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Agriculture-related sprain and strain injuries, 1985–1987

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Abstract

The National Institute for Occupational Safety and Health has expanded its research program investigating agricultural injuries. Data from the *Supplementary Data System* (SDS), maintained by the Bureau of Labor Statistics, U.S. Department of Labor, indicate that injuries to the back and lower extremities of agricultural workers are quite common. Injury data from SDS were examined for agricultural employees for the years 1985 through 1987 from the 21 states that consistently provided records for each year. During this 3-year period, a total of 71,098 injuries were reported to SDS for the agricultural Industry Groups included in this study. Of these, 26,450 (37.2%) were classified as sprains and strains. Analysis of the data indicate that workers in industries within the major groupings of crop production and agricultural services have an increased potential for sustaining a sprain or strain injury.

Relevance to industry

Data presented in this paper provide an indication of the musculoskeletal problems encountered by agricultural workers. The injury data and estimates of employment will supply researchers interested in agriculture with an estimate of the extent of musculoskeletal injuries in the industry. This information will assist in developing appropriate ergonomic interventions.

Keywords: Agriculture; Work; Statistics; Sprains and strains; Back

1. Introduction

The domestication of plants and animals has been one of the most important accomplishments in the history of humankind. Cultivation of crops and livestock contributed to the economic development of civilization through the settlement of stable farm communities, some of which evolved into towns and cities. Through the ages, agriculture has been chronicled as a manual-labor-intensive, life-shortening industry. In 1713, Ramazzini (translation, 1940) provided details on diseases and injuries that afflicted agricultural workers.

Agriculture is an important economic industry in the United States. Some type of agriculture is conducted in each of the 50 states. In nine states (California, Idaho, Iowa, Minnesota, Missouri, Montana, Nebraska, North Dakota, and South Dakota), agriculture is *the* leading economic industry (World Almanac, 1993). Agriculture is

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unique among U.S. industries because people of all ages are at risk of being injured in a work setting (Purschwitz and Field, 1990). This occurs because farms are both work sites and homes, and because farm employment often equates to whole-family employment, both among farm owners and migrant farm workers.

U.S. industries are classified by the type of economic activity in which they are engaged. They are separated into one of eleven Divisions and assigned *Standard Industrial Classification* (SIC) codes (Office of Management and Budget, 1972). Agriculture is Division A. Each Division is composed of two or more Major Groups, which are assigned 2-digit SIC codes. Each Major Group is divided into a variety of Industry Groups, which are identified by 3-digit SIC codes. Industry Groups are subdivided into Industries and are assigned 4-digit SIC codes.

Agriculture is composed of five Major Groups: crop production (SIC 01), livestock production (SIC 02), agricultural services (SIC 07), forestry (SIC 08), and commercial fishing, hunting, and trapping (SIC 09).

The National Institute for Occupational Safety and Health (NIOSH) has recently expanded its research program to investigate agriculture-related injuries. Within this research program, a project has been established to assess the magnitude of back sprain/strain injuries in agriculture. The intent of this paper is to provide some of the findings from this project, and to identify the agricultural Industries in which employees have an increased potential for sustaining a sprain/strain injury. The identification of these Industries will help guide future research activities aimed at developing injury prevention strategies.

2. Methods

2.1. Injury data

For agricultural employees in the United States, the only nationally representative occupational injury surveillance system is the *Annual Survey* conducted by the Bureau of Labor Statistics (BLS) (U.S. Dept. of Labor, 1985–1987). In an effort to collect specific information about occupational injuries, BLS established a system to supplement the *Annual Survey* information with data provided by state workers' compensation agencies (Jensen, 1987). This additional database, the *Supplementary Data System* (SDS), consists of workers' compensation records from states that voluntarily participate in the program. A thorough explanation of the limitations of the SDS is discussed in a Bureau of Labor Statistics report (U.S. Dept. of Labor, 1990).

Unfortunately, many farm owners/operators do not pay into the workers' compensation fund. In fact, 10 of the 21 states listed below specifically exempt farm labor from mandatory coverage by workers' compensation; three other states have partial exemptions for farms under a minimum payroll (U.S. Chamber of Commerce, 1985–1987). Thus, any injury incidents occurring on those farms may not be reported into the SDS database. *Therefore, the total number of injury incidents reported in this paper is less than the total number that are known to occur.* For this analysis, the authors made the assumption that any reporting biases will be roughly equal across all agricultural Industry Groups.

