37.8 %) and obesity (48.3 %) among participants.

Persistent Musculoskeletal Injury

Eighty-one percent of participants reported that they had experienced at least one PMI during the past 12 months while performing farm work (Table 2). The knees and back were the most common injury sites, affecting more than half. Participants reported experiencing an average of 2.9 ± 2.3 different injury events resulting in pain lasting an average of 5-8 weeks, depending on injury site. At interview, 68 % of participants indicated they were currently experiencing

Table 1 Participant characteristics (n = 177)

Participant characteristics	Mean ± SD no. (%)
Age (in years)	55.6 ± 8.8
40–45	24 (13.6)
46–50	30 (16.9)
41–55	34 (19.2)
56–60	36 (20.3)
61–65	28 (15.8)
>65	25 (14.1)
Sex	
Male	163 (92.1)
Birthplace	
Mexico/CA	169 (95.5)
US	8 (4.5)
Years working in US (foreign-born)	28.9 ± 9.9
≤20	35 (19.8)
>20	142 (80.2)
Marital status	
Legally married	102 (57.6)
Single	32 (18.1)
Separated or divorced	19 (10.7)
Common law union	17 (9.6)
Widowed	7 (4.0)
Currently lies with family in the US	
Yes	93 (52.5)
No	84 (47.5)
Formal education	5.4 ± 3.0
No formal education	9 (5.1)
1–3 years	39 (22.0)
4–6 years	90 (50.8)
7–9 years	28 (15.8)
10–12 years	8 (4.5)
Some post-secondary (college or technical school)	3 (1.7)
Language(s) spoken in home	
Spanish only	139 (78.5)
Spanish and indigenous language	4 (2.3)
Spanish and English	34 (19.2)
English reading proficiency	
Little-none	170 (96.0)
Good or better	7 (4.0)
English oral proficiency	
Little to no proficiency	171 (96.6)
Good or better proficiency	6 (3.4)
Spanish reading proficiency	
Little to no proficiency	72 (40.7)
Good or better proficiency	105 (59.3)

pain from an injury; 51.4 % reported pain at multiple body sites. However, despite the high prevalence of PMI pain, fewer than 25 % of participants reported that they had been treated for their PMIs by a physician, nurse, or other conventional health care provider. Even fewer noted being treated by a CAM practitioner (1.6–8.4 %) or practicing self-treatment with over-the-counter remedies (2.9–16.3 %).

Clinical Indicators of Pain, Disability, and Functionality

Clinical indicators of pain, disability and functionality measured by the WOMAC, SPADI, and SPPB exams were compared between participants with and without current work-related PMIs with adjustments for age and sex. The WOMAC results confirmed that participants with a current knee injury had significantly increased knee pain, stiffness, and dysfunction than their non-injured counterparts (Fig. 2). Their mean scaled scores also were higher indicating greater knee disability. Twelve percent had a score (>39) suggestive of severe osteoarthritis requiring possible knee replacement surgery [40].

Figure 3 shows that participants with current shoulder PMI had significantly greater pain and disability levels on the SPADI exam than those without such injury. They also had higher average SPADI global scaled scores indicating poorer upper extremity functioning.

The SPPB results revealed that as the number of current work-related PMIs increased, SPPB balance ($\beta = -0.16$; $t = -2.1$; $p = 0.037$) and strength scores decreased ($\beta = -0.19$; $t = -2.5$; $p = 0.014$). In contrast, walking scores did not ($\beta = 0.04$; $t = 0.56$; $p = 0.57$). Total SBBP score was marginally associated with PMI number primarily due to the contribution of balance and strength scores ($\beta = -0.15$; $t = -2.0$; $p = 0.048$).

