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these results can be replicated in settings with different socioenvironmental risk factors. □

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References

1. Handayani T, Mujiani HV, Rhode J. Child mortality in a rural Japanese village: a prospective study. *Int J Epidemiol.* 1983;12:88–92.
2. World Health Organization. Diarrheal Diseases Control Program: an overview of the problem in America. *Weekly Epidemiol Rec.* 1982;57:353–360.
3. Chandra RK. Reduced secretory antibody response to live attenuated measles and poliovirus vaccines in malnourished children. *Br Med J.* 1975;ii:583–585.
4. Cohen BE, Elin RJ. Vitamin A induced non-specific resistance to infection. *J Infect Dis.* 1974;129(5):597–600.
5. Watson RR. *Nutrition, Disease Resistance and Immune Function.* New York, NY: Marcel Dekker; 1984:299–312.
6. Sommer A, Katz J, Tarwotjo I. Increased risk of respiratory disease and diarrhea in children with preexisting mild vitamin A deficiency. *Am J Nutr.* 1984;40:1090–1095.
7. Milton R, Reddy V, Naidu A. Mild vitamin A deficiency and childhood morbidity: an Indian experience. *Am J Clin Nutr.* 1987;46:827–829.
8. Sommer A, Tarwotjo I, Djunaedi E, West K, Loeden R, Mele L. Impact of vitamin A supplementation on childhood mortality. *Lancet.* 1986;1:1169–1173.
9. West K, Djunaedi E, Pandji A, Kusdiono, Tarwatjo I, Sommer A. Vitamin A supplementation and growth: a randomized community trial. *Am J Clin Nutr.* 1988;48:1257–1264.
10. Sommer A. *Nutritional Blindness: Xerophthalmia and Keratomalacia.* Oxford, England: Oxford University Press; 1982.
11. Feachem RC. Vitamin A deficiency and diarrhea: a review of interrelationships and their implications for the control of xerophthalmia and diarrhea. *Trop Dis Bull.* 1987;84(3):R1–R16.
12. Feachem RG. Infections related to water and excreta: the health dimension of the decade. In: Dangerfield BJ, ed. *Water Supply and Sanitation in Developing Countries* (Water Practice Manuals). No. 3. London: Institution of Water Engineers and Scientists; 1983:25–46.
13. Abdeljaber MH. Doctoral thesis, University of Michigan. Impact of Vitamin A Supplements on Childhood Morbidity: A Randomized Community Trial; 1989
14. Greenland S. Limitation of the logistic analysis of epidemiologic data. *Am J Epidemiol.* 1980;110:693–698.
15. Tupasi TE, Velmonte MA, Sanvectores ME, et al. Determinants of mortality and morbidity due to acute respiratory infections. *J Infect Dis.* 1988;157(4):615–623.

ABSTRACT

In Washington state, 29,451 workers' compensation claims were filed by farm workers between 1982 and 1986. Five percent of claimants were under 18 years of age; including 3.3% under the age of 16. Agricultural workers were found to be at higher risk than other workers in the state for fatal injury (relative risk [RR] = 2.5; 95% confidence interval [CI] = 1.7–3.7), sprains and strains (RR = 1.4; CI = 1.3–1.4), fractures (RR = 2.3; CI = 2.2–2.4), dislocations (RR = 1.9; CI = 1.7–2.2), concussions (RR = 1.9; CI = 1.6–2.3), amputations (RR = 2.5; CI = 2.0–3.2), dermatitis (RR = 1.3; CI = 1.0–1.5), systemic poisoning (RR = 3.4; CI = 3.1–3.7), respiratory disease (RR = 1.7; CI = 1.0–2.9), and tendonitis (RR = 1.2; CI = 1.1–1.3). [*Am J Public Health* 1991;81:1656–1658]

Occupational Injuries and Illnesses among Washington State Agricultural Workers

Paul Demers, MS, and Linda Rosenstock, MD, MPH

Introduction

Agricultural employment is among the nation's most hazardous occupations.[1,2] Farm workers have been noted to be at increased risk for musculoskeletal disorders, noise-induced hearing loss, dermatitis, respiratory diseases, and cancer.[1,3–5] The most widely recognized hazards of farm work are pesticides and agricultural machinery, but farm workers are also exposed to severe climatic conditions, physical fatigue and stress, parasites, infectious diseases, toxic plants, and chemicals needed to maintain farm machinery.[5,6]

We reviewed workers' compensation claim data for farm workers in the state of Washington between 1982 and 1986 in order to characterize the nature of work-related illnesses and injuries among farm workers and compare their rates to those of nonagricultural workers.

Methods

The state supplied the investigators with computer tapes containing data on all claims filed in Washington between January 1, 1982, and December 31, 1986. The nature and source of injury and illness claims were derived from the first report received at the time the claim was filed, and claim status was determined as of April 1988. Using hours submitted to the state by employers for billing purposes, the number of full-time equivalent (FTE) agricultural workers was estimated. In or-

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Occupational Injuries and Illnesses Among Washington State Agricultural Workers

bited.

