

Hand Problems in Migrant Farmworkers

D. J. Shah, E. M. Shipp, S. P. Cooper, J. C. Huber,
D. J. del Junco, A. A. Rene, J. S. Moore

ABSTRACT. *Purpose:* We estimated the self-reported prevalence of hand problems and identified factors associated with them in this cross-sectional study including 390 farmworkers representing 180 migrant farmworker families from Starr County, Texas. *Methods:* A two-year cohort study (1999-2001), "Injury and Illness Surveillance in Migrant Farmworkers (MANOS)," provided the data for this study. We calculated the prevalence for the two-year follow-up period, stratified by family member and survey year. The associated work and non-work factors were identified for the entire sample using multilevel mixed-effects logistic regression analysis. *Results:* Prevalence for hand problems was 29.0% and 17.8% for the first and second study years, respectively. Significant factors (associated odds ratios) included increasing age (1.07), female gender (3.49), duration of sleep while migrating (0.68), participation group working in both study years 1 and 2 (0.21) or year 2 only (0.14), working on average more than 11 hours per day (8.23), moving heavy objects at work (3.97), working with hand-held vibrating tools/machinery (5.16), and working in meat processing (40.48). *Conclusions:* The prevalence of hand problems in migrant farmworkers reported by this study was notable for mothers, fathers, and children. Further research with refined ergonomic exposure and outcome assessments for investigating hand injuries in migrant farmworkers is indicated, specifically among youth. The role of sleep in preventing symptoms should also be explored.

Keywords. Agriculture, Family, Farmworkers, Hand pain, Hand symptoms, Hispanics, Migrants, Multilevel mixed effects regression, Musculoskeletal disorders, Upper extremity disorders, Starr County, Texas.

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The authors are **Dimpy Jagdish Shah**, MD, MSPH, Graduate, Texas A&M Health Science Center, School of Rural Public Health, College Station, Texas; **Eva M. Shipp**, PhD, Assistant Professor, and **Sharon P. Cooper**, PhD, Professor and Regional Dean, The University of Texas Health Science Center, Houston School of Public Health, San Antonio Regional Campus, San Antonio, Texas; **John C. Huber**, PhD, Assistant Professor, Department of Epidemiology and Biostatistics, Texas A&M Health Science Center, School of Rural Public Health, College Station, Texas; **Deborah del Junco**, PhD, Associate Professor, The University of Texas Health Science Center, Houston Center for Clinical and Translational Sciences, Houston, Texas; **Antonio A. Rene**, PhD, Assistant Dean of Academic Affairs, Director of Distance and Distributed Learning, and Associate Professor, Department of Epidemiology and Biostatistics, Texas A&M Health Science Center, School of Rural Public Health, College Station, Texas; and **John S. Moore**, MD, PhD, Professor and Program Director, Department of Environmental and Occupational Health, Texas A&M Health Science Center, School of Rural Public Health, College Station, Texas. **Corresponding author:** Eva M. Shipp, UTHSC-SPH SARC, 7703 Floyd Curl, MC7976, San Antonio, TX 78229; phone: 210-562-5524; fax: 210-562-5528; e-mail: eva.m.shipp@uth.tmc.edu.

Agriculture is one of the most important as well as most hazardous industries in the U.S. (Kandel, 2008; Davis and Kotowski, 2007; NIOSH, 2004; McCurdy et al., 2003; Villarejo et al., 2000; May-Lambert et al., 1998). Due to the seasonal nature of agriculture, migrant and other seasonal farmworkers play a critical role in the economic success of this industry. Out of nearly 1 million migrant farmworkers in the U.S. (Kandel, 2008), approximately 362,724 migrant farmworkers reside in Texas (in households that include non-farmworkers), with 8,458 in Starr County, one of the poorest counties in the U.S. (Larson, 2000; U.S. Census, 2000). The definition of “migrant farmworker” used for the annual National Agricultural Workers' Survey (NAWS) is a farmworker who traveled at least 75 miles in the previous year to obtain a farm job, but the definition varies for different studies. The majority of this population is foreign-born, with substantial representation from Mexico. According to NAWS 2001-2002, 75% of all crop workers were born in Mexico, and 42% of the crop workers were migrant farmworkers. The number of new foreign-born workers increased by 60% from 1993-94 to 2001-02 (Carroll et al., 2005). It is anticipated that there will be an increased demand for intensive manual labor performed by migrant farmworkers in the U.S. (U.S. GAO, 1998), and thus it follows that ensuring the occupational health and safety of these workers is critical.

