Brief Report
Musculoskeletal Trauma in Tobacco Farming
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Abstract
The incidence of musculoskeletal injury sustained during tobacco farming has been poorly documented. Using the trauma registry for all farm-related injuries occurring during a 16-month period, hospital charts, radiographs, and clinic charts were reviewed to identify those patients sustaining tobacco farming-related injury.

Twenty-three of 24 persons who sustained a farm-related injury during the study period were injured while farming tobacco. Seventeen (74%) were injured in falls from vented tobacco-drying barns, and 18 (75%) sustained skeletal injury. Extreme heat, humidity, and poor barn design and maintenance contribute to the incidence of falling. These injuries, largely underreported, may be substantially reduced by improvements in barn design and construction.

Farming has long been recognized as one of the most hazardous occupations in the United States. The medical literature contains many reports detailing the characteristics of the farm environment, and of the farmers themselves, that contribute to the risk of injury in an agricultural setting.

In Kentucky and the Carolinas, tobacco is the major cash crop for many farmers. According to data from the Kentucky Department of Agriculture Extension Service, tobacco production employs more than 200,000 people on 60,000 farms, and in 1995, accounted for $665 million in sales in Kentucky alone.

Tobacco is planted during the spring as seedlings, not seeds, using machines that “set” the young plants in the ground. In the early fall, when the stalks are mature, they are cut with a large knife that resembles a machete, placed on a spiked tobacco spear (a sharply pointed stick, 4’ long, 1” in outside diameter), and left to dry in the field for several hours. The stalks are then collected and hung in a vented drying barn to cure for 2-3 months prior to being prepared for baling and eventual sale.

Despite the hazards of farming and the volume of annual tobacco production, almost no data are available on the incidence or mechanism of injury to tobacco farm workers. This article describes the etiology of musculoskeletal trauma as a result of tobacco farming.

Materials and Methods
The Trauma Registry at the University of Kentucky Hospital Albert B. Chandler Medical Center was searched for all patients admitted to our level I trauma center with a farm-related injury from August 1994 through November 1995. Emergency department records, hospital charts, radiographs, and outpatient clinic records were examined retrospectively for each patient identified.

Occupation, mechanism of injury, type of musculoskeletal injury sustained and treatment received, any associated injuries and their treatment, injury severity score, eventual discharge disposition, and the last known work or disability status were recorded for each patient. Only patients injured as a direct result of engaging in tobacco planting, harvesting, drying, or leaf preparation were included in this study. All patients with non-tobacco-related farming injuries were excluded from the study. Data were collected for all patients until they...
returned to work or were declared disabled or lost to follow-up.

**RESULTS**

Twenty-four patients with farm-related injuries were identified; of these, 23 were injured in the production of tobacco. Twenty-two of these patients were male. The average age at admission was 33.3 years. The average length of stay of those admitted with a tobacco-related injury was 8.3 days (range: 1-49 days). There were no readmissions.

Seventeen (74%) of the 23 patients were injured when they fell from a height in a vented tobacco-drying barn. One man sustained a closed head injury and another a tibia fracture when struck by a beam that fell from the rafters of a drying barn. There was one tobacco knife injury sustained while harvesting tobacco, one tobacco spear injury incurred while preparing the stalls for drying, one patient whose foot was caught in a planting machine, and one patient who was burned while incinerating tobacco-related waste.

Eighteen (78%) of the 23 patients with a tobacco farming-related diagnosis sustained 26 injuries to the musculoskeletal system. Of those 18 patients with a skeletal injury, the mechanism of injury in 15 (83%) was a fall from a height in a vented tobacco-drying barn. In those with musculoskeletal injuries, there were 12 spine fractures, 2 tibia fractures including 1 grade IIIIB open injury, 3 femur fractures, 2 acetabular fractures, 6 foot and ankle injuries including 3 calcaneus fractures, and 1 distal radius fracture.

All patients with a musculoskeletal diagnosis were admitted to the hospital, and the average length of stay was 9.1 days (range: 1-49 days). The average injury severity score for those patients with skeletal injury was 10.4 (range: 4-25). Twelve of these patients required 18 surgical procedures to treat their injuries.

None of the patients in this series died as a result of their injuries. Overall, 19 patients were discharged from the hospital to home from their acute inpatient hospitalization and 4 required an inpatient rehabilitation admission. Of those patients sustaining skeletal injury, 15 were discharged to home and 3 required inpatient rehabilitation.

At last follow-up of all patients with a tobacco farming-related injury (range: 4-19 months), 8 patients had returned to work and 7 were unable to work including 2 who were permanently disabled. The status of 8 patients could not be determined from the clinical record. Of those patients sustaining a skeletal injury, 7 had returned to work and 6 were unable to work (including both patients who were permanently disabled). Five patients with skeletal injuries were lost to follow-up.

