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# Green Tobacco Sickness: Occupational Nicotine Poisoning in Tobacco Workers

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**ABSTRACT. In this study the authors describe the investigation of a 1992 outbreak of green tobacco sickness, a form of nicotine poisoning from dermal exposure, among 47 tobacco workers in a five-county region of central and south-central Kentucky. Cases were identified through medical record searches at participating hospitals, as well as from reports submitted to the Occupational Health Nurses in Agricultural Communities program. A case-control study was undertaken to assess risk factors for green tobacco sickness. In a 20-min telephone interview, 40 cases and 83 controls responded to questions contained in a questionnaire. In 1992, 47 persons (3 were under age 16 y) in the study region sought medical treatment for green tobacco sickness. Twelve persons were hospitalized and 2 required intensive-care treatment. The crude incidence in 1992 was 10.0/1 000 tobacco workers. In 1993, 66 cases (7 were under age 16 y) of green tobacco sickness were identified in the study region (i.e., annual incidence of 14.0/1 000). A case-control study demonstrated that ill workers were younger, and were more likely to have worked in wet conditions, compared with workers who were not ill. Green tobacco sickness is a common problem among tobacco workers that may be prevented by avoiding work in wet tobacco or by use of protective clothing. Children younger than 16 y of age represented 9% of the green tobacco sickness cases in 1992 and 1993. Current occupational safety and health laws do not address protection of tobacco workers with respect to green tobacco sickness.**

GREEN TOBACCO SICKNESS (GTS) is a form of nicotine poisoning that affects tobacco workers who have direct contact with tobacco plants during cultivation and harvesting. More than 20 y ago, GTS was first described among tobacco workers in Florida,[1] and GTS was later found to be caused by absorbed nicotine from wet tobacco plants.[2,3] Nicotine is a water-soluble alkaloid found in the leaves of the tobacco plant.[4] It is absorbed readily through the skin, lungs, and gastrointestinal tract.[5,6] Nicotine poisoning has been reported in tobacco workers,[2,6,7] as well as in persons who intentionally or accidentally ingested tobacco or nicotine-containing solutions[8] or who had dermal contact with nicotine-based insecticides.[9,10] GTS has been described among tobacco workers in India and Japan.[6,7,11] Subsequent to the original studies in the 1970s, only a few published articles have addressed GTS in tobacco

workers in the United States,[12,13] despite knowledge of the existence of GTS among some clinicians and tobacco workers in tobacco-growing regions of the United States. Green tobacco sickness is potentially preventable through the use of protective clothing, which reduces nicotine absorption in tobacco workers.[14,15]

Green tobacco sickness has a short duration (i.e., usually 1–2 d) and is characterized by nausea, vomiting, weakness, dizziness, and occasional fluctuations in blood pressure or heart rate.[2,3,16] There have been no known fatalities associated etiologically with GTS, but the effects of nicotine may make unrecognized contributions to morbidity and mortality from cardiovascular or cerebrovascular disease[17,18] and may be particularly hazardous to individuals with preexisting cardiovascular conditions. Clinical diagnosis of GTS is based on the presence of symptoms consistent with the condition and on a history of working with tobacco plants. The symptoms of GTS are similar to those of organophosphate or carbamate poisoning, and distinguishing between the two conditions has implications for diagnostic procedures and treatment beyond supportive measures.[18] The diagnosis of green tobacco sickness may be achieved by a test for urinary or serum nicotine (half-life = 3–4 h) or, in the case of nontobacco users, cotinine (a nicotine metabolite with a half-life of 36 h) may be useful diagnostically. Whereas cotinine levels have been used to differentiate between tobacco users and nonusers,[19,20] they cannot be used to differentiate between heavy tobacco users and persons with green tobacco sickness because nicotine/cotinine concentrations that represent toxic levels have not been established.

