Childhood Injuries in Washington Agriculture

Final Performance Report

R01/CCR516767-02-1

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July 31, 2002

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List of Abbreviations

YVFC	Yakima Valley Farm Workers Clinics
NIOSH	National Institute for Occupational Safety and Health
CDC	Centers for Disease Control and Prevention
BLS	Bureau of Labor Statistics
NSC	National Safety Council
PNASH	Pacific Northwest Agriculture Safety and Health Center
OR	Odds Ratio
CI	Confidence Interval

Abstract

The objective of this study was to characterize the distribution, determinants, and circumstances of medically treated agriculture related injuries to children and adolescents in the Yakima Valley of Washington State, and to evaluate the utility of existing records in local medical facilities for identifying agriculture related injuries.

The study was a case-control study with a potential for a nested case-crossover sub-study. Eligible cases children and youth under age 20 who were treated for an agriculture related injury at one of five hospitals or three farm worker clinics in the Yakima Valley of Washington State. The emergency room logs and emergency room personnel were the primary source of screening information at the hospitals. Records for potentially eligible injuries were reviewed and all likely candidates were contacted by letter then telephone or in person to verify the injury as eligible and recruit the participant for the study. Up to 2 controls were selected from the neighborhood where the case lived using a structured door-to-door selection protocol. The controls were matched on age group, gender, and the child's relationship to agriculture. The latter matching criterion was used to ensure that the control population represented the exposure experience of the population from which the case arose. Although this method provided a theoretically more valid control sample, it was difficult o carry out. After obtaining informed consent an in-person interview was conducted with the case or control, and the parent of the participant if the child was under age 18. Demographic, work history, personal habits, history of injury and illness and safety behavior information was collected, as well as a description of the injury event from the case.

Of the 398 potentially eligible injuries, 173 were detemined ineligible when the case was contacted, 81 were potentially eligible, but could not be located, 63 were eligible for inclusion, but declined to participate, and 81 injury cases completed the study. Of the 81 participating cases 66 were work-related injuries. Sixty percent of the participating cases were age 17 and older and 72% were male. The predominant injuries resulted from ladder falls while working in tree fruit orchards (N=12) and seven injuries were lacerations caused by knives used to harvest asparagus. Contact with or falls from animals accounted for another 15 injuries. Few identifiable factors were strongly associated with the risk of injury other than the type of job being done. One exception was that the risk of injury was lower for persons who were usually supervised in their job (OR=0.24, 95% CI=0.08-0.76) and for those who reported receiving formal safety training (OR=0.32, 95% CI = 0.12-0.82).

Barriers to identifying and enrolling cases of agriculture related injuries treated at these facilities was a major limitation of this study. Less than 50% of the eligible injuries identified participated and it was clear that the procedures under-ascertained these injuries. Consequently the results must be interpreted with extreme caution.

Significant Findings

The agriculture related injuries to children in the Yakima Valley, which is representative of the Pacific Northwest are unique to the agriculture practiced in the region. The pattern of injuries differ from those seen in much of the rest of the country. Therefore prevention strategies should be developed that are specific to the injuries such as ladder injuries and asparagus knife injuries.

The records available through emergency rooms can identify potential agriculture related injuries, however the process is very labor intensive and produces many false positives. The use of community based clinics for surveillance provides a much larger problem for surveillance. Unlike the hospital there is no central point of entry where the agriculture related injuries can be identified on an ongoing basis. Maintaining this type of surveillance system with out substantial resources dedicated to the reporting sites is not feasible.

Usefulness of Findings

Although this study did not achieve its original goal of characterizing host-specific determinants of injury in this population, it did characterize the major types of agriculture related injury in this region. As a result of this study two studies have been initiated by PNASH and the Washington State Department of Labor and Industries to better understand ladder related injuries in tree fruit production.

This study also provides some lessons on the study of injuries in this community and the application of analytical epidemiologic study designs for studying agriculture related injuries. Clearly this community includes many persons who feel marginalized, and may fear that there are consequences for participating in these studies. Being formally approached for an interview study may be too intimidating. The control selection protocol had been used successfully elsewhere, however the nature of this community makes it difficult to randomly identify individuals for recruitment. The results of this study also clarified a problem with a lot of agriculture related injury research; that it is difficult, if not impossible, to define agriculture related injuries in a manner that allows focus on specific etiologies. Future research should focus on very specific types of injuries, such as the above-mentioned studies of ladder related injuries.

Introduction

Agriculture production is recognized as one of the most dangerous occupations (National Safety Council 1992). The 1993 fatality rates for farm operators, and farm workers were 36, and 21 deaths/100,000 workers which far exceeds the national average of 5/100,000 workers (BLS, 1993). In Washington State, workers compensation claims data indicate that agricultural workers are at greater risk of fatal and nonfatal injury than non-agriculture workers (Dept. of Labor and Industries 1996). Demers and Rosenstock (1991) reported the rate of fractures, dislocations, concussions, and amputations in agricultural workers to be 2.3, 1.9, 1.9 and 2.5 times greater than non-agricultural workers. Dairy farmers and orchard workers in Washington State were at greater risk for brain trauma of 8.9 and 1.6 respectively when compared to other workers (Heyer and Franklin, 1994).

A unique characteristic of the agricultural work place is that children are more frequently exposed to the same hazards as adults either through living and working on a farm or being a paid employee of an agriculture production operation. Children who live on farms interact directly with the agriculture production environment as bystanders at an early age, and are increasingly involved with the actual work as they grow. The distribution of injuries seen in children on farms attest to the variety of risks they encounter. Childhood farm injuries in Wisconsin were attributed to farm implements, tractors, animals, tools, and falls in older children and preschoolers (Stueland, et al. 1991). Similar underlying causes have also been described across all ages of children using national data (Rivara, 1997).

Most of the literature on childhood agricultural injuries has focused on children living on family farms. Another sizable portion of children and adolescents exposed to farming are employed as farm laborers. Five of the ten major crops in Washington State require large numbers of seasonal workers (Dept. Employment Security, 1995). The epidemiology of occupational health problems of migrant and seasonal laborers, however, is not well described (Mobed, et al. 1992). Employment of minors in agriculture is common as regulatory restrictions are less stringent than for non-agricultural industries. Statutory age limits for employing children in Washington State for non-agricultural occupations prohibit the employment of children under age 14 (Dept. Labor and Industries 1993). In agriculture production, however, minors as young as 12 can be legally employed to pick certain crops (Dept. Labor and Industries 1993a). Minors under the age of 16 are not allowed to perform some particularly hazardous jobs, such as operating or assisting in the operation of machinery, operating a tractor of over 20 PTO horsepower, and working at heights over 20 feet. These restrictions apply, to the extent they are followed, only to minors who are not immediate family member of the producer. Minors age 16 and 17 are allowed to operate most agricultural implements and machinery that are related to agriculture production and only excluded from applying pesticides, handling blasting agents, applying anhydrous ammonia, and a few jobs that are not directly related to agriculture production.