Musculoskeletal Injury and Health-Related Quality of Life

The SF-36 compared the HRQOL of participants with and without a current work-related PMI. Participants who reported a PMI at one of seven sites (i.e., shoulder, knee, back, foot, hand, neck, other) had significantly reduced average physical health domain and PCS scores compared to those without such an injury ($p = 0.0001$). The same general pattern was observed for MCS as well as most mental health domain although the strength of the identified associations varied from $p = 0.03$ to 0.0001. The exception to this pattern was hand injury which showed a non-significant association with social functioning or role emotional ($p > 0.05$).

Since multiple PMIs were common, the association of current PMI number with PCS and MCS was examined. As Fig. 4 indicates, the simple linear regression analysis results showed that as the number of PMIs increased, PCS

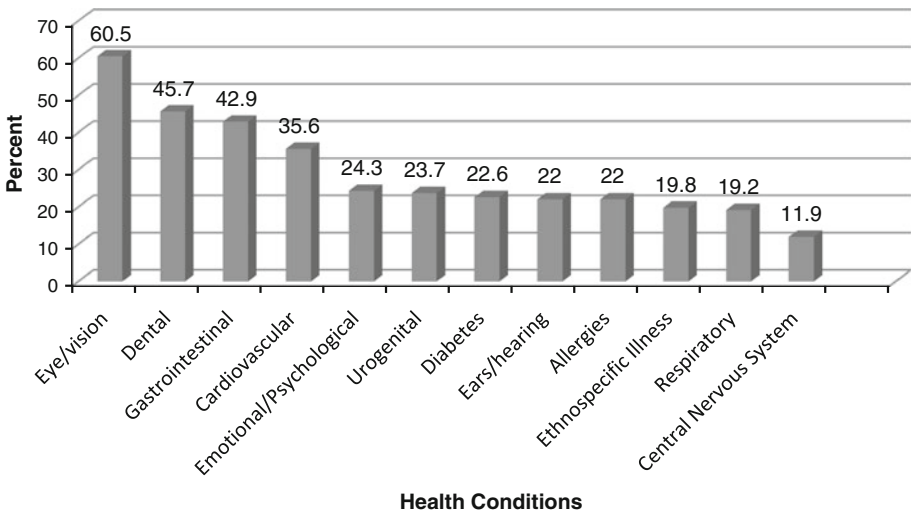

Fig. 1 Health conditions reported by participants for the previous 12-month period (n = 177)

and MCS scores decreased. We next constructed MLR models to examine the association of multiple PMIs with PCS and MCS. Table 3 shows that when participant age, sex, and education covariates were added to model 1, the strength of the previously identified association between PMI number and PCS remained relatively constant (Model 2). Likewise, little appreciable change in association strength was seen with the addition of the health-related covariates, i.e., BMI, diabetes, CVD, treatment (Model 3). In Model 3, the covariates retaining their association with PMI number were age, sex, and diabetes. The final model R^2 indicated that PMI number and covariates accounted for nearly half of the explained variance in PCS.

Table 4 shows that adding the age, sex, and education covariates to Model 1 caused little change in the association strength of PMI number with MCS (Model 2). In Model 3, the addition of the health-related covariates resulted in a slight decrease in the strength of association between PMI number with MCS. However, as the table shows, none of the model covariates were themselves significantly associated with MCS. The amount of MCS variance explained by Model 3 was less than that observed for PCS, i.e., 9 %.

Discussion

The study findings underscore the high burden of work-related PMIs, dysfunction, disability, and reduced HRQOL experienced by aging farmworkers. We believe that this is the first study to specifically focus on these issues in this group. Mexican immigrants account for ~75 % of US farmworkers [16]. This workforce is expected to continue to age, at least in the foreseeable future, due to increasing consumer demand for fresh produce requiring intensive hand-labor [41], the declining number of Mexican nationals seeking work in the US [42], and a reluctance of US citizens to perform low-paying, physically demanding crop work [3]. Furthermore, poor access to retirement, disability, and other benefits appears to force many immigrants to continue working in agriculture.