At a time when much attention is being directed to the health effects of tobacco, one overlooked population includes persons employed in tobacco harvesting who are exposed to nicotine through direct contact with tobacco leaves. We describe the detection and investigation of and the response to an outbreak of green tobacco sickness, identified by an agricultural surveillance system in the Commonwealth of Kentucky.

## Method

The Kentucky Department for Health Services has established a surveillance system for identifying work-related illnesses and injuries among farmers, farm families, and agricultural workers in nine counties. The surveillance system is a component of the Occupational Health Nurses in Agricultural Communities (OHNAC) program, which is a 5-y demonstration project funded by the National Institute for Occupational Safety and Health (NIOSH) to support education, surveillance, and prevention activities by public-health nurses in agricultural communities of 10 states.[21] Active community-based surveillance and case ascertainment through health-care providers and local hospitals is a mainstay of this program. During September 1992, the Kentucky OHNAC program identified 47 persons with GTS who sought treatment at five hospital emergency departments in five central and south-central counties. The surveillance case definition was a person with an emergency-department diagnosis consistent with GTS (e.g., green tobacco sickness, tobacco/nicotine poisoning), whose symptoms were characteristic of the condition, and whose recorded work history included tobacco harvesting at the time of illness. Cases were identified through medical-record searches at participating hospitals, as well as from reports submitted to the OHNAC program. Because symptoms of GTS are similar to gastroenteritis or other common conditions; however, we did not consider it feasible to conduct case-finding through review of medical records for patients with non-GTS–related diagnoses that may have been GTS.

To evaluate possible risk factors associated with green tobacco sickness, we conducted a case-control study during the month of October 1992, which coincided with the end of the harvest. All persons who met the surveillance case definition were initially included in the study. Cases and local agricultural extension agents were asked to identify persons who might serve as control subjects. A control was defined as a person who resided in the study region, who worked in tobacco during the 1992 harvest season, and who had not experienced symptoms consistent with green tobacco sickness during that year. Controls were selected according to the control definition via telephone-screening interviews; controls were not matched by age or sex. In a 20-min telephone interview, study subjects responded to questions about job duties performed during the tobacco-growing season; exposure to wet tobacco leaves; whether clothing became soaked from exposure to wet tobacco; whether wet clothing was replaced with a dry set during work hours; type of work clothing usually worn (e.g., short or long pants, short- or long-sleeved shirts, no shirt); use of protective clothing (e.g., gloves, rain gear); work duration (measured as h/d or d/wk); and personal tobacco use. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated from stratified analyses and from logistic regression models for risk factors associated with GTS.[22]

## Results

**Case descriptions.** During the cutting of tobacco plants throughout harvest, 47 cases of green tobacco sickness occurred in August and September of 1992. The median age of the 47 cases was 29 y (range = 14–54 y), and 3 (6%) cases were under the age of 16 y. Six cases (13%) were female. The most frequently reported symptoms included weakness (100%), nausea (98%), vomiting (91%), dizziness (91%), abdominal cramps (70%), headache (60%), and difficulty breathing (60%). The median time from starting work in the morning to initially feeling ill was 10 h (range = 3–17 h). The median duration of illness (i.e., number of days symptoms were experienced) was 1 d (range = < 1–14 d). All case patients were treated initially with antiemetic drugs in emergency departments, and 35 (74%) received intravenous fluids. Twelve persons (26%) were hospitalized for periods of 1–2 d, and 2 (4%) persons required intensive-care treatment for

hypotension and bradycardia. Thirty-six of 40 interviewed cases (i.e., 90%) had previous work experience with tobacco, 14 (39%) of whom in previous years had sought medical care for symptoms suggestive of GTS.

Hospital costs were calculated for three levels of care received by 31 cases who were treated at two participating hospitals. On average, fees were $250 for outpatient treatment, $566 for hospital admission, and $2,041 for intensive-care treatment.

Based on these 47 cases, we calculated estimates of GTS incidence. Using U.S. Department of Agriculture/Kentucky Department of Agriculture data,[23] we estimated the population of tobacco harvest workers to be 4 696 in the five counties affected. The incidence for developing occupationally related GTS was 10.0/1 000 workers during the 1992 harvest season in the five central and south-central counties.