Like adults, children will suffer injuries when engaged in agricultural work, and the injuries will often be severe. Children employed in agriculture production in California had elevated risks for death by Machinery (OR=81), animals (OR=10), electricity (OR=5), and motor vehicle non-traffic (OR=3) (Schenker, et al., 1995). Minors under the age of 15 employed on farms in Washington State were over-represented in the number of claims filed by all minors (Heyer, et, al. 1992). Furthermore, 26% of claims filed by minors employed in agriculture were for serious injuries, compared to 16% for all other occupations. Children employed in agriculture are clearly at substantial risk of injury, however the extent of this problem is not known.

Surveillance mechanisms for work-related injury are inadequate as children working on family farms and short term workers, (Washington State less than $150 from one employer) do not fall under the workers' compensation umbrella.

Tractor accidents is the largest single cause of farm fatalities and between 46 to 76 percent of tractor related fatalities are from tractor rollover accidents (Purshcwitz and Field, 1990); a pattern also seen in the Pacific Northwest. O'Connor, et al. (1993) reported that 51% of all agricultural fatalities in the Oregon Injury Register between 1988 and 1990 were tractor related deaths, and 35% were due to tractor rollovers. Surveillance data for such compelling problems can lead to effective interventions, such as roll over protection devices (CDC 1993). Unlike fatal injuries there is no single major cause of non-fatal injury. The cause of non-fatal injuries vary from region to region depending on the type of agriculture production. For example a study of incidence of farm work related injury in Central Wisconsin reported that animals were the leading cause of non-fatal injury (Nordstrom, et al 1995), which was similar to injuries seen in Vermont hospitals (Waller 1992); another area with a large number of dairy farms. By contrast, a hospitalized non-fatal injuries in Oregon were largely attributed to farm machinery other than tractors (24%) followed by falls(21%), animals (21%), and tractors (10%) (O'Connor, et al. 1993). When considering the causes and potential avenues for prevention of childhood injuries in agriculture it is important to understand the regional variation in agriculture as the crops and production practices will influence the risks of injury.

Specific risk factors for childhood agricultural injuries are not well defined. It is clear from the available descriptive data that age, gender, and the activity of the child or adolescent are important indicators of risk. The rates of injury are higher for older adolescents with males age 15-17 having the highest rates of injury (Stueland, 1991, Rivara 1985, 1997). The gender difference is seen across all age groups. These patterns are similar to childhood injuries not associated with agriculture. Other factors predisposing children and adolescents to injury are less clear. Supervision by an adult, safety training, experience, level of fatigue, ergonomic factors, history of injury, are possible contributing factors (Wilke, 1993). The level of fatigue is of particular concern not only from an injury prevention standpoint, but the effect that excessive hours of employment for minors puts their educational performance at risk (Miller, 1995). Part-time employment has been shown to affect sleep patterns and school attentiveness in high school students (Carskadon 1990). Whether the lack of sleep affects the risk of injury in minors working in agriculture has not been thoroughly evaluated.

The National Committee for Childhood Agricultural Injury Prevention has recognized that the knowledge to develop and implement effective injury prevention programs is lacking (NCCAP, 1991). Two substantial limitations are the absence of rigorous evaluations of the etiology of childhood injuries in agriculture and information to address problems specific to the nature of agriculture in different regions. The proposed study will utilize state-of-the-art epidemiological research methods to examine factors related to childhood agricultural injuries in a population with agriculture production characteristic of the Pacific Northwest.

METHODS

Overview

The study design for this study was a community based case-control study with the potential for a nested case-crossover study. The case-control study identified cases of potential agriculture related injuries from five hospitals and four outpatient clinics in the Yakima Valley of Washington state. The study design was modeled after successful case-control studies of injuries conducted by researchers at the Harborview Injury Prevention and Research Center (HIPRC). In these studies the effectiveness of bicycle helmets was determined in a case-control study that identified cases of bicycle injuries through emergency departments.(Thompson, et al. 1996) The control selection method for this study was modeled after studies by HIPRC researchers that used neighborhood controls in case-control studies of homicide and suicide. (Kellerman, et al, 1992; Kellerman, et al, 1993; Kellerman, et al, 1996);

Study Area

The study was conducted in the Yakima Valley in Washington State. The agriculture production in the Yakima Valley represents much of the unique agriculture of the Pacific Northwest and differs from much of the rest of the United States. The major crops include a variety of tree fruit, hops, and mint, as well as substantial production of row crops, wheat, and beef. The agriculture of the Yakima Valley is labor intensive and requires a large seasonal labor force and, unlike regions where field crops are dominant the majority of work is done manually.

Sources of Cases

The emergency departments of five hospitals and four clinics in the Yakima Valley were initially recruited for participation in the study. ; Providence Medical Center in Yakima, Memorial Hospital in , Providence Medical Center in Toppenish, Sunnyside Community Hospital in Sunnyside, Prosser Memorial Hospital in Prosser. The recruited clinics included three clinics from the Yakima Valley Farm Workers Clinic system, Yakima, Toppenish, and Grandview, and one large general pediatrics practice, Yakima Pediatrics. It was beyond the scope of the study to establish a surveillance system for all agriculture related injuries in the region, however the recruited hospitals provided most of the emergency room care to the region and the clinics would be representative of the type of injuries presenting at clinic.

Key personnel at the hospitals and clinics were identified and appropriate channels of authorization were sought to permit the study staff to work with the hospital and clinic personnel. The methods for case finding and recruitment were tailored to each hospital and clinic to accommodate the different record keeping systems and rules for patient contact. In general, the hospital and clinic staff were supportive of the study and offered assistance, however due to the very busy schedules of the hospital and clinic staff the study staff assumed responsibility for as much of the recruitment procedures as hospital and university Institutional Review Board restrictions would allow. Site-specific manuals were developed to detail the procedures for each clinic or hospital these manuals were updated with changes in administrative procedures when necessary. The study was presented to personnel at each site and information sheets summarizing the study recruitment requirements were posted at each site to keep providers aware of the study.

The general procedures for the hospitals were for the hospital or study personnel to review the emergency room logs on a regular basis to screen the visits for potential agriculture related injuries. These logs usually contain only the age, gender, date of visit, and major complaint of for the individual. The supporting records for injuries that may meet the inclusion criteria were

subsequently reviewed to determine eligibility. Three hospitals, Providence Yakima, Providence Toppenish, and Sunnyside Community, permitted the study staff to conduct this review and then follow-up by requesting the more specific data. The head of the Emergency Department in Prosser chose to review the records for the study. Memorial Hospital in Yakima assigned an emergency room nurse to review the records for the study.