A variety of issues related to poor living and working conditions, such as substandard housing; exposure to pesticides; lack of toilets, drinking, and hand-washing facilities at work; and lack of quality medical services, access to public assistance programs, and full Social Security benefits, to which they may be entitled, are just some of the hardships faced by migrant farmworkers. Other challenges include low wages, lack of job security, seasonal variation in the availability of jobs, and periods of unemployment (Kandel, 2008). In addition to being economically disadvantaged and a vulnerable population, migrant farmworkers are exposed to a number of work hazards, which may put them at an increased risk of fatal as well as nonfatal injuries.

It has been suggested that hand, arm, shoulder, and back aches are the most common health problems for farmworkers (Baron et al., 2001). Musculoskeletal disorders (MSDs) can involve a variety of tissues, including nerves, tendons, muscles, intervertebral discs, and supporting structures. MSDs of the upper extremities (e.g., hands, wrists, arms, shoulders) can range from mild to debilitating problems such as “pain, numbness, tingling; carpal tunnel syndrome and tenosynovitis” (NIOSH, 1997). A possible mechanism for MSDs is that tissue inflammation leads to repair and/or fibrotic scarring with peripheral nerve injury and central nervous system reorganization (Barr et al., 2004). These injuries can remain subclinical and unnoticed for a long time. Eventually, they can become permanent, especially given continued trauma without treatment (Putz-Anderson, 1988).

Occupational exposures play a substantial role in the development or exacerbation of MSDs. As such, NIOSH (National Institute for Occupational Safety and Health) defined work-related musculoskeletal disorders (WMSDs) as “musculoskeletal disorders caused or made worse by the work environment.” NIOSH also designated WMSDs as one of the 21 priority research areas under the first decade of the National Occupational Research Agenda (NORA). The economic burden due to WMSDs is large and can reach \$45 billion to \$54 billion annually, considering lost wages along with lost taxes and revenues. The workers' compensation costs associated with the work days lost due WMSDs range from \$13 billion to \$20 billion annually. These figures are underestimated, as they account for documented cases only (NRC/IOM,

2001). Of all the anatomical regions, WMSDs of the upper extremities lead to the greatest economic impact, as they are associated with the longest absences from work (Barr et al., 2004). Consequently, WMSDs of the upper extremities can be painful, permanent, disabling, and economically burdensome for the employee, the employer, and the nation as a whole.

Common risk factors for hand/wrist disorders are repetitiveness, forcefulness, pinch grasp, awkward posture, localized mechanical compression, vibration, and cold temperature (Moore et al., 2001). Intensity, frequency, and length of exposure to these risk factors determine the level of risk for these disorders (NIOSH, 1997). Many of these known risk factors (specifically repetitive hand work, lifting objects repetitively, and moving heavy objects) are common exposures among migrant farmworkers during the migration season (Cooper et al., 2006).

Focus group data suggest that the risk of hand/wrist musculoskeletal disorders among farmworkers may be further increased by the following: lack of proper training, intense working patterns for long hours within a short hiring period, constant pressure to work with a fast rhythm, few work rest periods, and a helpless feeling because of a lack of control over working conditions (Earle-Richardson et al., 1998).