**Case-control study.** Forty of the 47 cases (85%) and 83 non-ill tobacco worker controls were contacted and were interviewed for the case-control study. Seven cases could not be located and were not included in any aspect of data analysis for the case-control study. All the remaining cases and all controls who were contacted agreed to participate. The 7 noninterviewed persons with GTS were younger than the remaining cases (median age = 19 y; range = 17–32 y), but they were similar to the others with respect to sex and severity of illness. Interviewed cases and controls were proportionately similar by gender, but the ages of controls exceeded the ages of cases (Table 1). Odds ratios and 95% confidence intervals were calculated to compare cases and controls for hypothesized risk factors (Table 2). Ill workers were more likely than non-ill workers to young. In an analysis that treated age as a continuous variable, the beta coefficient for increasing age in 1-y intervals was estimated to be –.05993. The model-predicted odds ratios for 5-, 10-, and 15-y age differences, in which younger subjects were compared with older subjects, were 1.3 (CI = 1.1–1.6), 1.8 (CI = 1.3–2.5), and 2.5 (CI = 1.5–4.1), respectively. When age was treated as a dichotomous variable, we found that cases were more likely to be younger than 30 y of age (OR = 3.1; CI = 1.4–7.0). All cases and 69 (83%) controls had worked in fields of wet tobacco, where their clothes became wet from moisture on the tobacco plants. The OR for current use of personal tobacco products (e.g., cigarettes, snuff, chewing tobacco, pipe, cigars) was 0.69 (CI = 0.32–1.5). The interpretation of this weak protective effect was hampered by the wide confidence interval. Prevalence of tobacco use was 43% among cases and 54% among controls. Reported use of protective clothing worn at least once during the growing season was low for the study population as a whole (i.e., 5% for waterproof clothing and 32% for gloves). There was no significant difference between cases and controls with respect to these protective items. In addition, gender, work duration, and type of work clothing were not associated with illness.

**Public health response.** After investigating the 1992 outbreak of green tobacco sickness in Kentucky, we initiated an educational campaign that targeted tobacco workers and health-care providers. We provided on-the-job educational programs in local hospitals in the study area and mailed published literature[24] on GTS to all licensed physicians in the Commonwealth of Kentucky. In an effort to target tobacco workers at risk of developing GTS, local newspapers and radio stations carried news stories at the end of the 1992 harvest and at the beginning of the 1993 season. Green tobacco sickness was described, and recommendations for its prevention were presented.

To document the impact of GTS over time, we intensified surveillance activities at the beginning of the 1993 tobacco-growing season in Kentucky. Diagnostic criteria and uniform coding for the diagnosis of GTS in medical records were discussed with staff at all hospitals in the counties that participated in the agricultural surveillance system.

**1993 surveillance findings.** During the 1993 tobacco harvest, 66 cases of GTS among tobacco harvesters were identified in the five-county study region; 7 (11%) of the harvesters were between 12 and 15 y of age. Eleven of the 66 cases (17%) were hospitalized for at least 1 d. The crude incidence rate calculated for the

**Table 1.—Characteristics of Cases and Controls: Green Tobacco Sickness**

| Characteristic | Cases | Controls |
|---|---|---|
| Age (y) | | |
| Median | 29 | 39 |
| Range | 14–54 | 16–70 |
| Sex | | |
| Female | 5 (13%) | 11 (13%) |
| Male | 35 (87%) | 72 (87%) |
| Total | 40 | 83 |