The administrative structure for the clinics did not allow for a single source of information to be reviewed that would capture the potential injuries in a reasonable time frame. The Yakima Farm Workers Clinics have several clinics within each unit of operation, and a child presenting with an injury could be seen in more than one clinic. In general the urgent care/walk-in clinics handle most of the traumatic injuries, however patients may be seen in the pediatric or family medicine clinics if providers are available and the urgent care clinics are busy; a frequent condition. Several options were explored to identify and recruit potentially eligible injured children or youth. Unlike the hospitals, a central patient log could not be screened on a routine basis. Initially the medical records department provided lists of potentially injured patients. This procedure was in efficient, resulted in many false positives, and was likely to be missing potential cases. With the assistance of the medical director for the Yakima Valley Farm Workers Clinics a plan was developed to have providers identify potential cases. All physicians, physicians assistants, and nurse practitioners were informed of the study. To identify potentially eligible injuries a Post-it note was attached to the chart of every patient under the age of 20 who was being seeing for an injury. The note asked if the injury could be agriculture related. If so, the note with the identifying chart number was forwarded to a central person at each clinic. The study staff would routinely contact that person to collect the information and review the descriptions of the injuries. If the injury appeared to meet the study definition a contact letter was sent. To monitor use of this system the study coordinator and other field staff visited each clinic on a weekly basis and discussed the study with the key contact person and, whenever possible, the providers. The Principal Investigator at the University of Washington, Dr. Keifer, sees patients for work-related injuries and illnesses in the Toppenish Clinic once a month. On these visits he also enquired about the progress with recruiting patients.

The recruitment at Yakima Pediatrics relied on telephone contact with the central administration office. Any report of a suspected agricultural related injury was to be reviewed with the study coordinator. After the first year of data collection the patient population and the methods for recruitment were reviewed and it was concluded that continued efforts at this clinic were likely to yield few, if any, cases for the study. This site was subsequently dropped from the study.

The following case inclusion criteria were developed;

- Medically treated injury to child or adolescent under age 20.
- Treated at one of the hospitals or clinics participating in the study.
- Identified by routine review of records from ED or clinic and through providers.
- Injury has some relationship to agriculture.

The first year of the study included only children and youth below age 18, however to increase the numbers in the study and be in line with other NIOSH funded research ages 18 and 19 were included in following years.

To identify these potentially agriculture related injuries from the existing records at the hospitals and clinics the following screening criteria were developed for the study. The records for any patient meeting the initial inclusion criteria who had any of the following characteristics were reviewed for consideration for enrollment in the study

Injury occurs on a farm, ranch, orchard, or other agriculture production facility to any farm residents, worker, or guest.

- Any work activity (for pay or not); includes routine chores
- Any injury related to a structure, implement, or vehicle on the premises
- Any injury caused by a farm animal (includes horses used for work)
- Any motor vehicle crash related to farm work

Indicator injuries. Will be followed up unless explicitly stated that it is not related to agriculture.

- Burns
- Carbon monoxide poisoning
- Chemical poisonings, excluding poisonings by common household products
- Falls from heights
- ATV injuries

Exclusions: (may be determined after initial contact)

- Injuries that occur in the house
- Injuries caused by pets.
- Sport injuries.
- Motor vehicle injuries when vehicle not being used for agriculture purpose.

The potential cases were assigned a tracking number and then contacted by a letter from the hospital or clinic. The letter, in Spanish where appropriate, included an informational brochure about the study, was mailed to the parent of children under age 18 and directly to the adult teens. The letter was followed up with a telephone call or, where necessary, a visit to the house. At that point the determination was made whether the case was an agriculture related injury. If the case met the enrollment criteria they were then recruited for the study and an interview was scheduled. In-person interviews were conducted with the case, and the parent of the case for those under age 18. The participant received fifteen or twentyfive dollars for participating in the study. The initial sum of fifteen dollars was increased to twentyfive after the first year when feedback from participants, and those who chose not to participate suggested that a larger incentive was warranted.

Control selection

Controls were selected to represent the population from which the cases arose. For each case we attempted to identify two community based controls. The control was eligible if they were not suffering the effects of an agriculture related injury at the index date. The controls were matched on age group, [0-2, 3-5], [6-12], [13-16, 17-19], which could be relaxed within brackets to aid finding a suitable control, and gender. In some cases the gender restriction was relaxed to aid control identification. The final, and most problematic matching factor was the child's relationship to agriculture. As with most community based case-control studies it was not possible to enumerate the entire population of children or youth who may be at risk of an agriculture related injury. These children and youth that are at risk of such injury and represent the exposures to agriculture that may result in such an injury are integrated with other children in the community. In the Yakima Valley the types of youth potentially at risk of an agriculture related injury include; the children of farm owner/operators who live on the farm, children of farm owner/operators who do not live on the farm, children of farm working families who are or are not also present on the farm, and visitors to the farm. Because each of these groups represent a unique cohort of children at risk of injury it was necessary to account for these differences in

the study design. Figures 1A and 1B represent the matching scheme to identify controls that represented the source population from which the case arose.

To approximate the source cohort of similar children with a similar exposure profile we sampled controls from the same neighborhood as the cases. Controls were selected from the case's neighborhood using a systematic procedure for identifying potentially eligible controls. Starting at a the nearest home that is at least 100 meters away from the case, the study team went door to door to recruit controls. Following a script, the interviewers would introduce themselves and explain the purpose of the study. If the adult present at the door was agreeable, all household members under age 20 were enumerated by age, gender, and whether the work in agriculture. If a child or youth of the proper age or gender is present the child they are recruited to participate. Eligible controls that decline to participate were noted and a census of children in household was retained, without identifiers, in the event other searchers were conducted in the neighborhood. The control selection procedure was very labor intensive. Similar procedures were used in the studies that this study were modeled after. However the model study was conducted in an urban area with much higher density housing and those studies did not have the restrictive matching criteria. To make the control selection valid only four houses with no one home could be identified in one outing. Before proceeding with the neighborhood search those houses had to be visited at least two other times at different times of the day or on the weekend before the search could proceed. This criteria was in place to avoid biasing the control sample with families who are more often at home, and thus be very different from families who are frequently gone, often working.

Questionnaire Development

The questionnaire was developed for specifically for the study to capture determine the cause of the injury and characteristics of the cases and controls that may explain injury risk factors. The injured cases were asked to describe the circumstances surrounding or leading up to the injury event; what they had been doing at the time, whether or not they were under supervision, and if they felt there was a reason the injury happened, and whether a worker compensation claim was filed in the case of a work-related injury. Of particular interest is the relationship of machinery or tool use or the handling of animals by the cases and controls. The condition of equipment and presence of safety guards will be asked of equipment used by or around the children . Of a priori interest in this study was whether the activity at the time of injury or the level of fatigue differs at the time of the injury and prior to the injury. This may be related to normal activities or having an medical condition on the day of the injury. The normal hours of sleep and the hours of sleep estimated the night before the injury or index date were used to estimate fatigue. Cases and controls were also compared with respect to the number of reported hours of weekly extracurricular activities.

An abbreviated assessment of disability from the injury was also collected during the interview. Although a majority of these injuries did not result in long term disability some may result in lost school or work time for either child, parent or both. The interview will assess the number of days of lost work or school time and the number of days of restricted normal activity.