Injury data for agricultural employees were examined from the SDS for the years 1985 through 1987 to conform with the availability of the employment data. Specifically, injury data that were considered for this analysis were restricted to 'closed cases' for the 3-year period; cases that were open or pending were excluded. During this period, only 21 states consistently provided workers' compensation claim records for each of the 3 years. The 21 states that contributed to the SDS during 1985 through 1987 are: Alaska, Arizona, California, Colorado, Hawaii, Indiana, Iowa, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, Nebraska, New Mexico, Ohio, Oregon, Tennessee, Virginia, Washington and Wisconsin.

For later years, 1988 through 1990, the number of states that provided workers' compensation claim records steadily decreased. In fact, the SDS database was phased out in 1990 and 1991. The Bureau of Labor Statistics has developed the *Redesigned Occupational Safety and Health Statis-*

tical System (ROSH), which will collect 1992 data that is expected to be available for analysis in late 1993 to mid-1994 (Weber, 1992).

2.2. Employment data

Two sources were used to collect information regarding employment in the agricultural Industries: (a) two biennial surveys conducted by the U.S. Department of Agriculture; these are respectively entitled 'The Agricultural Work Force of 1985 – A Statistical Profile' (Oliveira and Cox, 1988), and 'The Agricultural Work Force of 1987 – A Statistical Profile' (Oliveira and Cox, 1989), and (b) the annual *County Business Patterns* census conducted by the Bureau of the Census, U.S. Department of Commerce (U.S. Department of Commerce, 1987).

The two Department of Agriculture surveys were used to estimate total employment for crop and livestock production (Major Groups 01 and 02, respectively). The estimates of employment were listed by various 'agricultural activity' categories (Oliveira and Cox, 1988, 1989). To be able to make use of this employment data, it was necessary to assume that the agricultural activity categories, which were reported by the USDA, were actually based on the industry classifications provided by the SIC coding manual.

The biennial agriculture survey was expanded in 1985 to include farm operators and unpaid farm workers, as well as hired farm workers. These surveys estimated the total number of persons who were employed on U.S. farms at some time during 1985 and 1987. Workers who were employed more than 150 days of the year were considered to be 'full-time' employees. The average values between the 1985 and the 1987 data were used to estimate the 1986 employment figures for each specific agricultural activity. It should be noted that additional biennial surveys were *not* conducted by the Department of Agriculture after the 1987 survey. Thus, the analysis was limited to the 3-year period, 1985 through 1987.

The *County Business Patterns* census was used to estimate total employment for Major Group 07 (agricultural services) for each of the three years of interest. The *County Business Patterns* collects annual summary data on the number of employees for the mid-March pay period, the first-quarter total payroll, total annual payroll, number of establishments, and number of establishments by employment-size class (U.S. Department of Commerce, 1987).

2.3. Relative injury index

The SDS database was used to determine the total number of sprain/strain compensation claims that were filed in all agricultural Major Groups for 1985 through 1987 in the 21 states listed previously. These injuries are linked to a 3-digit SIC code in the SDS database, thus identifying the Industry Group in which the injured worker was employed.

Because of the limited scope of this database (21 states versus 50 states) and the exclusion of small farming operations from many State workers' compensation programs, the actual frequency count is not the focus of the analysis. Rather, the percentage of sprain/strain injuries that occurred in a specific grouping is more important. This percentage distribution provides a general indication of which Industry Groups are sustaining greater numbers of sprain/strain injuries.

Similarly, employment sources provide a distribution (not an exact count) of the numbers of workers, as listed by agricultural activity categories. Thus, the percentage distribution of workers among the various agricultural activities is used as the most representative index of population distribution for this analysis.

A relative injury index (for sustaining a sprain/strain injury) has been calculated. This is simply the percentage of sprain/strain injuries for a specific agricultural Industry Group (defined by a 3-digit SIC code) divided by the percentage of employment for that same agricultural activity.

The listing of the agricultural activity categories (Oliveira and Cox, 1988, 1989) matched the SIC breakdown of industries at either the 3-digit or the 4-digit coding level. There was only one exception to this matching between agricultural activity categories and the SIC Industry Groups.

In the two references for employment in crop and livestock production, there was *not* a separate listing for an employment category designated as 'GENERAL FARMS, PRIMARILY CROP' which would correspond to the SIC code for Industry Group 019. Since employment data were not available for SIC 019, any injuries that were coded to have occurred in this Industry Group were eliminated from further data analysis.