Musculoskeletal disorders of the back and hand are the most commonly studied musculoskeletal disorders in general; however, very few studies have examined hand problems among migrant farmworkers. A growing literature reports on hand problems among farmers/farm owners/operators and indicates a high prevalence of this outcome (12.0% to 29.5%) (Villarejo et al., 2000; Faucett et al., 2001; Gomez et al., 2003; Holmberg et al., 2003; Barr et al., 2004; Rosecrance et al., 2006; Alterman et al., 2008). However, the majority of studies focus on farm owners/operators. Since migrant farmworkers differ from farmers in many respects (e.g., socio-demographics, job tasks, legal status, access to healthcare), research findings from one of these two populations may not be entirely applicable to the other (Frank et al., 2004). A handful of studies report the prevalence of hand problems among farmworkers, but they rarely identify associated factors. Knowledge of such factors could substantially impact the design and implementation of prevention programs that target this largely Hispanic and mobile population. To begin filling research gaps, this study examines hand problems and associated work and non-work factors experienced during the past migration season among migrant farmworker families.

Materials and Methods

For the current study, we used data from the two follow-up years (during 1999-2001) of a cohort study, "Injuries and Illness Surveillance in Migrant Farmworkers (MANOS)." The main objective of the cohort study was to determine the frequency of acute nonfatal occupational injuries and associated risk factors in a random sample of 267 migrant farmworker families. Farm work was defined as "any work that involved an aspect of food production in the U.S. (e.g., field work, packing sheds, and butchering) for pay or not for pay." A migrant farmworker was "any farmworker who would have to spend a night away from their home to do their farm job" (Cooper et al., 2006).

Study Population

Starr County is located on the Texas-Mexico border with a population of 53,597 in 2000 (U.S. Census, 2004). Rio Grande City Consolidated Independent School District (RGCCISD) is the largest of the three public school districts in the county, with approximately 60% of the county's students enrolled in it. The other two are Roma ISD and San Isidro ISD, with 38.9% and 1.6% of the county's students, respectively. Nearly 99.6% of the students in Starr County are Hispanic, and 99.7% of them are classified as economically disadvantaged (Texas Education Agency, 2006). In Texas, the Migrant Education program maintains an electronic system called New Generation System (NGS) to identify migrant students and transfer their enrollment, demographic, academic, and health data across the U.S. as the students migrate. This system was used to obtain a random sample of potential participants from students enrolled in RGCCISD. The 1520 migrant farmworker families listed in NGS comprised the accessible population for this study.

Sampling and Recruitment

From the 1520 families listed in the NGS, a random sample of 372 families was selected. From these families, 371 mothers were interviewed for the first time in spring 2000 (baseline interview), and the cohort study enrolled and followed up 267 mothers because they expressed an intention to migrate during the following season. Of these, 154 migrated during the migration season in fall 2000 (year 1 follow-up), and 143 migrated in 2001 (year 2 follow-up). The mothers were interviewed after each migration season during the two follow-up years. Thus, up to three interviews were done for each family in the cohort study. Families were offered a \$15 gift card to a local grocery/discount store for their participation in each follow-up survey, and the response rate for mothers completing the follow-up survey each year was 96% (Cooper et al., 2006). We used survey data from follow-up years 1 and 2 for this study.

Data Collection

The mothers provided data on behalf of their husbands and their oldest and youngest children who had also migrated during the prior migration season. Since only a small proportion of youngest children actually participated in farm labor in year 1, they were not included in the year 2 survey in order to reduce participant burden. Written consent was obtained from the mothers. The survey was conducted by experienced bilingual interviewers and supervised by an expert bilingual field supervisor with over 20 years of experience in Starr County to ensure standardization of field procedures for data collection. The survey, adapted from previous surveys on farmworkers (McCurdy et al., 2003; Kolbe et al., 1993; Mehta et al., 2000), was bilingual in Spanish and English with questions regarding demographics, work history, injuries, health symptoms, work hazards, pesticide exposure, and sleep. The final draft was reviewed by a panel of academic investigators, physicians trained in occupational epidemiology, and government researchers. It was pilot tested with Spanish-speaking interviewers and migrant farmworker mothers. The interviews lasted from 30 to 60 minutes each (Cooper et al., 2006). All the procedures in the original study were approved by The University of Texas Health Science Center Committee for the Protection of Human Subjects, and the current study was approved by the Texas A&M University Institutional Review Board.

