

## **n-Hexane Induced Polyneuropathy Among Press-proofing Workers**

In December 1983, two workers from a press-proofing factory were seen by a neurologist at Chang-Gung Memorial Hospital complaining of bilateral numbness and weakness of the upper and lower extremities. On physical examination, both workers had muscle wasting and decreased deep tendon reflexes. Nerve conduction studies (NCS's) revealed slowed conduction velocities in upper and lower extremities, and the diagnosis of polyneuropathy was established. Both workers had a history of frequent exposure to an organic solvent used in removing ink from press rollers. Neither used protective gloves or a respirator.

To determine the prevalence and cause of polyneuropathy among press-proofing workers, we investigated 16 factories in the Taipei area. All workers were interviewed and examined to determine signs and symptoms of polyneuropathy. We conservatively defined polyneuropathy as symptoms of numbness or weakness in the extremities with abnormal nerve conduction velocities in both upper and lower extremities ( $<45$  m/sec in upper extremities or  $<40$  m/sec in lower extremities), or two abnormal studies in the lower extremities. Occupational exposure to organic solvents was determined in 14 of the 16 factories by gas chromatography;<sup>1</sup> one factory refused permission to collect air samples and the other was no longer in operation at the time of our investigation. Sibata-type personal air samplers were used for collection. Samples of bulk cleaning solvents from all 16 factories were also analyzed to determine their chemical composition.<sup>1</sup>

Of the 59 workers interviewed and examined, 15 (25%) had polyneuropathy. Two others had abnormal NCS's, however, both were asymptomatic. All but one of the factories were small ( $<360$  cubic meters) and the number of employees ranged from three to nine per factory. Most employees shared many of the same duties, and only four of the 59 workers did not have regular direct contact with solvents. Among workers with polyneuropathy, length of employment ranged from six months to five years with a median of 1.5 years. Their ages ranged from 16 to 29 years with a median of 19 years. No correlation between polyneuropathy and length of employment or age was found. n-Hexane was found in solvent samples of all 16 factories. The concentration ranged from less than 10 percent to over 50 percent. Other organic and inorganic chemicals known to cause polyneuropathy were not present in significant amounts.<sup>2</sup> All cases of polyneuropathy occurred in factories using solvents with over 50 percent concentration of n-hexane. In the 14 factories where air samples were collected, eight workers had polyneuropathy. Six worked in one factory with an air concentration of 190ppm n-hexane. The other two cases worked in a factory with an air concentration  $<50$ ppm, however, the door in this factory was open and the ventilation fan was on at the time the air samples were collected. According to employees, this was not the normal practice. In several factories, working overtime, eating and even sleeping in the factory were not uncommon. Of 13 workers who regularly slept in the factory, 12 (92%) had polyneuropathy compared to 3 (7%) of 46 workers who did not sleep in the factory (relative risk = 172;  $p < .001$ ).

Occupational n-hexane induced polyneuropathy has been reported in many manufacturing and processing industries.<sup>3</sup> However, to our knowledge it has not been previously reported among press-proofing workers. Press-proofing is not a new industry in Taiwan, and we wondered why occupational polyneuropathy among these workers has not been previously observed. From discussions with workers and factory owners, we conclude that several changes related to the rapid growth of this industry in recent years are responsible for the occurrence of this illness.

First, the press-proofing industry in Taiwan has changed from toluene to hexane-based solvents in recent years because hexane evaporates faster allowing production time to be reduced. Second, many factories (15 out of 16 in this study) have recently installed air conditioning units to speed the cooling of equipment—another means of reducing production time. To make air conditioners more efficient, doors and windows are usually closed and ventilation fans are not turned on. Lastly, the increase in volume of business in recent years has led to increased working hours and longer exposure to solvents. The practice of encouraging workers to sleep in the factory overnight also significantly prolongs exposure.

As a result of this investigation, we recommended the use of solvents with low n-hexane content, improvement in ventilation, and restriction of the number of hours employees spend in the factory. Since the implementation of these recommendations, no new cases of polyneuropathy have been detected.

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