Analysis

The planned analysis included a comparison of the cases and controls with respect to various risk factors for injury including specific risk factors such as the use of machine guarding, personal protective equipment, supervision and training, as well as personal and demographic

characteristics. Unfortunately the low participation rate and difficulties locating cases resulted in a substantially smaller sample size than anticipated. Our original estimates were targeting up to 350 enrolled cases with controls, with a minimum of 150 cases enrolled. The final enrollment was a little over half the minimum expected number. Thus much of the planned analysis was obviated due to small numbers. With the data we did collect the types of injury, causes of injury, and resulting disability are described. Because a majority of the enrolled injuries were work-related injuries a limited analysis estimating the risk of injury associated with some more, e.g. history of injury, fatigue, type of pay, supervision, and experience are presented. For these analyses the risks are estimated with odds ratios and 95% confidence intervals using conditional logistic regression models. Due to the limitations of the data the case-crossover analysis will not be conducted.

Results

Over the course of the study period a total of 398 potentially eligible injuries were located at the participating sites. (Table 1) Of these, 173 were determined ineligible following contact with the injured individual or their parent. Eighty-one were potentially eligible, but were not found and 61 were eligible, but refused participation. Ultimately 81 cases agreed to participate and were interviewed for the study. The refusals were more likely to be male and in younger age categories as were those determined to be ineligible (Table 1.) The large number of potentially eligible but not found cases makes the true participation rate difficult to calculate. However, assuming the proportion of ineligibles in those contacted is the same as those not found (45%), an estimated total of 181 eligible injuries were identified. The 81 participants represent a forty-five percent participation rate.

There were 97 individual injuries reported in the 81 cases. (Table 2) Overall the injuries were fairly minor. One severe injury did occur to a child who suffered a serious crushing injury after falling off a box being carried by a forklift. This injury ultimately resulted in the amputation of her entire arm. Of the 81 cases, 66 cases (81.5%) reported that the injury was related to work or a work-related activity. The distribution of the injuries were similar between work related injuries and all injuries.

The types and source of injury suggest that falls from ladders, being cut by a knife while picking asparagus, and encounters with animals are the most common agriculture related injuries in this region. (Tables 3-4). Falls from ladders accounted for 14.8% (N=12) of the injuries. These injuries could be expected to be common in this tree fruit growing region where ladders are used for picking, thinning, and pruning. Asparagus harvesting is also characteristic of this region. The harvesting of this crop entails cutting and trimming the asparagus stalks with sharp knives. The animal related injuries were predominantly related to horses and cattle. More horse related injuries were recorded in the non-work injury cases.

A majority of the cases were older teens, age 17 and older, who were injured during the course of work. This is reflected in the relationship to agriculture distribution where 54.3% and 65.2% of the cases and work-related cases, respectively, were youth who worked at a site, but did not live there and their parents were not working there. (Table 4).

The injuries, while not life threatening, did result in some measurable temporary disability. Fifty percent of the cases reported that they were unable to resume their normal activities for one week or more. (Table 5) Of the work related injuries, twenty-seven percent reported missing at least one week of work. Few injuries resulted in missed school time, which may be related to the season in which most injuries occurred.

Recruitment of controls was particularly problematic, and more labor intensive than expected. Of the 81 cases, a suitable control was not found for 27 (33%). The control search was abandoned after looking for approximately 4 months after the case was interviewed. In the early phases of the study this period was longer, but as the work-load increased and the number of controls to find grew this period was shortened. The majority of the cases without controls were identified late in the study and the funding for the field staff expired before all controls could be identified. The control selection process required the field staff to visit between 1 to 450 households, with a median number of 40 households. (Table 6) The laborious nature of the process of finding, recruiting, and interviewing the cases resulted in long lag times between injury, cased interview, and control interviews. The initial target was to interview the cases within fourteen days of the

injury date and the controls within another seven to ten days. The actual interval periods were far larger. The median time between injury date and case interview was 43.5 days, with a range of eight to 176 days. The median time between case interview and control identification was 32.5 days, with a range of 1 to 177 days. (Table 6) Much of the delay in enrolling the cases was related to delays in identifying the cases at the site, making initial contact via the provider, and then arranging an interview time and place. The contact information on the chart was often incorrect, thus additional tracing was needed. Also, catching working people at home when they are willing to sit through a twenty minute interview is difficult. The delays related to control identification were due to the strict matching criteria, the protocol for the neighborhood search which limited the number of not-at-homes that could be encountered in one day, and the relatively low participation rate. The difficulties in identifying appropriate controls were somewhat disproportionate by relationship to agriculture, gender, age, ethnicity, and the year of injury. Table 7 displays the characteristics of the cases by the number of controls identified. Control selection appeared more successful for cases who were males, older, and of Hispanic ethnicity. The year of injury also influenced control identification as controls for several cases injured in the harvest season of 2000 were not identified by the end of the field work period in December, 2000.

The cases and their matched controls were similar not only on the matching factors, but also by race or ethnicity and family income, which is likely a reflection of the neighborhood control sampling scheme. (Table 8) Cases did differ from controls slightly be the how long the family had lived in the current neighborhood. Cases were less likely to have lived in their current neighborhood for more than one year (74.1% vs 84.4%), and much less likely to have lived in the neighborhood for five years or more (OR =0.35, 95% CI=0.12-0.98 for 5+years vs <1year). (Tables 8 and 13) Cases or the parents of cases were much less likely to report leaving home for at least one month in the last year in search of work (OR=0.1, 95% CI=0.01-0.74). (Tables 8 and 13). The average hours of sleep, hours of sleep before the injury, and reported weekly hours of extracurricular activities were not associated with injury risk. (Tables 12 and 13) The reported odds ratios were calculated for work-related injuries only.

There was little indication that minor (colds, cough, headache), major (flu, bronchitis) or chronic (asthma allergies, diabetes, seizure disorders) health conditions around the time of injury were risk factors for an injury. If anything the opposite was trew. Few cases reported either an agriculture or other related injury in the previous year. (Tables 9 and 13). Cases reported seatbelt use and bicycle helmet use more frequently than did controls, suggesting that these safety behaviors are not positive predictors for injury.

The demographics distribution between and controls for work-related injuries were similar to non work-related injures (Table 10). Of interest was that only 35 percent of cases indicated they would file a worker compensation claim for the work-related injury. The jobs on the index date was more likely to be related to asparagus harvesting, as reflected in the number of lacerations from asparagus knives, and also more likely related to working with animals, particularly cattle. (Table 11). The cases were somewhat less likely to be doing a job they did not consider their normal job (OR=0.3, 95% CI=0.06-1.72). (Table 14) Being paid on a piece work scale, which may result in risk taking to increase pay, did not appear to alter the risk of work-related injury (OR=1.24, 95% CI=0.53-2.80). (Table 11). Being supervised and reporting that they had received formal safety training appeared to be associated with a reduction in injury risk (OR=0.24, 95% CI=0.08-0.76, and OR=0.32, 95% CI=0.12-0.82 respectively). A self-report of

'a lot of experience' vs 'little or no experience' in this type of work was not related to the risk of injury. (Table 14).