Independent and Dependent Variables

Various terms are used to describe upper extremity disorders based on anatomy, etiology, or pathophysiology; however, Katz et al. (2000) noted that it is preferable to use a simple phenotypic description such as “shoulder pain.” We selected hand problems as the outcome variable. Participants were categorized as a case if the mother provided positive endorsement of one or both of the following variables: “burning, tingling, numbness, stiffness, or muscle/joints aches and pains in the hand or wrist or fingers experienced during the prior migration season” or “any difficulty in picking up or holding things with hands or fingers experienced during the prior migration season.” The possible responses for these questions were “yes,” “no,” “don’t know,” “refused,” and “not applicable.” Survey items remained the same for both years, but we slightly modified the Spanish translation of one of the hand problem items in year 2: *dolores* was used for year 1, and *problemas* was used for year 2. This minor change in wording was unlikely to markedly impact responses, since the question included a detailed description of the hand/wrist problems as indicated by a professional Spanish translator.

The main exposures of interest were details of each farm job held during the migration season, including the crop worked (i.e., corn, beets, potato, peanuts, cotton, grapes, and asparagus), the job task (i.e., weeding, harvesting from the ground, harvesting from the trees, sorting, hoeing, cleaning, cutting, detasseling, operating farm machinery, working with trees, working with poultry, and working in a meat-related job), work intensity (i.e., days per week and hours per day), location (i.e., Texas only, out of Texas only, and both), employer type (i.e., grower, contractor, and combined employer types), type of work during majority of life, other ergonomic hazards (i.e., repetitive hand work, moving heavy objects at work, using hand-held vibrating tools or machinery, using hitched equipment, using power driven tools, using knives or cutting tools, and lifting objects repetitively), surrogates of safety climate (i.e., drinking water employer-provided/self-provided, toilet facilities employer-provided, toilet paper employer-provided/self-provided, training provided, language of training, working with electrical lines, soap and water for washing hands employer-provided/self-provided), and number of years involved in migrant and non-migrant farm work. Additional potential independent main effects, confounders, and effect modifiers assessed included participation group (i.e., worked for year 1 only, worked for both years 1 and 2, and worked for year 2 only), demographic characteristics (i.e., age, gender, years of education, number of years spent in Starr County), and non-work related variables (i.e., drinking alcohol while migrating, number of alcoholic drinks per week, smoking and tobacco history, feeling sad for more than two weeks in past 12 months and past migration season, and amount and quality of sleep while migrating and at home in Starr County).

Statistical Analyses

We used Intercooled STATA, version 10.0 (STATA, 2007) to complete all data analyses. Given a fixed sample size of 580 observations, two-sided alpha 0.05, there was 80% power to detect relative risk ratios from 1.86 to 3.09 given a range of exposure prevalence (10% to 60%) and outcome prevalence (10% to 20%) (Schlesselman, 1974). After preliminary data examination for consistency, the prevalence of hand problems was determined by calculating the number of participants with the outcome divided by the total number of participants. Prevalence of hand problems was also

stratified by family member (e.g., mother, father, oldest child, youngest child) and survey year.