The high prevalence of work-related musculoskeletal injuries is consistent with data reported on similarly aged crop workers in Texas [9], North Carolina [43] and Oregon [44]. The data also are consistent with those from the NAWS indicating that multiple injuries are commonplace [16]. The study data indicated that PMIs caused significant pain and dysfunction for the participants, affecting their ability to perform work, self-care, and other daily activities. Such injuries have the potential to exacerbate pre-existing pathology, especially in aging persons [45], and increase their risk for work-place accidents [43] and permanent disability [46]. Furthermore, decreased physical functionality such as that measured by the SPPB is associated with increased risk for future hospitalization, institutionalization, and death [47–50]. The reduced ability of farmworkers with PMIs to perform self-care is also worrisome because it may reduce their ability to adequately deal with the consequences of other occupational exposures (e.g., pesticides, other farm chemical) and non-occupational health conditions.

Current PMI pain was associated with significantly reduced SF-36 scores for all physical and most mental health domains as well as for both PCS and MCS. The effect of PMI pain on physical functionality and HRQOL has not been previously described for farmworkers. However, upper-extremity injury has been linked to diminished physical HRQOL among females employed in poultry processing and other low wage jobs [51] and for workers with arthritis or similar musculoskeletal disorders [27, 30]. Furthermore, the evidence indicates that adolescents [52], young adults [53], and adults [54] with musculoskeletal

Table 2 Prevalence of work-related persistent musculoskeletal injuries and their treatment during previous 12-month period (n = 177)

Injury site	No.	(%)
Knee injury		
Experienced persistent pain at site lasting more than 1 week	98	55.4
Currently experiencing pain from the injury[a]	75	76.5
Received any type of treatment for the injury[b]	34	34.7
Medical practitioner[c]	16	16.3
CAM practitioner[d]	2	2.0
Self-treatment[e]	16	16.3
Back injury		
Experienced persistent pain at site lasting more than 1 week	83	46.9
Currently experiencing pain from the injury[a]	58	69.9
Received any type of treatment for the injury[b]	37	44.6
Medical practitioner[c]	20	24.1
CAM practitioner[d]	7	8.4
Self-treatment[e]	10	12.0
Hand injury		
Experienced persistent pain at site lasting more than 1 week	68	38.4
Currently experiencing pain from the injury[a]	59	86.8
Received any type of treatment for the injury[b]	11	16.2
Medical practitioner[c]	6	8.8
CAM practitioner[d]	3	4.4
Self-treatment[e]	2	2.9
Foot injury		
Experienced persistent pain at site lasting more than 1 week	62	35.0
Currently experiencing pain from the injury[a]	52	83.9
Received any type of treatment for the injury[b]	14	22.6
Medical practitioner[c]	9	14.5
CAM practitioner[d]	1	1.6
Self-treatment[e]	4	6.5
Shoulder injury		
Experienced persistent pain at site lasting more than 1 week	61	34.5
Currently experiencing pain from the injury[a]	48	78.7
Received any type of treatment for the injury[b]	23	37.7
Medical practitioner[c]	12	19.7
CAM practitioner[d]	3	4.9
Self-treatment[e]	8	13.1
Neck injury		
Experienced persistent pain at site lasting more than 1 week	52	29.4
Currently experiencing pain from the injury[a]	35	67.3
Received any type of treatment for the injury[b]	9	17.3
Medical practitioner[c]	2	3.8
CAM practitioner[d]	2	3.8
Self-treatment[e]	5	9.6
Other injury (leg, hip, arm)		
Experienced persistent pain at site lasting more than 1 week	44	24.9
Currently experiencing pain from the injury[a]	33	75.0
Received any type of treatment for the injury[b]	14	31.8
Medical practitioner[c]	10	22.7
CAM practitioner[d]	2	4.5
Self-treatment[e]	2	4.5

[a] Number and percent refer to the study participants who reported the injury

[b] Refers to participants with an injury who received any type of treatment

[c] Medical treatment provided by a physician, nurse, or other medical professional