**Table 2.—Risk Factors for Green Tobacco Sickness: Case-Control Study**

| Risk factor | OR* | 95% CL |
|---|---|---|
| Age | | |
| 5-y age difference† | 1.3 | 1.1–1.6 |
| 10-y age difference† | 1.8 | 1.3–2.5 |
| 15-y age difference† | 2.5 | 1.5–4.1 |
| < 30 y versus ≥ 30 y | 3.1 | 1.4–7.0 |
| Wet clothes from wet tobacco | infinite | 1.8–infinite |
| Current use of tobacco products‡ | 0.70 | 0.32–1.5 |
| Not changing out of wet clothes | 3.6 | 0.51–85 |
| Not wearing rain gear | 2.5 | 0.32–121 |
| Nonuse of gloves | 0.78 | 0.26–1.9 |
| Female versus male | 0.94 | 0.27–2.8 |
| Harvesting > 7 h/d | 0.96 | 0.42–2.2 |

*From a maximum likelihood estimate of the odds ratio.
†From logistic regression model, including age as continuous variable, comparing younger to older age and adjusting for smoking status.
‡Age-adjusted.

five-county area in 1993 was 14.0/1 000 harvesters (1992 population estimate was used).

## Discussion

The clinical spectrum of GTS described in this study is similar to that found by Gehlbach[2] and by others in published case reports[12,13]: the condition is self-limited; it has a duration of 1–2 d; and the predominant symptoms include weakness, nausea, vomiting, dizziness, and headache. Although green tobacco sickness is not a new problem, the magnitude of illness has not been recognized previously because surveillance mechanisms for agricultural health conditions have been instituted only recently in a few states.[21] The only previously documented estimate of the magnitude of GTS was 9% of North Carolina tobacco harvesters who reported illness in 1973.[3] This estimate cannot be compared with the incidence rate in Kentucky because case numbers were based on self-reports in North Carolina and were based on hospital-treated cases in Kentucky. Kentucky surveillance data showed that the incidence for hospital-treated GTS was greater in 1993 than in 1992 (i.e., 14 versus 10/1 000, respectively, tobacco workers), despite an intensive public-awareness campaign that stressed prevention strategies prior to the 1993 harvest. This increase in incidence, however, is not surprising. Heightened awareness about GTS on the part of both tobacco workers and health-care providers may have contributed to a greater number of affected workers seeking treatment, as well as to a greater number of cases being diagnosed with GTS in 1993. In addition, surveillance activities for GTS were intensified in 1993. It was originally thought that an excessively rainy season contributed to the unusual number of GTS cases in 1992, but a more likely explanation is that 1992 was the first full year of the agricultural surveillance system, and the magnitude of the problem had simply not been recognized previously. The high treatment cost for GTS in Kentucky (i.e., approximately $250 for emergency-department care) may be an important barrier to seeking treatment and could contribute significantly to an underestimation of GTS incidence when hospital-treated cases are measured. Given the seasonal nature of the work, tobacco workers may not have health insurance, and agricultural workers are not covered by the Kentucky worker's compensation program.

Results from the case-control study reported in this article showed that younger workers were more likely than older workers to develop GTS—a finding consistent with other studies.[2] Possible explanations for this age effect include selection bias, introduced by the use of a convenience sample of controls that may have included an older sample than the true population of tobacco harvesters, or a survival effect in which workers most sensitive to nicotine dropped out of this work force at a young age. Inclusion in the analysis of the seven identified GTS cases who were not interviewed would have increased the strength of the age association because their median age was 19 y, compared with 29 y for the study cases. Case-control study findings also suggested that ill workers were less likely to use tobacco. This finding, however, was much less prominent than reported previously; in a North Carolina study, the OR for tobacco use was 0.06 (CI = 0.01–0.24 [calculated from published data]).[3] Personal use of tobacco products may confer a protective effect resulting from an increased tolerance to the effects of nicotine among regular tobacco users. Nonetheless, the documented occurrence of GTS among tobacco users suggests that this acquired tolerance may not be protective if the user's customary nicotine intake is exceeded substantially.[25] Wearing clothing that became wet from contact with wet tobacco was also a risk factor for disease in this study; however, many of the specific behaviors or work practices that increased direct dermal contact with wet tobacco leaves (e.g., wearing short-sleeved shirts, not using gloves or rain gear, not changing wet clothes at the end of the day, harvesting for more than 7 h/d) were not associated significantly with GTS. Given that the controls and cases were not matched by date of illness, the study was limited in its ability to detect important differences between ill and non-ill tobacco harvesters for the use of these specific behaviors and work practices. This type of matching would have enabled a comparison between the effect of work clothing/practices that increased exposure to wet tobacco and rainy weather on illness for the specific day a case occurred.