The data for the current study were sampled by families over two-year period and hence had a potential for being clustered by common environment (e.g., family members living together, sharing same genes) and by data collection on the same individual for a maximum of two years. Due to sampling participants by family, observations may not be independent, which is a violation of the assumption of the logistic regression model. Hence, we used multilevel mixed-effects logistic regression analysis to account for the possible clustering (Dohoo et al., 2003). We calculated the unadjusted odds ratios and 95% confidence intervals (CI) with their p-values for each independent variable and hand problems. Then, we constructed a final model using a forward selection process by entering variables significant at $p \leq 0.25$ in the model one at a time (Mickey and Greenland, 1989). Variables were retained in the model if they were significant at the 0.05 level or if they induced a greater than or equal to 15% change in the odds ratio of another significant variable of primary interest, indicating confounding (Rothman and Greenland, 1998). Previously eliminated variables ($p > 0.25$) were entered one at a time to ensure that all variables were given the opportunity to appear in the final model. Finally, we tested for all first-order interactions one at a time (Cooper et al., 2006; Shipp et al., 2006) and used the locally weighted scatter-plot smoother (lowess) graph to test the fit of the final model (Long and Freese, 2001).

Results

Descriptive Statistics

Since families could participate for a maximum of two years, the dataset contained 580 records representing information on 390 unique individuals from 267 families. There were 119 and 105 mothers, 104 and 95 fathers, 71 and 65 oldest children, and 21 youngest children (year 1 only) who migrated in the previous season to do farm work for year 1 (1999-2000) and year 2 (2000-2001), respectively. The sample was equally distributed by gender (e.g., 51.6% male in year 1; 50.2% male in year 2). Ages ranged from 10 to 69 years with a mean of 34.5 years in year 1 and 37.1 years in year 2. In years 1 and 2, the majority worked only for growers/owners (75.2%; 57.7%) and only at sites located in Texas (66.0%; 72.1%). The majority of the population worked for more than or equal to six days per week (77.7% mothers, 82.4% fathers, 79.4% oldest children, and 80.9% youngest children), and a substantial fraction worked for more than or equal to 11 hours per day (20.5% mothers, 26.3% fathers, 26.5% oldest children, and 23.8% youngest children). The most common crops cultivated were cotton (39.0%, 26.0%), corn (17.1%, 20.4%), asparagus (13.3%, 10.6%), potatoes (11.7%, 10.9%), and beets (11.7%, 9.8%), and the most common tasks performed were hoeing (37.1%, 37.0%), sorting (21.0%, 17.7%), weeding (18.7%, 8.7%), and harvesting from ground (18.4%, 12.5%) for years 1 and 2, respectively. A more detailed description of the sample characteristics is provided in the article examining injuries in migrant farmworker families in south Texas (Cooper et al., 2006).

Prevalence of Hand Problems

Prevalence of hand problems in year 1 (1999-2000) and year 2 (2000-2001) for the entire sample was 29.0% and 17.8%, respectively. The prevalence of hand problems

was stratified by family member and survey year, as listed in table 1. Despite using the same survey methods, the prevalence of hand problems for the total sample decreased during the second year (2000-2001). A similar decrease in the prevalence of hand problems was observed when stratified by family member. The prevalence for hand problems was highest for mothers during the first study year (37.3%) and lowest for oldest children during the second year (6.2%).

Unadjusted Multilevel Mixed-Effects Logistic Regression Analyses

Of the non-work variables, we found odds ratios (ORs) significant at $p \leq 0.05$ for increasing age (1.06), female gender (2.23), increasing years of education (0.76), increasing average hours of sleep while migrating (0.58), bad/very bad average quality of sleep while migrating (3.48), increasing average hours of sleep in Starr County (0.68), bad/very bad average quality of sleep in Starr County (3.08), sad mood every-day for more than two weeks (6.87), and participating in year 1 and year 2 (0.38) and year 2 only (0.06).

Farm work variables with significantly increased ORs for hand problems were increased average hours worked per day (4.87), working with hand-held vibrating tools/machinery (3.95), involvement in meat processing (50.1), moving heavy objects at work (3.08), working with/around animals (7.01), working with/around chemicals (2.30), working with/around tractors (2.19), and working with beets (9.26).