The calculated relative injury indices are *not* injury rates, since the injury data (numerator values) are based on the reports from the 21 states in SDS for 1985 to 1987, while the employment data (denominator values) are for all 50 states, based on: (a) a sample from the U.S. Department of Agriculture (USDA) and (b) a census conducted by the U.S. Department of Commerce. (Individual state data were not available from USDA.) Thus, the ratio of these two percentages provides a relative indication of the likelihood of workers sustaining a sprain/strain injury in that particular agricultural Industry Group.

The relative injury index would be a true rate ratio if the injury and employment proportions reported for each agricultural Industry Group are the actual proportions for the entire U.S. agricultural population. If either of these proportions (injury or employment) are biased, then the corresponding injury index is also biased, which would cause a specific index to be either an overestimate or an underestimate of the actual index value. Although these data are not a true measure of risk, they do provide some direction for identifying those agricultural sectors that should be considered for further examination.

3. Results

3.1. Overall injury data

The analysis of the SDS database for 1985 through 1987 indicated that 71,098 compensation claims were filed by agricultural workers for all types of injuries. Of these, a total of 26,450 (37.2%) claims were filed for a sprain/strain injury. This particular nature-of-injury category was the largest one in all of agriculture. The next largest category was cut/laceration with 11,215 (15.8%) of the agriculture-related compensation claims filed in those 3 years. Table 1 provides a breakdown of the injuries for 1985 through 1987.

Table 1
Distribution of workers' compensation injuries for all agriculture (excluding SIC 019 [a]), by nature, 1985–1987

Nature of injury	Frequency (pct total), 1985	Frequency (pct total), 1986	Frequency (pct total), 1987	3-yr total
Sprain/ strain	9,089 (37.1%)	8,872 (37.7%)	8,489 (36.8%)	26,450 (37.2%)
Cut/ laceration	3,783 (15.4%)	3,738 (15.9%)	3,694 (16.0%)	11,215 (15.8%)
Fracture	2,673 (10.9%)	2,645 (11.3%)	2,625 (11.4%)	7,943 (11.2%)
Contusion	2,312 (9.4%)	2,141 (9.1%)	2,232 (9.7%)	6,685 (9.4%)
Other (56 categories	6,666 (27.2%)	6,113 (26.0%)	6,026 (26.1%)	18,805 (26.4%)
Totals	24,523 (100%)	23,509 (100%)	23,066 (100%)	71,098 (99.9%) [b]

[a] SIC 019 is 'General Farms, Primarily Crop'. Please refer to section 2 for an explanation of why this code is excluded.
[b] Grand total does not add to 100% because of rounding.

Table 2 presents the percentage distribution of sprain/strain injuries for the five Major Groups in agriculture for the three years of interest. This table indicates that a total of 94.9% of all sprain/strain injuries occur in three Major Groups: SIC 01, 02, and 07. The other two, forestry (SIC 08) and commercial fishing, hunting, and trapping (SIC 09), were eliminated from further data analysis, since they represented only 5% of the total injuries filed into workers' compensation.

Table 2
Percentage distribution of sprain/strain injuries (26,450) for all agriculture (excluding SIC 019), 1985 through 1987

SIC 01: Crop production	*SIC 02*: Livestock production	*SIC 07*: Agricultural services	*SIC 08*: Forestry	*SIC 09*: Fishing, hunting, and trapping
10,398 (39.3%)	3,683 (13.9%)	11,040 (41.7%)	1,146 (4.3%)	183 (0.7%)

Table 3
Distribution of employment for crop production (SIC 01, excluding SIC 019), livestock production (SIC 02), and agricultural services (SIC 07), 1985 through 1987

SIC code	Specific industry	1985 (from USDA survey)	1986 (avg of 1985 & 1987)	1987 (from USDA survey)	3-year total	Pct of grand total
011	Cash grains	136,000	131,000	126,000	393,000	11.76
013	Field crops, ex cash gr's	100,000	92,000	84,000	276,000	8.26
016	Vegetables and melons	57,000	58,000	59,000	174,000	5.21
017	Fruits and tree nuts	112,000	92,000	72,000	276,000	8.26
018	Horticultural specialties	49,000	45,500	42,000	136,500	4.08
0211, 0212	Beef cattle	62,000	72,500	83,000	217,500	6.51
024	Dairy farms	137,000	145,500	154,000	436,500	13.06
0213–214 0219, 025 027, 029	Other livestock	110,000	113,500	117,000	340,500	10.19
Data from: *County Business Patterns*						
		1985	1986	1987		
071	Soil prep'n services	4,221	3,491	2,882	10,594	0.32
072	Crop services	32,983	31,602	31,599	96,184	2.88
074	Vet services	80,690	83,934	95,326	259,950	7.78
075	Animal specialties, ex vet	30,252	29,854	27,161	87,267	2.61
076	Farm labor & mgmt services	19,256	16,809	17,913	53,978	1.62
078	Landscape & hort services	172,835	197,585	213,768	584,188	17.48
Totals		1,103,237	1,113,275	1,125,649	3,342,161	100.02