Prevention strategies to reduce the incidence of GTS include avoiding the handling of wet tobacco. NIOSH recommends that workers should avoid working in tobacco fields during or immediately after a rainfall; delay work hours until dew has dried; wear protective clothing (e.g., chemical-resistant gloves[26] or waterproof rain gear) when working with wet tobacco plants; and change into dry clothing as soon as possible if clothing becomes wet.[27] Nonetheless, these prevention strategies may not be practical for many reasons. Because of a tight schedule for harvesting tobacco, workers are often in the field 10–12 h/d, and growers may not be able to postpone work until plants are dry or allow frequent breaks for changing clothes. Use of personal protective equipment (e.g., impermeable clothing, gloves, rubber boots) may increase the risk of heat stress in hot weather. Mechanization of tobacco harvesting reduces dermal contact with wet tobacco leaves and represents a potential method for prevention, but equipment for mechanical harvesting is not currently available for burley tobacco—the dominant type grown in Kentucky. Even if such equipment were available, Kentucky tobacco is grown primarily on small, family-operated farms, and the expense of purchasing such equipment is likely to be prohibitive. In the Southeastern United States, flue-cured tobacco is grown on large- and medium-sized farms where mechanical harvesting has increased from 14% in 1987 to 29% in 1991.[28]

Nationally, both the population at risk for GTS and the number of persons affected are unknown. There are an estimated 80 000–150 000 full-time workers who harvest, strip, grade, and haul tobacco to market during a 4-mo period.[29,30] (This range is based on figures from

the U.S. Department of Labor and from the U.S. Department of Agriculture, 1993 [calculated from estimates of person-hours for all tobacco-growing activities, excluding preharvest, for flue-cured and burley tobacco production (i.e., 93.5% of all tobacco grown in the United States)].) Included in the tobacco workforce nationwide are two vulnerable groups: migrant workers and children. The number of migrant and foreign workers hired to harvest tobacco is increasing.[30–32] In the National Agricultural Workers Survey (1989–1991), the U.S. Department of Agriculture estimated that at least 20 000 migrants were employed nationwide as tobacco workers.[30] Prevention and treatment of green tobacco sickness are more difficult in migrant populations who face barriers to health care access because of poverty, inadequate sanitary facilities, lack of transportation, immigration status, cultural beliefs, and misunderstandings that arise from language differences.[33] Although the number of children who are involved in tobacco harvesting is unknown, green tobacco sickness does occur in child workers. In Kentucky, 9% of the cases of GTS that occurred during 1992 and 1993 were experienced in children under 16 y of age. Federal and Kentucky child labor laws prohibit children who are younger than 18 y of age from working in hazardous nonagricultural industries. In agriculture, however, the standards are more lenient (i.e., hazardous work that involves handling of toxic substances is prohibited only until age 16 y), and work on family farms is totally exempt from all regulations concerning child labor.[34,35] In addition to nicotine poisoning, young children are at considerable risk for injury while working in tobacco, mostly from falls, lacerations, and punctures.[36]

In summary, tobacco workers are exposed routinely to nicotine, a toxic chemical capable of producing an incapacitating illness that was first recognized and described more than 20 y ago. As many as 150 000 workers nationwide may be at risk, including vulnerable groups such as children who are younger than 16 y of age, as well as migrant workers. Prevention of GTS through the complete avoidance of contact with wet tobacco is difficult to achieve. Given the inadequacy of available control measures, one of the best prevention strategies available is to educate tobacco workers about the risk of developing GTS and, taking into consideration language and literacy barriers, provide them with current recommendations for prevention. There is no legal requirement that workers be informed about hazards of nicotine[37]; this suggests that current health and safety regulations and practices may not protect tobacco workers adequately. Child labor laws do not cover tobacco production, and the laws do not in general protect children who work in agricultural settings in which health and safety hazards are known to exist.[38,39]