Discussion

The primary findings of this report indicate that agriculture related injuries identified in emergency departments and farm worker clinics in Washington State are primarily related to activities involved with tree fruit production, asparagus growing, and working with animals. The most frequent injuries were falls from ladders and cuts from asparagus knives. There were also injuries related to the use of tractors, machinery and ATVs, however the underlying causes of these injuries are not as specific. Few potential risk factors for injury were identified. However, it appeared that being regularly supervised and having formal safety training for a job reduced the risk of injury. These findings have to be considered in light of the many limitations of the data. Due to the difficulty in identifying and recruiting cases and suitable controls these results should be interpreted with extreme caution.

The main limitation of this study resulted from difficulties identifying and recruiting cases and the complexity of finding suitable controls. Administrative difficulties working with in the health care settings, the limitations of the existing records, mobility of the population, time constraints on potential participants, and suspicion of 'outsiders' inquiring about the risk of injury to children resulted in a much lower than anticipated sample size. The following is a summary of the challenges that this study faced. Through out the course of the study attempts were made to overcome these obstacles, however these efforts were met with little success.

Case identification

The first clear problem encountered was that of obtaining functional participation on the part of the clinical centers in identifying potential cases. The recruitment strategy differed from site to site. It differed principally in the access to patient records we were permitted by the institution, and by the "searchability" of the patient records. In locations were computerized record systems permitted our field team to review diagnosis, age, gender quickly, the process was efficient and productive. At other sites, the absence of a computerized patient data system left us either the task of reviewing patient records individually, or depending upon willing clinical staff to identify potential cases. The former was, from a practical perspective, impossible due to the volume of charts and the relative rarity of agricultural injuries in children compared to other medical problems. The latter was dependent upon the good will of the clinical staff. At the present time, the pressure to see and attend to more and more patients efficiently and quickly overshadowed any willingness to provide the un-reimbursed case identification service. This was clearly an issue in the Farm Workers clinics where we were asking the clinicians to assist in identifying potential cases. As a result, at those locations where our access to patients was determined by clinician identification of potential cases, our strategy was inadequate to assure a sizable sample. In certain locations we even encountered subtle opposition towards the study. Resistance to the study may have been rooted in the additional, although small, burden our study put on an already busy emergency department, and, to some extent, concern that contacting patients for the study was a violation of privacy. The two main trauma centers for the region were both participants in our study and generally share equally in the trauma care provided to incoming patients from the Yakima Valley. When the study was initially presented key personnel at both sites were enthusiastic about participating. After the details of case identification were worked out the project was warmly received and fully endorsed by the emergency room staff at one center. From that site we received the bulk of our cases. At the other main trauma center, key staff appeared to consider the study with less regard and resistance to the study was subtle but apparent. At that site the study team was not permitted to assist with the case finding efforts. From this potentially equal partner, despite repeated visits by study staff to encourage participation and several

meetings to resolve questions about the case identification procedures, we received only three cases through the entire study period; a number was inconsistent with expected frequency. No easy method for estimating the number of missed cases due to the difficulties encountered with participation of various clinical sites. However, it is likely that only a small fraction of the potential cases for the study were brought to the attention of the study team.

After the first year of the study the recruitment strategies were altered at the clinical sites to improve case finding. The study staff also went to great lengths to present the study in a positive light and develop a positive rapport with the clinic staff to encourage participation. However these changes had limited success in improving case identification.

Case finding and eligibility

Locating candidates for interview represented a very significant challenge for the field team. In a very high percentage of cases, addresses were given merely as P.O. boxes. This made locating those candidates for interview dependent upon their willingness to respond to recruiting materials we mailed to them. Frequently the mailings we sent to these P.O. boxes were never responded to and we were unable to locate the candidate. Another problem that led to difficulty in locating candidates was the inadequacy or inaccuracy of addresses even when available. Many of our candidate cases were members of migrant or seasonal farm worker families, in some cases the candidates had moved from the temporary address that had been provided. Other times the address was frankly false or sufficiently inaccurate as to not permit us to locate the candidate. Overall, candidates not found when sought in the community represented about 20% (81/398) of identified candidates.

Clinical sites varied dramatically in the quality of records that were maintained. We were able at times to determine case eligibility simply by record review. At other times, finding and interviewing the potential case was the only manner to determine eligibility. Candidates found ineligible (after interview) due to age, type or injury location represented 43 % (173/398) of potential candidate, substantial percentage of our almost 400 candidate contacts during the study period. This coupled with the difficulty of candidate finding represented a very substantial drain on study resources.

Refusals

Refusals by candidates or candidate's families to participate in the study represented another barrier to study recruitment. In total some 44% (63/144) of located eligible candidates refused to participate. We were unable in most cases to characterize the reason for refusal. Most refusals went unexplained by the individual, however in some cases it was clear to the interviewer that potential candidates or their families were fearful of the consequences of participation. The farmworking community from which the majority of our candidates came are largely migrant and many are undocumented. The reasons for refusal and our inability to locate many candidates are linked to the migrant and marginal status of this farm working community. We anticipated these issues when planning the study and hired personnel who were from the area, had grown up in farm working families, and were bi-lingual and bi-literate. Clearly this does not cross all barriers.

Summary of Case Recruitment Issues

The principal problem in conducting this study was the inability to conduct efficient and successful recruitment. We faced and were unable to overcome the limitations presented by patient data systems, which were difficult to use with respect to candidate identification. We

were hampered by the inability, and at times unwillingness, of clinical caregivers to provide the study with assistance in identifying study candidates. Moreover we faced the difficulties inherent in finding and coaxing into participation a population, which is marginalized and fearful of authority. These complications limited the study in several ways. In addition to only a select few cases being recruited, the time from injury till interview was longer than anticipated. Therefore recall of specific events leading up to the injury may be biased or telescoped.

Control Recruitment

As mentioned previously the control identification and recruitment protocol was complicated. The protocol, coupled with concerns of participation to those of the cases resulted in a lower than anticipated recruitment of controls. The control selection protocol was reviewed several times to determine whether it could be more efficient. The trade off for efficiency was validity. As mentioned in the methods section identifying a source population from which the controls came was very challenging for this study. Data do not exist with which to enumerate the population which may attend a clinic or hospital, and with in that population it is difficult to determine the population that represents the exposure experience of the at risk population. We were not able to identify controls in a rapid enough manner, which then limited the validity of the information we collected about activities around the time of the index injury date.

Some lessons can be learned from this study. The agriculture related injuries to children in the Yakima Valley, which is representative of the Pacific Northwest are unique to the agriculture practiced in the region. The pattern of injuries differ from those seen in much of the rest of the country. Therefore prevention strategies should be developed that are specific to the injuries such as ladder injuries and asparagus knife injuries.

Developing improved surveillance systems for agriculture related injuries is an important step in developing and monitoring prevention programs. The records available through emergency rooms can identify potential agriculture related injuries, however the process used in this study is very labor intensive and produces many false positives. The use of community based clinics for surveillance provides a much larger problem for surveillance. Unlike the hospital there is no central point of entry where agriculture related injuries can be identified on an ongoing basis. Maintaining this type of surveillance system with out substantial resources dedicated to the reporting sites is not feasible. Other non-provider based methods should be explored.