3.2. Employment distribution

Table 3 provides a breakdown of the estimate of employment for each year and for each individual agriculture Industry Group (14 total – five in crop production, three in livestock production, and six in agricultural services). As mentioned, SIC code 019 has not been included in the data analysis.

3.3. Crop production industry groups

Table 4 presents the percentage distribution of the sprain/strain injuries for the agricultural Industry Groups that comprise Major Group 01 (crop production) during 1985 through 1987. These particular Industry Groups are defined by a 3-digit SIC code. Also included in Table 4 is the percentage distribution of the employment for the SIC 01 Industry Groups. The last column of Table 4 presents the relative index for workers in these Industry Groups for their susceptibility to a sprain/strain injury.

In crop production, there are three Industry Groups that have an elevated sprain/strain injury index – horticultural specialities (SIC 018), fruits and tree nuts (SIC 017), and vegetables and melons (SIC 016). Along with an increased injury index, the fruits and tree nuts workers sustained more than 15% of all SDS agriculture-related

Table 4
Percentage distribution of sprain/strain injuries (10,398) and employment (1,255,500) for crop production Industry Groups 1985 through 1987, with calculated injury index

SIC code	Specific industry groups	Percentage of sprain/strain injuries, SIC 01, 02, 07 (21 States)	Percentage of industry employment, SIC 01, 02, 07 (50 States)	Relative injury index (±95% C.I. [a])
011	*Cash grains*: Wheat, Rice, Corn, Soybeans	1.93	11.76	0.16 (±0.01)
013	*Field crops, ex cash grains*: Cotton, Sugar crops, Tobacco	4.84	8.26	0.59 (±0.03)
016	*Vegetables and melons*	8.03	5.21	1.54 (±0.06)
017	*Fruits, Tree nuts*: Berries, Grapes, Citrus & tree fruits, Tree nuts	15.52	8.26	1.88 (±0.05)
018	*Horticultural specialties*: Nursery products, Ornamental plants, Foods under cover	11.07	4.08	2.71 (±0.10)

(*Note*: Injury data are from the SDS database; employment data are from the two U.S. Department of Agriculture employment surveys.)
[a] 95% C.I. = 95% Confidence Interval

sprain/strain injuries. In addition, one out of every 12 agriculture workers (8.3% of the total) are employed in the fruits and tree nuts Industry Group.

3.4. Livestock production industry groups

Table 5 presents the percentage distribution of the sprain/strain injuries for the agricultural In-

Table 5
Percentage distribution of sprain/strain injuries (3,683) and employment (994,500) for livestock production Industry Groups, 1985 through 1987, with calculated injury index

SIC code	Specific industry groups	Percentage of sprain/strain injuries, SIC 01, 02, 07 (21 States)	Percentage of industry employment, SIC 01, 02, 07 (50 States)	Relative injury index (±95% C.I. [a])
0211 & 0212	*Beef cattle*	2.26	6.51	0.35 (±0.03)
024	*Dairy farms*	3.87	13.06	0.30 (±0.02)
	Other livestock:	8.53	10.19	0.84 (±0.03)
0213	Hogs			
0214	Sheep and goats			
0219	Gen'l livestock			
025	Poultry and eggs			
027	Animal specialties			
029	Gen'l farms			

(*Note*: Injury data are from the SDS database; employment data are from the two U.S. Department of Agriculture employment surveys.)
[a] 95% C.I. = 95% Confidence Interval

dustry Groups that comprise Major Group 02 (livestock production) during 1985 through 1987. Also included in Table 5 is the percentage distribution of the employment for the SIC 02 Industry Groups.

For livestock production, the employment census (Oliveira and Cox, 1988, 1989) lists only three categories: (a) 'Beef cattle', (b) 'Dairy', and (c) 'Other livestock'. Therefore, the subsequent injury analysis had to correspond to these same three categories. To accomplish this, a more detailed analysis was required since 'Beef cattle' is a subset of the Industry Group entitled 'LIVESTOCK, EXCEPT DAIRY, POULTRY, AND ANIMAL SPECIALITIES'. as listed in the *Standard Industrial Classification Manual*. This is the only instance where a 4-digit SIC code analysis was needed.