Adjusted Multilevel Mixed-Effects Logistic Regression Analyses

The final multiple logistic regression model included eight variables based on farmworkers' records with complete data ($n = 541$ observations). We calculated unadjusted ORs for the eight variables in the final model using complete data from the 541 farmworkers to be able to appropriately compare unadjusted and adjusted values. The unadjusted and adjusted ORs and CIs did not differ considerably, as shown in table 2. Significant non-work variables (adjusted) were increasing age (1.07), female gender (3.49), increasing average hours of sleep while migrating (0.68), and participation group working in both years 1 and 2 (0.21) or year 2 only (0.14). Farm work variables were working more than 11 hours per day on average (8.23), moving heavy objects at work (3.97), working with hand-held vibrating tools (5.16), and involvement in meat processing (40.48). There was no significant interaction found between any of the variables in the final regression model. No additional variables resulted in more than or equal to a 15% change in the main effects, an indication of confounding. The lowess graph indicated that the data fit the model very well (Long and Freese, 2001).

Table 1. Prevalence of hand problems stratified by family members of migrant farmworkers of Starr County, Texas (1999-2001).

Sample		Prevalence	95% CI
Total sample	Year 1	0.29	0.24-0.34
	Year 2	0.18	0.13-0.23
Mother	Year 1	0.37	0.29-0.47
	Year 2	0.28	0.20-0.38
Father	Year 1	0.33	0.24-0.43
	Year 2	0.15	0.08-0.23
Oldest child	Year 1	0.13	0.06-0.23
	Year 2	0.06	0.02-0.15
Youngest child	Year 1	0.19	0.05-0.42
	Year 2	Not available	Not available

Table 2. Final multilevel mixed-effects logistic regression model examining hand problems in migrant farmworkers in Starr County, Texas (1999-2001).

Variable ^[a]	Unadjusted Models			Adjusted Model		
	OR	95% CI	p	OR	95% CI	p
Age	1.06	1.03-1.09	0.00	1.07	1.03-1.12	0.00
Gender						
Male	1.00			1.00		
Female	2.40	1.18-4.87	0.02	3.49	1.47-8.30	0.01
Hours of sleep while migrating	0.55	0.41-0.74	0.00	0.68	0.48-0.97	0.03
Participation group						
Year 1 only	1.00			1.00		
Years 1 and 2	0.35	0.17-0.73	0.01	0.21	0.09-0.50	0.00
Year 2 only	0.09	0.01-0.53	0.01	0.14	0.02-0.83	0.03
Average hours worked per day						
≤11	1.00			1.00		
>11	5.03	1.86-13.62	0.00	8.23	2.29-29.62	0.00
Moved heavy objects at work						
No	1.00			1.00		
Yes	2.92	1.06-8.01	0.04	3.97	1.23-12.79	0.02
Worked with hand-held vibrating tools/machinery						
No	1.00			1.00		
Yes	3.28	1.14-9.42	0.03	5.16	1.45-18.39	0.01
Involved in meat processing						
No	1.00			1.00		
Yes	47.79	3.18-718.43	0.01	40.48	2.04-802.82	0.02

^[a] Total number of observations = 541.

Discussion

The prevalence (18.0% to 29.0%) of hand problems in the present study is comparable to estimates from other agricultural populations, although study definitions vary and include different recall periods. For example, a survey conducted with 213 Spanish-speaking immigrant farmworkers (commercial nursery workers) from southern California found that 21% had hand/wrist pain during the past 30 days (Faucett et al., 2001). According to the California Agricultural Workers' Health Survey, the prevalence of self-reported hand pain lasting for at least one week in the year prior to the survey was approximately 13% (Villarejo et al., 2000). A high burden of hand problems was also reported for other agricultural workers (e.g., owners, operators, non-migrant workers) (Gomez et al., 2003). A study by Rosecrance et al. (2006) reported a 12% prevalence of hand/wrist pain among active farmers of a farmer's co-operative in southeast Kansas ($n = 499$). A recent study by Alterman et al. (2008) of 7,137 farm operators across the U.S. indicated the highest prevalence of 29.5% for hand trouble (ache, pain, or discomfort), although this population was much older (mean age = 55 years) than the participants in the current study.