Although this study did not achieve its original goal of characterizing host-specific determinants of injury in this population, it did characterize the major types of agriculture related injury in this region. As a result of this study two studies have been initiated by PNASH and the Washington State Department of Labor and Industries to better understand ladder related injuries in tree fruit production.

This study also provides some lessons on the study of injuries in this community and the application of analytical epidemiologic study designs for studying agriculture related injuries. Clearly this community includes many persons who feel marginalized, and may fear that there are consequences for participating in these studies. Being formally approached for an interview study may be too intimidating. The control selection protocol had been used successfully elsewhere, however the nature of this community makes it difficult to randomly identify individuals for recruitment. The results of this study also clarified a problem with a lot of agriculture related injury research; that it is difficult, if not impossible, to define agriculture

related injuries in a manner that allows focus on specific etiologies. Future research should focus on very specific types of injuries, such as the above-mentioned studies of ladder related injuries.

Presentations, Planned Publications, and Future Plans

Presentations;

Alexander BH, Keifer MC, Rivara FP. Case-Control Studies of Agriculture Related Injuries in Children. National Occupational Injury Research Symposium. October 17-18, 2000. Pittsburgh PA.

Planned Publications

The descriptive results of the study will be summarized and submitted for publication in the peer reviewed literature. The following publications are planned.

1. A summary of the essential results: Agricultural Injuries to Children and Youth in the Yakima Valley of Washington State.
2. A discussion of the process and ways to improve methods for studying injuries in this population.

Future Plans

The lessons learned from this study have initiated two investigations into ladder injuries in the Yakima Valley. The first study partnered the Pacific Northwest Agriculture Safety and Health Center (PNASH), a NIOSH funded center, with the Washington State Department of Labor and Industries to evaluate claims for ladder related injuries in Washington. This is being followed up with a study funded through the PNASH center to interview workers filing claims for ladder related injuries to ascertain the circumstances and consequences of these injuries.

The following data sources have not been analyzed, but will be explored;
We have two years of an almost complete enumeration of all injury visits to three hospitals in the Yakima Valley, including one trauma center, two medium sized community hospitals in smaller towns with an agriculture base. The data come from the emergency room logs, but they can potentially provide an estimate of the number of agriculture related injuries treated in reference to all injuries.

Acknowledgements
The investigators would like to thank the staff of Providence Medical Center Yakima, Providence Medical Center Toppenish, Yakima Memorial Hospital, Sunnyside Community Hospital, Prosser Memorial Hospital, and the Yakima Valley Farm Workers Clinics. We especially appreciate the extensive efforts of the field research coordinator, Ms. Maria C. Negrete.

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Table 1. Summary of case recruitment and enrollment.

	Age group	Male		Female		Total	
		N	%	N	%	N	%
Enrolled in study	5	1	1.7	2	8.7	3	3.7
	6-12	12	20.7	5	21.7	17	21.0
	13-16	6	10.3	6	26.1	12	14.8
	17	39	67.2	10	43.5	49	60.5
	Total	58		23		81	
Eligible but refused	5	7	18.9	1	3.8	8	12.7
	6-12	9	24.3	10	38.5	19	30.2
	13-16	12	32.4	15	57.7	27	42.9
	17	8	21.6	0	0	8	12.7
	Unknown	1	2.7	0	0	1	1.6
	Total	37		26		63	
Possible eligible injuries, not found	5	4	6.6	2	10.0	6	7.4
	6-12	14	23.0	5	25.0	19	23.5
	13-16	11	18.0	4	20.0	15	18.5
	17	32	52.5	9	45.0	41	50.6
	Total	61		20	100	81	100
Determined ineligible	5	17	14.0	6	11.5	23	13.3
	6-12	41	33.9	23	44.2	64	37.0
	13-16	34	28.1	8	15.4	42	24.3
	17	29	24.0	15	28.8	44	25.4
	Total	121	100.0	52	100	173	100
Total		277		121		398	

Table 2. Distribution of the types of injuries reported for all injuries and work-related injuries.

Injury Type	Number of cases with injury	Percent of cases with injury
All Injuries		
Sprains	16	19.8
Open wound upper extremities	18	22.2
Open wound lower extremities	6	7.4
Open wound head	5	6.2
Fracture	8	9.9
Abrasions	10	12.3
Contusions	25	30.9
Crushing injury	4	4.9
Concussion	1	1.2
Toxin	2	2.5
Internal injury (kidney)	1	1.2
Hernia	1	1.2
Total Injuries	97	
Total Cases	81	100
Work-related injuries		
Sprains	13	19.7
Open wound upper extremities	15	22.7
Open wound lower extremities	3	4.5
Open wound head	3	4.5
Fracture	7	10.6
Abrasions	9	13.6
Contusions	23	34.8
Crushing injury	2	3.0
Concussion	1	1.5
Toxin	2	3.0
Internal injury (kidney)	1	1.5
Hernia	1	1.5
Total Injuries	80	
Total Cases	66	100

Table 3. Type of injury and source of injury for all cases and work-related injuries..

Type of injury		All Cases N	All Cases %	Work-Related N	Work-Related %
Falls	From Ladders	12	14.8	12	18.2
	From Animals	6	7.4	4	6.1
	From Vehicles	2	2.5	2	3.0
	From other	1	1.2	1	1.5
	Against	2	2.5	2	3.0
Struck by/against	Animal	5	6.2	5	7.6
	Falling object	3	3.7	3	4.5
	Vehicle	2	2.5	1	1.5
	Other unspecified	1	1.2	2	3.0
Other animal	Stepped on	1	1.2	0	0.0
	Bitten by	1	1.2	1	1.5
	Dragged by	1	1.2	1	1.5
	Caught by	2	2.5	2	3.0
Caught in/under	Tractor	4	4.9	2	3.0
	Machine	2	2.5	2	3.0
Object handled	Sissors/shears*	13	16.0	9	13.6
	Other	4	4.9	3	4.5
Motor vehicle	Tractor	2	2.5	2	3.0
	ATV	7	8.6	4	6.1
	Other	4	4.9	3	4.5
Stepped in/on	Object	2	2.5	1	1.5
Other	Overexertion	2	2.5	2	3.0
	Contact with toxics	2	2.5	2	3.0

*Seven of the 13 injuries fro objects handled were lacerations from knives used to harvest asparagus.

Table 4. Injured child's relationship to agriculture and crop or type of production involved.

	All		Work-related	
	N	%	N	%
Relationship to Agriculture*				
Own and live on farm	10	12.4	7	10.6
Not own/worked/parents worked	15	18.5	11	23.0
Not own/worked/parents not worked	44	54.3	43	65.2
Not own/not worked/parents worked	2	2.5	0	0
Not own/not worked/parents not worked	10	12.4	5	7.6
Crop or production				
Tree Fruit	27	33.3	26	39.4
Asparagus	10	12.4	9	13.6
Hops	6	7.4	6	9.1
Alfalfa/pasture	2	2.5	1	1.5
Grapes	1	1.2	1	1.5
Cattle	13	16.1	12	18.8
Horses	4	4.9	4	6.1
Pigs	1	1.2	1	1.5
Non-specific	16	19.8	6	9.1
Work related Injury				
Yes	66	81.5		
No	15	18.5		

* See Figure 1A and 1B for relationship to agriculture tree.