[d] Treatment provided by a complementary and alternative medicine (CAM) practitioner (e.g., chiropractor, sobador, curandero, herbalist)

[e] Self-treatment including anti-inflammatory agents, analgesic creams, and other over-the-counter remedies

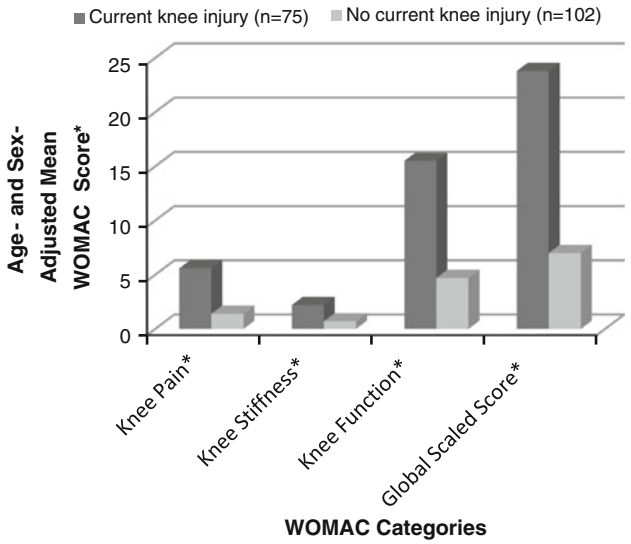

Fig. 2 Comparison of Western Ontario and McMaster Universities Knee Osteoarthritis Index (WOMAC) scores between participants with current work-related persistent musculoskeletal injuries of the knee. * $p = 0.0001$

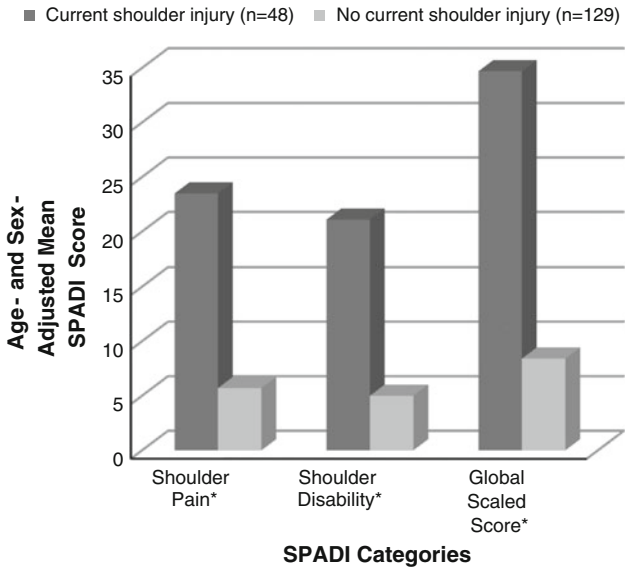

Fig. 3 Comparison of shoulder pain and disability index (SPADI) scores between participants with current work-related persistent musculoskeletal injuries of the shoulder. * $p = 0.0001$

pain at multiple sites caused by injuries or other musculoskeletal conditions [54] have significantly reduced quality of life compared to non-injured persons or those with pain at a single site. Future studies should consider the impact of multiple musculoskeletal injury pain on farmworker HRQOL along with other co-morbidities known to influence quality of life outcomes. It should be pointed out that despite their pain, fewer than half of injured participants reported receiving any form of treatment. This finding is consistent with other studies describing poor health care access for other farmworker groups [1, 7, 9, 55–59].