TABLE 1—Workers' Compensation Claim Status: Washington State Farm Workers, 1982 to 1986

Claim Status	Total
Medical bills only	19 994
Time loss paid	7375
Total permanent disability	27
Fatality	13
Other[a]	305
Rejected	1732
Total	29 451

[a]Kept on salary, loss of earning power, or no decision as of the time the data were generated.

der to calculate rates for nonagricultural workers, data from the state employment security commission were used. Relative risks were calculated by comparing the rate for agricultural workers to the rate for all other workers in the state. Confidence intervals were calculated using Taylor series methods.[7]

Results

A total of 29 451 claims were filed by farm workers between 1982 and 1986. The status of all claims as of 1988 is given in Table 1. Table 2 shows the number of accepted claims by the type of injury or illness. The claims rate for agricultural workers was almost 50% higher than for nonagricultural workers, with substantial excesses for each of the categories examined except hearing loss (Table 3).

Between 1982 and 1986 only 53 claims were filed for organophosphate pesticide (OP) related illnesses, with 11 (21%) rejected and only 3 (6%) resulting in compensable time loss. Of the 54 claims filed for pesticides other than organophosphates, 9 (17%) were rejected and only 3 (6%) resulted in compensable time loss. During the study period there were 148 dermatitis claims, and 106 systemic poisoning claims were attributed to "other and unspecified chemicals."

Although 74% of all claimants were between the ages of 18 and 40, 5% were under 18 years of age and 1.3% were under 16. Ninety-four percent of these claims were accepted and 20% had compensable time loss. One claim was accepted for a childhood fatality: a 15-year-old orchard worker died from multiple injuries following a work-related motorcycle accident. Other serious injuries for which claims were accepted for children included 7 amputations, 90 fractures, 11 dislocations, and 8 concussions. These serious injuries represented 8.8% of all claims accepted for children vs 7.1% of all claims filed by adults.

Discussion

We found agricultural workers in the state of Washington to be at higher risk than other workers for both occupational injuries and illnesses. Approximately 5% of the claims examined by this study were filed for children. It is not possible to determine if the higher proportion of serious injuries seen in children compared to adult farm workers was because children are at higher risk or because claims were not filed for less serious injuries. Because of the serious nature of many of these claims, this population should receive special attention by regulatory and health agencies.[8]

We were able to identify relatively few pesticide related claims. This may be due to a lower than anticipated risk or to inaccurate or underreporting. In analyses of California pesticide-related illnesses, Kahn[9] and Blanc et al.[10] found that only a small fraction of cases were reported despite the fact that physicians are required to report pesticide poisonings in that state. A survey of farm workers in Washington State found that only 8% to 15% of those who felt ill after exposure to pesticides sought medical attention.[11] In addition, the relatively large number of claims attributable to other and unspecified chemicals points to the need for better reporting by physicians and more detailed coding by the responsible state agency. The recent enactment of legislation making pesticide poisonings reportable in Washington may provide a better means of surveillance in the future.

This study suffers from an inherent limitation: compensation records are known to be insensitive to the total extent of occupational disease.[9,10,12-14] Despite this limitation, recent investigations have found that internal analyses of compensation data appear to be valid.[15,16] Moreover, in the case of farm workers few other sources of data are available. An additional limitation was the lack of reliable estimates of the number of farm workers in the state during the study period. One advantage of using workers' compensation data is that they are based on hours and allow the calculation of FTE workers. Because of the seasonal nature of farm labor, the use of FTE workers rather than estimates made at one particular time during the year may better represent person-years at risk.

TABLE 2—Accepted Injury or Illness Claims: Washington State Farm Workers, 1982 to 1986

Injury or Illness	Accepted Claims (%)
All injuries	25 007 (90.6)
Strains and sprains	8991 (32.6)
Lacerations	5353 (19.4)
Contusions	3840 (13.9)
Abrasions	2602 (9.4)
Fractures	1679 (6.1)
Chemical burns	245 (0.9)
Hernias	198 (0.7)
Heat burns	21 (0.8)
Dislocations	187 (0.7)
Concussions	100 (0.4)
Amputations	78 (0.3)
Electric shocks	12 (<0.1)
Multiple injuries	1601 (5.8)
All illnesses	1754 (6.4)
Contact dermatitis	398 (1.4)
Allergic dermatitis	69 (0.2)
Other dermatitis	69 (0.2)
Systemic effects due to toxic materials	403 (1.5)
Bronchitis, asthma, and related upper respiratory	38 (0.1)
Other systemic poisonings	7 (0.2)
Contagious diseases	224 (0.8)
Other diseases of the eye	33 (0.1)
Endocrine	221 (0.8)
Weber-Hess	93 (0.3)
Peripheral neuropathy	66 (0.2)
Infectious diseases	18 (0.1)
Respiratory disease	12 (<0.1)
Heat stroke	11 (<0.1)
Hearing loss	2 (<0.1)
Freezing	0 (<0.1)
Other illness	12 (<0.1)
Other, ill-defined, or unknown	962 (3.7)
Total	27 719 (100)