Overall in the current study, the prevalence of hand problems for year 1 (29.0%) was higher as compared to year 2 (17.8%). The exact reason for the lower prevalence in year 2 is not known. As presented earlier, the subtle change in wording was unlikely to result in decreased reporting in year 2, especially since the prevalence for other reported illness symptoms (e.g., difficulty in picking objects by hand, aches/pains in muscles/joints other than hand, headache, eye irritation, and rash) also dropped in year 2. The year 2 prevalence of all symptoms including hand problems was lower for

the participation group that worked in year 2 only as compared to the participation group that worked in year 1 and year 2, despite taking the same survey with identical Spanish translation. In addition, loss to follow-up in year 2 was greater among farmworkers who reported hand problems in year 1 compared to farmworkers who did not.

As described earlier, unlike the previous studies on migrant farmworkers, we examined many work and non-work variables that could contribute to hand problems. The measures of association reported by this study were very similar to other studies on farm operators/owners. For example, female gender (3.49) and increasing age (1.07) were significantly associated with hand problems in the present study. To compare, the study by Gomez et al. (2003) of owner, operators, and non-migrant workers reported a protective OR for male gender 0.59 (0.46, 0.75) and an elevated OR for increasing age 1.10 (1.02, 1.19) with having hand/wrist trouble during the past 30 days.

Another important variable present in the final model was duration of sleep while migrating (0.68). Two possible explanations for this association are: the workers did not get good peaceful sleep before the next exposure, giving their tissues inadequate time to recover from potential trauma at work; and/or the pain and discomfort caused by the hand problems prohibited adequate sleep. Holmberg et al. (2003) analyzed data from 657 matched pairs of male farmers and non-farmers from Sweden and reported longer sleep hours to be protective for hand/forearm musculoskeletal symptoms (0.84, 0.72-0.97).

The strongest work variable based on the final model was involvement in meat processing (40.48); however, the 95% confidence intervals were very wide, indicating few endorsements of this variable. Meat processing is well-known for its role in the development of musculoskeletal problems of the hand. Fagarasanu and Kumar (2003) compared the prevalence of carpal tunnel syndrome in poultry or meat processing and packaging workers from three different studies (53% by Falck and Aarnio, 1983; 37-41% by Chiang et al., 1990; and 19% by Yassi et al., 1996). Commonly associated risk factors across the three studies were force, repetitive motion, awkward posture, localized mechanical compression, and working in a cold environment.

Working with hand-held vibrating tools/machinery (5.16) was associated with hand problems in this study as well. Holmberg et al. (2003) also observed hand/forearm problems to be associated with vibrations (1.63, 95% CI 1.18-2.24) among male farmers compared to non-farmers. Gomez et al. (2003) found an elevated association (1.72, 95% CI 1.34-2.21) for hand/wrist trouble among owners, operators, and non-migrant workers. However, the point estimates reported for these two studies were lower than the current study.

Working more than eleven hours per day on average (8.23) was also significantly associated with hand problems. Working for such long hours each day would leave little time for sleep or rest breaks. Therefore, the soft tissues of the hand could have been subjected to an extreme workload without sufficient periods of rest. Lack of rest breaks prevents recovery from innocuous, repeated, gradual microtrauma, which further augments an injury (Barr et al., 2004).

Finally, we observed an increased odds ratio for moving heavy objects and hand problems in the current study (3.97). A cross-sectional study was conducted by Waters et al. (2007) using data from the General Social Survey with a population of 1484 U.S., non-institutionalized, English-speaking adults older than 18 years and employed at least 20 hours per week. The odds ratio for heavy lifting, pulling, or pushing and pain in the arms every day for a week or more during the last twelve months was

1.70 (1.35-2.14). This association was smaller in magnitude compared to the current study, but the outcome definition also included the entire upper extremity, not just the hand/wrist.