To reduce the burden of occupational nicotine poisoning in tobacco workers, we propose that additional education and research efforts are necessary. Healthcare providers and public-health professionals in tobacco-growing regions should be educated about GTS, thus assuring improved recognition and treatment. Priorities for further research on GTS should take a three-pronged approach: (1) education and training should be researched to determine if recommendations are observed and if preventive measures are effective; (2) effective and practical protective clothing and skin barriers should be developed; and (3) occupational health surveillances should be expanded to identify populations at risk of developing GTS, especially children and migrant workers.

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Terri Ballard is currently affiliated with the Tumor Registry of the Veneto Region, Padova, Italy.

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**References**

1. Weizenecker R, Deal WB. Tobacco cropper's sickness. J Florida Med Assoc 1970; 57:13–14.
2. Gehlbach SH, Williams WA, Perry LD, Woodall JS. Green tobacco sickness: an illness of tobacco harvesters. JAMA 1974; 229:1880–83.
3. Gehlbach SH, Perry LD, Williams WA, et al. Nicotine absorption by workers harvesting green tobacco. Lancet 1975; 1:478–80.
4. Dawson RF, Solt ML. Nicotine and its botanical sources. Ann NY Acad Sci 1960; 90:7–11.
5. Malizia E, Andreucci G, Alfani F, et al. Acute intoxication with nicotine alkaloids and cannabinoids in children from ingestion of cigarettes. Human Toxicol 1983; 2:315–16.
6. Misumi J, Koyama W, Miura H. Two cases of "green-tobacco sickness" in tobacco harvesters and absorption of nicotine through the skin in the rat. Jap J Ind Health 1983; 25:3–9.
7. Ghosh SK, Parikh JR, Gokani VN, Kashyap SK, Chatterjee SK. Studies on occupational health problems during agricultural operation of Indian tobacco workers. J Occup Health 1979; 21:45–47.
8. Saxena K, Scheman A. Suicide plan by nicotine poisoning: a review of nicotine toxicity. Vet Human Toxicol 1985; 27:495–97.
9. Faulkner JM. Nicotine poisoning by absorption through the skin. JAMA 1933; 100:1664–65.
10. Wilson DJB. Nicotine poisoning by absorption through the skin. Br Med J 1930; 2:601–02.
11. Ghosh SK, Parikh JR, Gokani VN, Rao MN, Kashyap SK, Chatterjee SK. Studies on occupational health problems in agricultural tobacco workers. J Soc Occup Med 1980; 29:113–17.
12. Ives TJ. Use of dimenhydrinate in the treatment of green tobacco sickness. Drug Intell Clin Pharmacol 1983: 17;548–49.
13. Hipke ME. Green tobacco sickness. Southern Med J 1993; 86:989–92.
14. Gehlbach, SH, Williams WA, Freeman JI. Protective clothing as a means of reducing nicotine absorption in tobacco harvesters. Arch Environ Health 1979; 34:111–14.
15. Ghosh SK, Gokani VN, Doctor PB, Parikh JR, Kashyap SK. Intervention studies against "green symptoms" among Indian tobacco harvesters. Arch Environ Health 1991; 46:316–17.