Table 5. Consequences of Injury; Time of restricted activities

		N	%
Time unable to do normal activities	None	22	27.2
	1-7 days	18	22.2
	1-4 weeks	32	39.5
	> 4 weeks	9	11.1
Days of school missed	None	76	93.8
	1 day	3	3.7
	>1	2	2.5
Time missed work*	None	23	34.9
	1-3	18	27.3
	4-7	7	10.6
	1-2	7	10.6
	2-4	9	13.6
	>4	2	3.0

* Work related injuries only.

Table 6. Summary of control recruitment.

Total number of cases enrolled	81
Total number of controls enrolled	96
Number of controls per case*	
0	27 (33.3%)
1	17 (21.0%)
2+	37 (45.7%)
Number of households interviewed per control	
Median	56.7
Minimum	1
Maximum	450
Time from hospital/clinic visit till interview	
Cases	
Median (days)	43.5
Minimum (days)	8
Maximum (days)	176
Time from case interview till control interview	
Median (days)	32.5
Minimum (days)	1
Maximum (days)	177

*Six cases had more than two controls selected.

Table 7. Characteristics of cases by the number of controls identified for that case.

Characteristic	Number of controls					
	0		1		2+	
	N	%	N	%	N	%
Total	27		17		37	
Relationship to agriculture						
Own and live on farm	6	22.2	1	5.9	3	8.1
Not own/worked/parents worked	6	22.2	3	17.6	6	16.2
Not own/worked/parents not worked	7	25.9	11	64.7	26	70.3
Not own/not worked/parents worked	1	3.7	0	0	1	2.7
Not own/not worked/parents not worked	7	25.9	2	11.8	1	2.7
Gender						
M	15	55.6	12	70.6	31	83.8
F	12	44.4	5	29.4	6	16.2
Age						
0-5	1	3.7	1	5.9	1	2.7
6-12	10	37.0	3	17.6	4	10.8
13-16	5	18.5	3	17.6	4	10.8
17+	11	40.7	10	58.8	28	75.7
Race/Ethnicity						
Hispanic	12	44.4	14	82.4	32	86.5
White	8	29.6	2	11.8	5	13.5
Native American	2	7.4	0	0	0	0
Mixed	5	18.5	1	5.9	0	0
Year of Injury						
1998	0	0	0	0	3	8.1
1999	5	18.5	1	5.9	28	75.7
2000	22	81.5	16	94.1	6	16.2

Table 8. Demographics of Cases, cases with matched controls, and controls.

	Cases		Cases with controls		Controls	
	N	%			N	%
Gender						
M	58	71.6	43	79.6	72	75.0
F	23	28.4	11	20.4	24	25.0
Age						
0-5	3	3.7	2	3.7	2	2.1
6-12	17	21.0	7	12.9	11	11.5
13-16	12	14.8	7	12.9	24	25.0
17+	49	60.5	38	70.4	59	61.5
Race/Ethnicity						
Hispanic	58	71.6	46	85.2	85	88.5
White	15	18.5	7	12.9	10	10.4
Native American	2	2.5	0	0.0	0	0
Mixed	6	7.4	1	1.9	1	1.0
Family income ($1000)						
<10,000	28	34.5	21	38.9	35	36.5
10-15,000	11	13.6	8	14.8	18	18.7
15-20,000	12	14.8	8	14.8	12	12.5
20-30,000	10	12.4	5	9.3	9	9.4
30-50,000	4	4.9	3	1.9	3	3.1
50,000	4	4.9	3	1.9	6	6.3
Not given	12	14.8	2	3.7	13	13.5
Family lived in current neighborhood						
< 1year	18	22.2	14	25.9	15	15.6
1-3 years	22	27.2	15	27.8	30	31.3
4-5 years	9	11.1	7	12.9	8	8.3
> 5 years	31	38.3	17	31.5	41	42.7
Not given	1	1.2	1	1.9	2	2.1
Parent or adult child leaves home for work purposes for more than one month						
Yes	7	8.6	3	5.6	22	22.92
No	73	90.1	50	92.6	72	75.0
Not given	1	1.2	1	1.9	2	2.1

Table 9. Health conditions around time of injury and other safety behaviors.

	Case		Cases with Controls		Control	
	N	%			N	%
Minor health problems on index date	2	2.5	1	1.9	10	10.4
Minor health problems previous week	6	7.4	6	11.1	6	6.3
Major health problems on index date	1	1.2	1	1.9	7	7.3
Chronic health conditions	10	12.4	3	5.6	15	15.6
Medication for chronic conditions	3	3.7	1	1.9	7	7.3
Prescription medications on index date	3	3.7	1	1.9	7	7.3
Ag related injuries in last year						
Structure, vehicle, implement	0	0.0	0	0.0	1	1.0
Farm animal	2	2.5	2	3.7	1	1.0
Motor vehicle crash	2	2.5	2	3.7	1	1.0
Chemical poisonings/exposures	0	0.0	0	0	9	9.4
Burns	0	0.0	0	0	0	0.0
Falls	1	1.2	0	0	2	2.1
ATV injuries	1	1.2	0	0	0	0.0
Other work related injuries	0	0.0	0	0	1	1.0
Other injuries in last year	3	3.7	1	1.9	10	10.4
Seatbelt use						
Always	57	70.4	43	79.6	48	50
Sometimes	23	28.4	11	20.4	43	44.8
Never	1	1.2	0	0	5	5.2
Seatbelt use last time in car						
Yes	69	85.2	50	92.6	75	78.1
No	12	14.8	4	7.4	18	18.8
Not given	0	0	0	0	3	3.1
Bicycle helmet use *						
Always	4	11.4	3	13.6	5	9.6
Sometimes	8	22.9	4	18.2	11	21.1
Never	21	60.0	15	68.2	37	71.1

*Among those reporting riding bicycles.

Table 10. Demographics of cases, cases with matched controls, and controls for work related injuries.

	Cases		Cases with controls		Controls	
	N	%			N	%
Total	66		48		87	
Gender	50	75.8	41	85.4	69	79.3
M	16	24.2	7	14.6	18	20.7
F						
Age						
6-12	10	15.2	4	8.3	5	5.8
13-16	8	12.1	6	12.5	23	26.4
17+	48	72.7	38	79.2	59	67.8
Race/Ethnicity						
Hispanic	53	80.3	44	91.7	80	91.9
White	10	15.2	4	8.3	7	8.1
Native American	2	3.0	0	0	0	0
Mixed	1	1.5	0	0	0	0
Family income ($1000)						
<10,000	23	34.9	19	39.6	35	40.2
10-15,000	10	15.2	7	14.6	17	19.5
15-20,000	10	15.2	8	16.7	9	10.3
20-30,000	8	12.1	5	10.4	7	8.1
30-50,000	3	4.6	2	4.2	2	2.3
50,000	1	1.5	1	2.1	5	5.8
Not given	11	16.7	6	12.5	12	13.8
Family lived in current neighborhood						
< 1year	18	27.3	14	29.2	2	14.9
1-3 years	16	24.2	13	27.1	13	29.9
4-5 years	9	13.6	7	14.6	26	9.2
> 5 years	22	33.3	13	27.1	8	43.7
Not given	1	1.5	1	2.1	38	2.3
Parent or adult child leaves home for work purposes for more than one month						
Yes	7	10.6	3	6.3	21	24.1
No	58	87.9	44	91.7	64	73.6
Not given	1	1.5	1	2.1	2	2.3

Table 11. Work characteristics of work-related injury cases and their matched controls.