Table 5 also presents the relative index of their susceptibility to a sprain/strain injury in livestock production. None of the three Industry Groups listed for Major Group 02 has an elevated sprain/strain injury index.

3.5. Agricultural services industries

Table 6 presents the percentage distribution of the sprain/strain injuries for the agricultural Industry Groups that comprise Major Group 07 (agricultural services) during the years 1985 through 1987. Also included in Table 6 is the percentage distribution of the employment for the SIC 07 Industry Groups. Finally, the last column presents the relative index for a worker's susceptibility to a sprain/strain injury in the agricultural services sector.

In these six Industry Groups, three have elevated indices: crop services (SIC 072), farm labor and management services (SIC 076), and landscape and horticultural services (SIC 078). The landscape and horticultural services Industry Group represents the largest individual segment of employment for all of agriculture (17.5%), and it accounts for one in every four sprain/strain injuries (26.5%) that occurred in agriculture.

3.6. Distribution of injuries by body part

Table 7 presents the distribution of sprain/strain injuries by body part for the three agricultural sectors being analyzed (crop production, livestock production, and agricultural services) for the years 1985 through 1987. The back is affected most often for all three of these Major Groups. Back sprains and strains occurred slightly more

Table 6
Percentage distribution of sprain/strain injuries (11,040) and employment (1,092,161) for agricultural services Industry Groups, 1985 through 1987, with calculated injury index

SIC code	Specific industry groups	Percentage of sprain/strain injuries, SIC 01, 02, 07 (21 States)	Percentage of industry employment, SIC 01, 02, 07 (50 States)	Relative injury index (±95% C.I. [a])
071	*Soil preparation services*	0.25	0.32	0.78 (±0.15)
072	*Crop services*: Crop planting, Cultivating, Harvesting; Preparation services; Cotton ginning	9.32	2.88	3.24 (±0.12)
074	*Veterinary services*: For livestock; For animal specialties	1.18	7.78	0.15 (±0.02)
075	*Animal specialties, except veterinary*	2.49	2.61	0.95 (±0.07)
076	*Farm labor and management services*	4.19	1.62	2.59 (±0.16)
078	*Landscape and horticultural services*	26.51	17.48	1.52 (±0.03)

(*Note*: Injury data are from the SDS database; employment data are from the *County Business Patterns* census.)
[a] 95% C.I. = 95% Confidence Interval

Table 7
Frequency distribution of sprain/strain injuries according to part of body involved, 1985 through 1987 (21 States)

Body part	*SIC 01*: Crop production	*SIC 02*: Livestock production	*SIC 07*: Agricultural services	3-year total (pct of total)
Back	4,964	1,704	5,142	11,810 (47.0%)
Ankle	860	328	928	2,116 (8.4%)
Knee	725	417	929	2,071 (8.2%)
Multiple parts	821	255	751	1,827 (7.3%)
Shoulder	542	184	560	1,286 (5.1%)
Wrist	389	86	424	899 (3.6%)
Neck	224	97	271	592 (2.4%)
Other (30 categories)	1,873	612	2,035	4,520 (18.0%)
Total	10,398	3,683	11,040	25,121 (100%)

often in agricultural services than in crop production (5,142 versus 4,964, a 3.6% increase). However, back injuries occurred twice as often in both crop production and agricultural services as in livestock production (4,964 versus 1,704, a 191% increase, and 5,142 versus 1,704, a 202% increase, respectively).

For the overall statistics (the 3-year totals), the ankle and knee, respectively, were the next two most frequently injured body parts. However, there was some variation within Major Groups 02 and 07, where the knee was injured more often than the ankle.