16. Morgan DP. Recognition and Management of Pesticide Poisonings, 4th ed. Washington, DC: Environmental Protection Agency, 1989.
17. Benowitz NL. Clinical pharmacology of nicotine. Ann Rev Med 1986; 37:21–32.
18. Le Houezec J, Benowitz NL. Basic and clinical psychopharmacology of nicotine. Clin Chest Med 1991; 12:681–99.
19. Wall MA, Johnson J, Jacob P, Benowitz NL. Cotinine in the serum, saliva and urine of nonsmokers, passive smokers and active smokers. Am J Public Health 1988; 78:699–701.
20. Wald NJ, Boreham J, Bailey A, Ritchie C, Haddow J, Knight G. Urinary cotinine as marker of breathing other people's tobacco smoke. Lancet 1984; January 28:230–31.
21. Connon CL, Freund E, Ehlers JK. The occupational health nurses in agricultural communities program: identifying and preventing agriculturally related illness and injuries. AAOHN Journal 1993; 41:422–28.
22. EGRET Statistical Package. Seattle, WA: Statistics and Epidemiology Research Corporation (SERC), 1991–1994.
23. U.S. Department of Agriculture/Kentucky Department of Agriculture. Kentucky Agricultural Statistics, 1992–1993. Frankfort, KY: Kentucky Department of Agriculture, 1993.
24. Centers for Disease Control and Prevention. Green tobacco sickness in tobacco harvesters—Kentucky, 1992. MMWR 1993; 42:237–39.
25. Jaffe JH. Drug addiction and drug use. In: Goodman AG, Rall TW, Nies AS, Taylor P., Eds. Goodman and Gilman's The Pharmacological Basis of Therapeutics, 8th ed. New York: Pergamon Press, 1990; p 548.
26. Forsberg K, Mansdorf SZ. Quick Selection Guide to Chemical Protective Clothing. New York: Van Nostrand Reinhold, 1989; p 43.
27. NIOSH. Update: "NIOSH issues warning to tobacco harvesters." July 8, 1993. DHHS (NIOSH) Publications No. 93–115.
28. Clauson A. Flue-cured tobacco production costs, harvest systems, and labor use (Abstract). 35th Tobacco Workers Conference, Savannah, Georgia; January 1993.
29. U.S. Department of Agriculture (USDA) Economic Research Service. Burley tobacco labor use, characteristics, and wages. Tobacco Situation and Outlook Report. Washington, D.C.; September 1990, TS-212.
30. Boccalandro B. The National Agricultural Workers Survey, Office of the Assistant secretary for Policy, U.S. Department of Labor, Washington D.C. Personal Communication, 1993.
31. U.S. Employment Service. 1987 Annual Report: Labor Certifications for Temporary Foreign Agricultural and Logging Workers. U.S. Employment Service, Division of Foreign Labor Certifications, Department of Labor, Washington D.C. June 1, 1988.
32. U.S. Employment Service. 1991 Annual Report: Labor Certifications for Temporary Foreign Agricultural Workers (H-2A Program). U.S. Employment Service, Division of Foreign Labor Certifications, Department of Labor, Washington D.C. September, 1992.
33. Meister JS. The health of migrant farm workers. Occup Med: State of the Art Review 1991; 6:503–18.
34. Office of the Federal Register. Code of Federal Regulations. Wage and Hour Division, Department of Labor: Regulations Relating to Labor. Child Labor Regulations, Orders, and Statements of Interpretation. 29 CFR 570.70. Washington D.C: Office of the Federal Register, National Archives and Records Administration; July 1, 1989.
35. Kentucky Labor Cabinet. Child Labor, Kentucky Labor Laws, Title 803; Chapter 1:100. Frankfort, KY: Division of Employment Standards and Mediation, 1992.
36. Auslander M. Excess farm injuries associated with tobacco harvesting (Abstract). 121st Annual Meeting of the American Public Health Association; San Francisco, California, 1993.
37. Office of the Federal Register. Code of Federal Regulations. Occupational Safety and Health Administration Standards. Hazard Communication. 29 CFR 1919.1220. Washington D.C.: Office of the Federal Register, National Archives and Records Administration; July 1, 1992.
38. Wilk VA. Health hazards to children in agriculture. Am J Ind Med 1993; 24:283–90.
39. Pollack SH, Landrigan PJ. Child labor in 1990: prevalence and health hazards. Ann Rev Public Health 1990; 11:359–75.