	Cases		Cases with controls		Controls	
	N	%			N	%
Total	66		48		87	
Job on injury or index date						
Tree fruit	20	30.4	17	35.4	38	43.7
Other fruit		0	0	0	6	6.9
Hops	6	9.1	4	8.3	1	1.2
Cutting asparagus	8	12.1	7	14.6	4	4.6
Picking other vegetables	0		0	0	1	1.2
Working with cattle	8	12.1	8	16.7	4	4.6
Working with horses	7	10.6	3	6.3	1	1.2
Working with other animals	3	4.6	1	2.1	1	1.2
Driving tractor	0	0	0	0.0	4	4.6
Irrigating	2	3.0	1	2.1	1	1.2
Other	11	16.7	7	14.6	4	4.6
Not working	0	0	0	0	3	3.5
Normal Job	58	87.8	44	91.7	65	74.7
Paid for work	50	75.8	40	83.3	62	71.36
Pay type						
Hourly	28	42.4	19	39.6	25	28.7
Piece	26	39.4	23	47.9	37	42.5
Both	0	0	0	0	3	3.5
Shift			0	0	1	1.5
Not reported/not paid	12	18.2	6	12.5	21	24.1
Will file a claim						
Yes	23	34.8	19	39.6	*	
No	36	54.6	24	50.0	*	
Don't know	4	6.1	4	8.3	*	
Did not respond	3	4.6	1	2.1	*	

Table12. Indicators of fatigue among cases and controls for all injuries and work-related injuries.

	Cases		Cases with controls		Controls	
	Mean	Range	Mean	Range	Mean	Range
All Cases						
Average hours of sleep	8.4	4-13	8.3	4-13	7.9	4-11
Hours of sleep night before injury	8.1	3-12	8.2	4-12	7.8	4-12
Hours of weekly activity	5.9	0-53	5.3	0-38	0-68	16.0
Work-Related Cases						
Average hours of sleep	8.2	4-13	8.2	4-13	7.9	4-11
Hours of sleep night before injury	8.0	4-12	8.4	4-12	7.7	4-12
Hours of weekly extracurricular activity	5.6	0-38	5.6	0-38	6.26	0-53

Table 13. Odds ratios and 95% confidence intervals from conditional logistic regression models for selected potential risk factors for work-related injuries.

	Category	OR	95% CI
Minor health problems on injury date	No	1.0	
	Yes	0.2	0.03-1.98
Minor health problems one week before injury	No	1.0	
	Yes	2.6	0.7-9.8
Major health problems on injury date	No	1.0	
	Yes	0.32	0.04-2.83
Chronic health condition	No	1.0	
	Yes	0.41	0.11-1.52
Taking medication for chronic condition	No	1.0	
	Yes	0.35	0.04-2.92
Taking other prescription medication	No	1.0	
	Yes	0.35	0.04-2.92
Family lived in current neighborhood			
< 1year		1.0	
1-3 years		0.52	0.19-1.48
4-5 years		0.74	0.19-2.89
> 5 years		0.35	0.12-0.98
Parent or adult child leaves home for work purposes for more than one month each year	No	1.0	
	Yes	0.10	0.01-0.74
Average hours of sleep		1.17	0.92-1.48
Hours of sleep on night before injury date		1.24	0.95-1.02
Hours of extracurricular activities per week		0.98	0.95-1.02

Table 14. Odds ratios and 95% confidence intervals from conditional logistic regression models for selected job related risk factors for work-related injuries.

	Category	OR	95% CI
Working at their normal job	Yes	1.0	
	No	0.31	0.06-1.72
Paid for the work	No	1.0	
	Yes	0.56	0.15-2.07
Paid as piece work (vs hourly or salary)	No	1.0	
	Yes	1.24	0.53-2.80
Usually supervised while doing	No	1.0	
	Yes	0.24	0.08-0.76
Experience	Little or no	1.0	
	A lot	1.12	0.50-2.53
Received formal safety training	No	1.0	
	Yes	0.32	0.12-0.82

Figure 1A. Child's Relationship to Agriculture to Match to Control

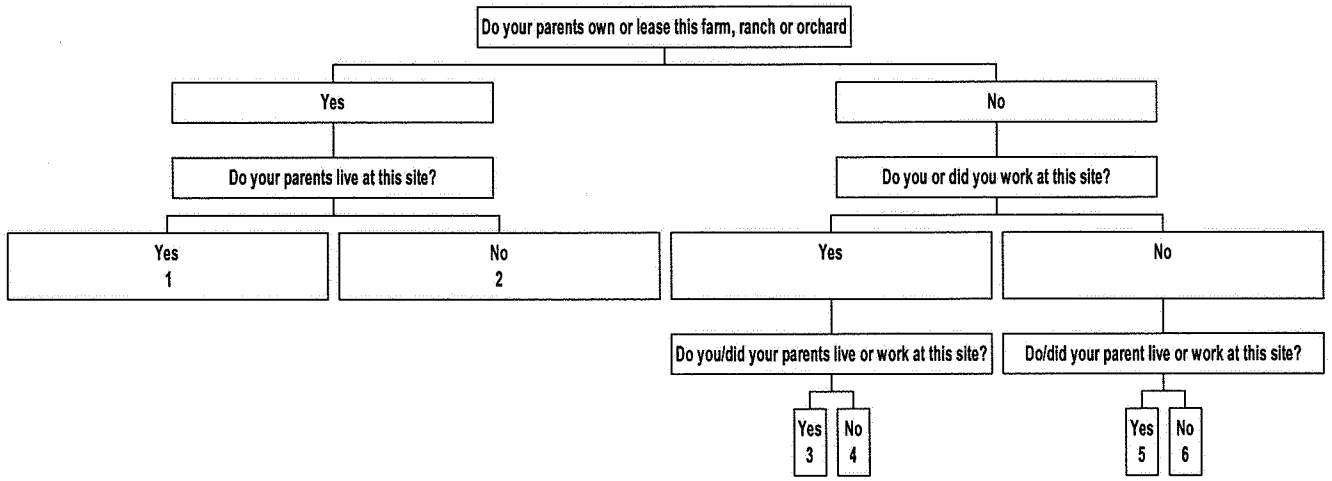

Figure 1B. Adult Teen's Relationship to Agriculture to Match to Control