An important strength of this study is its relatively large sample size, given the mobile nature of the study population. The study design also allowed for examining a wide array of exposures in the migrant farmworker population. The use of New Generation System of the Migrant Education Program to locate a cohort of migrant farmworker families in their own county was innovative. It enabled random sampling from a well-defined sampling frame and helped minimize selection bias. Sampling in this manner overcame difficulties of locating this population because of the migratory nature of their work and unconventional and hidden housing arrangements, distrust of outsiders, and language and literacy barriers (U.S. GAO, 2003). Half of the migrant farmworkers are unauthorized to work in U.S., which also may make them suspicious of researchers collecting data at the worksite (Kandel, 2008; Mehta et al., 2000). The method of interviewing the participants in their permanent homes away from the employer also helped to make them more comfortable to speak about work hazards and injuries (Cooper et al., 2006). This was unlike the NAWS data collection methods wherein the farmworker is interviewed at the place of employment, which has a potential for information bias. It is also likely that because the sampling frame was based on families identified through their children, the demographic profile of the migrant farmworker population is likely to be different from that of NAWS in terms of marital status, age, and authorization status. For example, the sample for the present study did not include single or unaccompanied farmworkers, which are included in NAWS.

The bilingual survey used for the study was developed using previous surveys on farmworkers (McCurdy et al., 2003; Kolbe et al., 1993; Mehta et al., 2000) and was reviewed by a panel of academic investigators and government researchers to ensure appropriateness of survey items. The survey was also pilot tested by Spanish-speaking interviewers, migrant farmworker mothers, and physicians trained in occupational epidemiology. The interviews were carried out by experienced interviewers under supervision of an expert field supervisor from Starr County to ensure standardization and quality of the data. The response rate for completion of the follow-up survey was very high at approximately 96% each year (Cooper et al., 2006).

The limitations of greatest concern were related to the use of self-reported data and the use of a proxy respondent for fathers and children. Since all data were self-reported, recall bias may lead to misclassification and underestimation of exposures and hand problems. Self-reported data are commonly used in national surveys examining musculoskeletal disorders among U.S. workers (NRC/IOM, 2001). Regarding estimates of the strength of the association between the exposures and hand problems, results could be shifted toward the null if such outcome misclassification takes place, as the bias would be expected to be non-differential with respect to the exposure. The use of a proxy respondent for the husband and children also may result in bias. Although not the ideal method, this is an accepted means of collecting data (Chapman et al., 2003; McCurdy et al., 2003). To better understand bias in the original cohort study, Burau et al. (2006) used a convenience subsample of 79 mother/husband and mother/oldest child pairs to compare responses provided by the mother on behalf of her family member with that family member's response. The study found that mothers systematically underreported hazardous activities as well as injury and illness for their family members, especially for their children. For hand problems, the specificity was

high for both husbands and children; however, sensitivity was somewhat low. Therefore, the actual prevalence may be notably higher among family members, especially among children.

Finally, this being a cross-sectional study, the incidence of hand problems and the temporality between exposure and outcome could not be determined. In addition, one potentially important non-work variable related to hand/wrist problems that was not included in this survey is the type and duration of housework. Given that this study involved secondary data analysis, it also lacked refined exposure assessments, especially those pertaining to hand problems. However, this study was designed for hypothesis generation in order to help provide a foundation for future research.

Conclusion

According to the National Occupational Research Agenda, there has been widespread recognition of the large and growing problem of WMSDs of the upper extremities, including hand problems. However, the causes of this problem and cost-effective solutions for migrant farmworkers need further research. Since there are not many studies examining hand problems in migrant farmworker populations, this study substantially adds to the current knowledge and provides prevalence estimates stratified by family member to help guide future research in this area. It also explored several work and non-work factors and their relationship with hand problems experienced during the migration season. Looking into associated factors is necessary for developing preventive measures with the goal of limiting discomfort, pain, and disabilities in this important agricultural workforce. Key areas for future research should focus on refined exposure and outcome assessment, youth, and exploring the potential protective role of sleep in the etiology of hand problems.

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