The increased risk for agricultural workers compared to other workers could be explained by different reporting rather than a real difference between the two populations. This could occur if farm workers were more likely to submit claims or if their numbers are underestimated. Because some farm work is paid for on a piece rate rather than on an hourly basis, farm owners may sometimes be forced to calculate hours based on a formula using

TABLE 3—Comparison of Workers' Compensation Claims Rates between Agricultural and Nonagricultural Workers: Washington State, 1982 to 1986*

Type of Claim	Agricultural Workers Rate†	Nonagricultural Workers Rate†	Rate Ratio (95% Confidence Limits)
All accepted claims	207.84	139.76	1.49 (1.48–1.50)
Sprains and Strains	69.08	49.91	1.38 (1.35–1.41)
Fractures	12.41	5.35	2.32 (2.21–2.43)
Dislocations	1.39	0.73	1.91 (1.66–2.20)
Concussions	0.76	0.40	1.92 (1.59–2.32)
Amputations	0.58	0.23	2.53 (2.04–3.14)
Dermatitis	2.83	0.86	4.32 (3.96–4.71)
Systemic poisoning	3.89	1.15	3.99 (3.11–5.69)
Tendonitis	1.65	1.32	1.25 (1.10–1.42)
Hearing loss	0.05	0.29	0.16 (0.08–0.34)
Respiratory disease	0.09	0.05	1.69 (0.97–2.94)
Fatalities	0.19	0.08	2.50 (1.71–3.66)

†Rates per 1000 person-years at risk.

the average number of bushels picked per hour or some other productivity estimate. While it is possible that this practice and the general difficulties of enforcing workers' compensation laws in agriculture could lead to some underreporting of hours, a bias in this direction would have to be extremely large to explain the magnitude of the observed differences for most of the outcomes, and substantial fines may be levied against an employer if a claim is filed and no workers' compensation premiums have been paid.

The analysis of workers' compensation claims submitted by farm workers in Washington State has provided a means to examine some aspects of work-related injuries and illnesses in this understudied population. The needs of farm workers should be prioritized for regulatory action and other forms of intervention. □

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References

1. Coye MJ. The health effects of agricultural production: I. the health of agricultural workers. *J Public Health Policy.* 1985;6:349–370.
2. Purschwitz MA, Field WE. Scope and magnitude of injuries in the agricultural workplace. *Am J Ind Med.* 1990;18:179–192.
3. Moses M. Pesticide-related health problems and farm workers. *Am Assoc Occup Health Nurs J.* 1989;37:115–130.
4. Strigini P. On the political economy of risk: farm workers, pesticides, and dollars. *Int J Health Serv.* 1983;12:263–292.
5. May JJ. Issues in agricultural safety. *Am J Ind Med.* 1990;18:121–131.
6. Myers JR. National surveillance of occupational fatalities in agriculture. *Am J Ind Med.* 1990;18:163–168.
7. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiological research: principles and quantitative methods. New York, NY: Van Nostrand Reinhold Co; 1982:351–355.
8. Pollack SH, Landrigan PJ. Child labor in 1990: prevalence and health hazards. *Annu Rev Public Health.* 1990;11:359–375.
9. Kahn E. Pesticide related illness in California farm workers. *J Occup Med.* 1976;18:693–696.
10. Blanc PD, Rempel D, Maizlish N, Hiatt P, Olson KR. Occupational illness: case detection by poison control surveillance. *Ann Intern Med.* 1989;111:238–244.
11. Mentzer M, Villalba B. Pesticide exposure and health: a study of Washington farm workers. Granger, Wash: Evergreen Legal Services, Farm Worker Division; 1988.
12. Discher DP, Kleinman GP, Foster FJ. *Pilot Study for Development of an Occupational Disease Surveillance Method.* Washington, DC: 1975. US Dept of Health, Education, and Welfare publication (NIOSH)75-162.
13. National Research Council. *Counting Injuries and Illnesses in the Workplace—Proposals for a Better System.* Washington, DC: National Academy Press; 1987.
14. Institute of Medicine. *Addressing the Physician Shortage in Occupational and Environmental Medicine.* Washington, DC: National Academy Press; 1991.
15. O'Malley M, Thun M, Morrison J, Toby Mathias CG, Halperin WE. Surveillance of occupational skin diseases using the supplemental data system. *Am J Ind Med.* 1988;13:291–299.
16. O'Malley M, Toby Mathias CG. Distribution of lost-work-time claims for skin disease in California agriculture. *Am J Ind Med.* 1988;13:715–720.