**DISCUSSION**

The leading cause of farm-related injury is reported to be related to machinery, falls, and animals.\(^5,6,9\) Browning et al.\(^10\) reported that among older Kentucky farmers, the leading causes for injury were falls (24.9%), machinery (22.5%), wood cutting (14.6%), and animals (14.3%). Those at highest risk worked on farms with beef cattle or on farms with beef cattle and tobacco.\(^10,11\)

Previous studies of farm-related injury patterns show that large farms, those that have the highest annual production, and those with the most workers are associated with the highest risk for injury. Male farmers, those that had the most experience, and spent the greatest amount of time farming also had the highest risk of injury.\(^4,5\) Although there have been numerous studies of both fatal and nonfatal agricultural injuries, the present study is unique because it focuses on the incidence and etiology of musculoskeletal trauma in tobacco workers.

A description of the design and construction of a tobacco barn and the process of drying enables one to readily understand why falls from a height comprised the majority of injuries sustained by the patients in this study. The interior of a tobacco-drying barn is composed of layers of rough-hewn 10' long boards, each 4x4' in cross section. These boards are placed 4' apart and span the width of the barn. The first layer of boards is typically 5'-6' above the floor of the barn. Each subsequent layer of boards is separated by 4.5' of vertical height. There are typically 6-7 levels of these boards in a tobacco-drying barn.

Each tobacco spear, mounted with freshly cut tobacco stalks, weighs a total of 200-300 N. A team of workers goes into the barn and begins climbing the 4x4' boards until there is at least one person on each drying level.

Once each level is "manned," the process of passing tobacco plant-laden spears up to the top levels of the barn begins. Workers on the lower boards must do more work to the, since they pass up two tobacco-laden spears for each one they lay across the boards to dry.

The tobacco plants are pushed to one side of the stick for easy handling, but immediately before they are laid on the drying boards, these wet plants must be spread apart on the stick to permit air circulation around each leaf of the plant to prevent rotting. This work continues throughout the day until all the freshly harvested tobacco has been hung to dry. This is typically done in the early fall, and temperatures in the upper layers of the barn can reach as high as 115° F.

Workers hanging plants in tobacco barns are clearly at considerable risk from loss of balance and falls attributable to repetitive, high-load lifting tasks in high heat and humidity, the potential balance-disturbing influence of nicotine (from skin contact with the secretions of the wet plants—the documented "green plant" disease\(^12,13\)), and the small, rough, and sometimes wet (from dew and plant moisture) board surfaces. The uneven surfaces of the rough-hewn boards make for precarious footing, and splinters are abundant, especially in those who choose not to wear footwear so that a better foot-grip may be obtained on these boards. This scenario is exacerbated by the lack of standard-
ized footwear or specifications for the strength or finish of these drying boards. Tobacco-laden spears are placed on these boards 3-4 in. apart; thus, each 10' long board may need to support from 1500 to 2000 lb of tobacco in addition to the weight of the worker(s). In a pinch, tree limbs are sometimes used to replace broken drying boards, further contributing to questionable working conditions.

When these boards or limbs break, not only is the worker on the boards at risk, but workers underneath are also in jeopardy from impact with falling workers and boards as well as from impalement with the heavy, sharply pointed tobacco spears. Ironically, the highest drying layers are the most "desirable" places to work since workers on the highest levels do not have to pass loaded tobacco spears upwards to those on higher levels.

The floor of the barn is typically hard dirt, which adds to the likelihood of injury from impact and contamination of open fractures. In addition, there are often pieces of farm equipment stored on the floor of the barn, which further adds to the hazards to the workers who fall from these higher levels.

The socioeconomic circumstances of typical tobacco workers and their persistent work ethic confers a serious flaw in the present study, i.e., the underreporting of actual tobacco-related work injuries. Many of those working the tobacco harvest are day laborers without medical or disability insurance. For them, returning promptly to work is paramount. For example, many tobacco knife or spear injuries are treated in the field and do not involve a visit to a physician. In addition, most of the simple closed fractures and non-multiple-injured patients are treated at local hospitals, sent home to convalesce, and are back at work as soon as possible. These patients are rarely seen at a level I trauma center, located far from the farm in the "big city" and thus are undocumented in studies such as ours. This environment also partially explains the reason why this study had a high loss to follow-up.

CONCLUSION
Because the vast majority of injuries occur during the harvest season, changes in production methods may decrease the number of injured workers, reduce the amount of lost productivity, and reduce costs. Improved tobacco farming technology, including the adoption of a cable-hoist tobacco drying system to mechanically hang the stalks in the barn, improved design and construction standards for new barns, and better maintenance of existing barns may decrease the morbidity associated with tobacco production.

REFERENCES