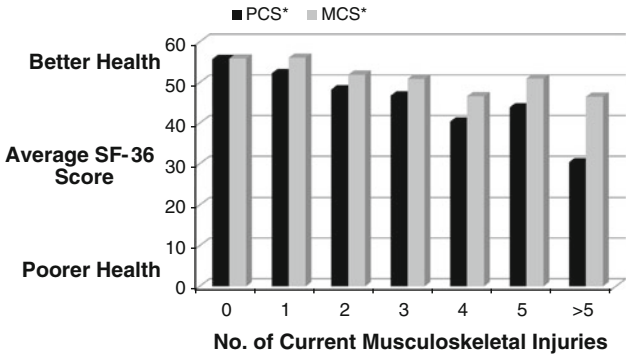

Fig. 4 Association of the number of current work-related persistent musculoskeletal injuries with SF-36 PCS and MCS * $p = 0.0001$

This study adds to scientific knowledge regarding the influence of work-related PMIs on physical functioning and HRQOL in aging farmworkers. However, its potential limitations should be considered when interpreting its findings. For example, although PMI pain is a plausible mechanism for explaining functional disability and poorer HRQOL, the cross-sectional design does not allow for the establishment of causality. It also is possible that confounding by variables not measured by the study could explain some of the identified associations. In addition, survivor or "healthy worker" bias may have been present since workers who suffered more severe or debilitating past injuries would have been underrepresented. The use of self-reported data, especially in aging individuals, may be subject to recall bias. However, we used a restricted time frame (within last 12 months) to help distinguish recent from past injuries. Furthermore, although the characteristics of participants were similar to other Southwest region farmworkers [9, 13–15], the results may not be generalizable to other groups.

In conclusion, studies are needed to better understand the work environment and safety issues of the growing US population of aging immigrant crop workers. Many of the injuries and health complaints identified in the study are potentially preventable and/or amenable to intervention. These should be targeted, culturally appropriate integrated interventions based on evidence. Beyond these, changes in policy and practices are needed. Farmworkers (documented and undocumented) are excluded from some of the important protections provided under federal (Fair Labor Standards Act, National Relations Act, OSHA, i.e., standards addressing falls, ladder safety, electrocution, unguarded machinery) and state provisions [60–62]. In addition, many states do not compel employers to provide workers compensation for migrant and seasonal farmworkers [60]. Policy changes in workman's compensation are needed to improve access to this important benefit by all farmworkers in all states regardless of their immigration status.

Table 3 Regression analysis of current persistent musculoskeletal injury (PMI) on the SF36 physical composite scale (PCS)

Variables	Model 1			Model 2			Model 3		
	β	t	*p*	β	t	*p*	β	t	*p*
Musculoskeletal injury (no.)	−0.64	−12.1	<0.0001	−0.62	−10.9	<0.0001	−0.57	−9.52	<0.0001
Age (years)				−0.17	−2.70	0.008	−0.15	−2.30	0.023
Sex (female)				−0.10	−1.74	0.84	−0.12	−2.13	0.035
Education (years)				0.01	0.10	0.92	−0.10	−0.17	0.87
Diabetes							−0.15	−2.58	0.011
Cardiovascular disease							−0.06	−1.06	0.29
Body mass index							0.49	0.88	0.38
Any treatment for PMI							−0.46	−0.80	0.43
R^2	0.45			0.48			0.49		

Table 4 Regression analysis of current persistent musculoskeletal injury on the SF36 mental composite scale (MCS)

Variables	Model 1			Model 2			Model 3		
	β	t	*p*	β	t	*p*	β	t	*p*
Musculoskeletal injury number	−0.31	−4.32	<0.0001	−0.31	−4.13	<0.0001	−0.27	−3.36	0.001
Age (years)				−0.49	−0.59	0.56	−0.60	−0.69	0.49
Sex (female)				0.07	0.97	0.34	0.62	0.81	0.42
Education (years)				0.10	0.09	0.93	−0.03	−0.31	0.76
Diabetes							−0.11	−1.39	0.17
Cardiovascular disease							0.03	0.38	0.71
Body mass index							−0.11	−1.44	0.15
Any treatment for PMI							0.06	0.82	0.41
							−0.11	−1.39	0.17
R^2	0.09			0.09			0.09		

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