3.7. *Industries with elevated injury indices*

Of the 14 Industry Groups presented above (five in crop production, three in livestock production, and six in agricultural services), there are six that have relative injury indices greater than 1.0. This means that workers in these Groups *may* have an increased potential of sustaining a

Table 8
Percentage distribution of sprain/strain injuries and employment for the increased-injury-potential Industry Groups in agriculture, 1985 through 1987

SIC code	Specific industry groups	Pct spr/str injuries SIC 01, 02, 07 (21 states)	Pct industry employment SIC 01, 02, 07 (50 states)	Relative injury index (±95% C.I. [a])
072	Crop services	9.32%	2.88%	3.24 (±0.12)
018	Horticultural specialties	11.07%	4.08%	2.71 (±0.10)
076	Farm labor and mgmt services	4.19%	1.62%	2.59 (±0.16)
017	Fruits and tree nuts	15.52%	8.26%	1.88 (±0.05)
016	Vegetables and melons	8.03%	5.21%	1.54 (±0.06)
078	Landscape and hort'l services	26.51%	17.48%	1.52 (±0.03)
	Cumulative total	74.64%	39.53%	N.A. [b]

[a] 95% C.I. = 95% Confidence Interval
[b] Not Applicable

sprain and/or strain injury that will be severe enough to qualify for submittal as a workers' compensation case. These six Industry Groups are presented in Table 8.

Included in Table 8 are the percentage distributions of: (a) sprain/strain injuries and (b) employment for the six Industry Groups with elevated relative injury indices. These six are ranked in decreasing order of the calculated injury index. All six of these Industry Groups have injury indices that exceed 1.5. More specifically, there is one Group (SIC 072, crop services) that has an injury index greater than 3.0, and two other Groups (SIC 018, horticultural specialties and SIC 076, farm labor and management services) whose sprain/strain injury index exceeds 2.5. The three remaining Industry Groups, SIC 017 (production of fruits and tree nuts), SIC 016 (production of vegetables and melons), and SIC 078 (landscape and horticultural services) all have injury indices that range between 1.5 and 1.9. Also included in Table 8 is the cumulative percentage total for both the employment and the sprain/strain injuries for these six Industry Groups.

4. Discussion

While the *Supplementary Data System* (SDS) excludes small farming operations in many states, and comprises only 21 of the 50 States for the years of interest (1985 through 1987), this database is the only source of information with sufficient detail to examine sprain and strain injuries occurring in the agricultural work force. Furthermore, because of these limitations with the SDS database, the analysis presented in this paper may not reflect the true potential for incurring a sprain or strain injury in each agricultural Industry Group. It does, however, provide a fairly reliable estimate of the sprain/strain potential, and establishes a starting point for developing engineering modifications to reduce the incidence of sprain and strain injuries.

The long-term goal of this research is to develop intervention strategies in an attempt to prevent the occurrence of sprain/strain injuries in agriculture. To help accomplish this, additional research should focus on the specific occupations that have the highest potential for sustaining a back injury in the six Industry Groups listed in Table 8. Along with the occupations, identification of the activities that cause or contribute to the workers being injured will also be necessary.

Future injury prevention activities conducted by NIOSH or other research groups can focus on *any* of the six Industry Groups listed in Table 8. Different criteria can be used to select a specific Industry Group for further study. For example, research may focus on a Group that: (a) has a high relative injury index, (b) employs a high percentage of workers, (c) sustains a high percentage of sprain/strain injuries, or even (d) has some combination of these three factors that justifies further analysis.

An example of research which could evolve might concern evaluation of commercially available redesigned tools (manual or powered) in an agricultural workplace to determine their effectiveness in reducing sprain/strain injuries, and to obtain feedback from the workers regarding potential improvements to the existing design of the tools.

5. Summary

Analysis of the SDS database for agriculture (1985 through 1987) has indicated that of the 14 Industry Groups considered in SIC 01, 02, and 07, six of them have an elevated relative sprain/strain injury index. Three of these six Industry Groups have relative injury indices that exceed 2.5. However, each of these three Groups employs 4% or less of the agricultural workforce.

Of the three remaining Industry Groups, two (landscape and horticultural services and production of fruits and tree nuts) employ a sizable percentage of workers (17.5% and 8.3%, respectively). Also, workers from these same two Groups sustain a considerable number of sprain/strain injuries (26.5% and 15.5% respectively).

In addition, analysis of the SDS database for 1985 through 1987 has indicated that 47% of all sprain/strain compensation claims involved the

back (Table 7). For the 3-year total, back-related sprain/strain injuries occurred almost six times more frequently than injuries to the ankle, the next most frequently sprained or strained body part.

Finally, as shown in Table 8, the six Industry Groups that had elevated sprain/strain injury indices collectively represented 39.5% of all the agricultural workers included in this study. More impressive is the fact that 74.6% of the sprain/strain injuries that occurred in agriculture were sustained by workers in these six Industry Groups. Any one of these Groups appears to be a prime candidate for future musculoskeletal (sprain/strain) research.

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