

Neurophysiological findings among house painters exposed to solvents

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SEPPÄLÄINEN AM, LINDSTRÖM K. Neurophysiological findings among house painters exposed to solvents. *Scand j work environ health* 8 (1982): suppl 1, 131—135. Seventy-two male house painters in maintenance work (aged from 35 to 44 a) with a mean of 20.2 a of painting experience were submitted to electroencephalographic (EEG) and electroneurographic examinations; 77 concrete reinforcement workers of similar ages served as the referents. The average long-term exposure level of the painters corresponded to 40 cm³/m³ of white spirit. Altogether six motor conduction velocities and seven sensory conduction velocities were measured for each subject. The frequency of abnormal EEGs among the painters was similar to that found for a normal population or for the referents, namely, 15 % of the painters showed a mild and 1 % a moderately severe EEG abnormality. The means of the nerve conduction velocities were similar among the painters and referents and also close to the means of the normal material of the laboratory. Slightly slowed nerve conduction velocities suggestive of peripheral nerve dysfunction were found in 20 % of both the painters and the referents. This exposure level did not affect the EEG noticeably. A few subjects with abnormally slow nerve conduction velocities may have been affected by occupational factors, either chemical or physical, but the solvent-exposed workers did not differ from their referents in this regard.

Key terms: electroencephalography, nerve conduction velocity, solvent exposure.

Many solvents are neurotoxic. They may cause central-peripheral distal axonopathy, which is expressed by neuropathic symptoms and signs, especially in the glove and stocking distribution (9). Symptoms may also arise in the central nervous system, and an increased occurrence of neuropsychiatric diseases among house painters has been reported (2, 7). In connection with a larger investigation on the health of workers in the construction industry (6), we studied nervous system effects among maintenance house painters.

Previous studies have shown electroencephalography (EEG) and nerve conduction velocity measurements to be sensitive methods for showing nervous system effects of solvents (1, 3, 4, 10, 14).

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Subjects and methods

The subjects of the present study were 72 maintenance house painters. They belonged to a cross-sectional representative sample of painters from the greater Helsinki area, a sample comprising 219 painters. All the participating painters of the age group 35—44 a were admitted to neurophysiological studies. Similarly, all the 77 concrete reinforcement workers of the age group 35—44 a and belonging to a total sample of 229 concrete reinforcement workers served as a reference group. All the subjects were male, and the mean age was 39.8 a for the painters and 39.6 a for the referents. On the average, the painters had worked in their present occupation for 20.2 a, which gives a considerably long period of exposure, and the concrete workers had held their present occupation 14.6 a. The mean length of heavy manual work was 23.1 a for the painters

and 21.6 a for the concrete workers. The average long-term air concentration, determined as white spirit, was 40 cm³/m³ among the painters studied (8). This estimation of exposure was based on information collected about paints used and about work experience from the painters themselves,

Table 1. Electroencephalographic (EEG) findings for 72 maintenance house painters and 77 concrete reinforcement workers.

EEG finding	Painters (N)	Concrete reinforcement workers (N)
Normal EEG	60	55
Diffuse slow wave abnormality	5	6
Local slow wave abnormality	5	10
Generalized paroxysmal abnormality	0	1
Generalized paroxysmal and slow wave abnormality	1	1
Local paroxysmal and slow wave abnormality	1	4

Table 2. The means and standard deviations (m/s) of nerve conduction velocities measured in 72 painters and 77 concrete workers.

Nerve ^a	Painters		Concrete reinforcement workers	
	Mean	SD	Mean	SD
Median				
MCV	55.8	5.0	55.3	3.5
SCV	57.7	4.1	58.2	3.7
dSCV	47.3	4.4	46.5	4.4
Ulnar				
MCV	58.1	5.4	57.0	4.6
CVSF	46.0	5.6	44.3	4.9
SCV	56.4	4.2	55.3	5.0
dSCV	50.3	4.4	49.8	4.2
Radial				
dSCV	49.2	3.4	49.1	3.7
Peroneal				
MCV	51.6	4.6	50.2	4.7
CVSF	39.4	3.6	38.7	3.2
Tibial				
MCV	47.7	5.1	47.4	5.0
Sural				
SCV	40.5	4.0	40.6	4.7
dSCV	31.5	5.3	31.5	4.4

^a MCV = motor conduction velocity, SCV = sensory conduction velocity, dSCV = distal sensory conduction velocity, CVSF = conduction velocity of the slower motor fibers.

as well as from hygienic measurements of the workplaces during the study.

According to a questionnaire alcohol consumption was similar among the painters and referents, and greater amounts of alcohol twice a week were consumed by 3 % of the painters and 2 % of the referents. One of the referents, but none of the painters, had suffered from a neuropsychiatric disease. Head injuries with unconsciousness had occurred to 22 % of the painters and to 25 % of the referents. None of the studied subjects had diabetes. The occasional use of pain-killers was common; 43 % of the painters and 55 % of the referents had occasionally used them during the month preceding the study.

All the subjects were given a self-administered questionnaire concerning various acute and chronic symptoms. The neurophysiological tests were EEG registered for 25 min, with photic stimulation and hyperventilation for 3 min as activating methods, and measurement of the nerve conduction velocity of six nerves. The maximum motor conduction velocity (MCV) was measured in the median, ulnar, deep peroneal, and posterior tibial nerves (15). The conduction velocity of the slower motor fibers (CVSF) was measured in the ulnar and deep peroneal nerves (11). The sensory conduction velocity (SCV) in the forearm section and the distal sensory conduction velocity (dSCV) from finger to wrist were measured orthodromically in the median and ulnar nerves (12), computerized averaging being applied. The dSCV of the radial nerve and the SCV and dSCV of the sural nerve were measured antidromically without signal averaging (12).

The same neurophysiologist (AMS) performed 86 % of the nerve conduction velocity studies of both the painters and the referents and supervised the rest of the measurements. She also evaluated the conduction velocities in comparison to the normal limits of the laboratory (12) and interpreted the EEGs. The interpretations and evaluations were made without knowledge of the occupation of the subject in question.

The chi-square test and Student's t-test were used in the statistical analysis of the results.

Results

The EEG findings were within normal limits for 83 % of the painters and 71 % of the referents. The EEG abnormalities were usually mild; a moderately severe abnormality was found in 1 % of each group. All 12 painters with abnormal EEGs had abnormalities in both hemispheres, also with respect to local abnormalities. Local EEG abnormalities were slightly more common among the concrete workers, seven of whom showed an EEG abnormality in one hemisphere only (table 1).

The means and standard deviations of the MCVs, CVSFs, SCVs and dSCVs were similar in both groups (table 2). The only statistically significant difference found in the nerve studies was the slightly longer motor distal latency of the ulnar nerve of the concrete workers than of the painters (3.6 ± 0.5 vs 3.4 ± 0.4 ms; $p < 0.05$). No difference was detected in the motor distal latency of the median nerve.

Of both the painters and the concrete workers, 20 % had one or more nerves with abnormally slow MCVs, while some of the SCVs or dSCVs of the arm nerves were abnormally slow for 19 % of the painters and 30 % of the concrete workers. Concrete workers complained more often of paresthesia in the hands or feet than the painters ($p < 0.01$).

The use of any type of drug did not increase EEG abnormalities or abnormal nerve conduction velocities significantly. However, 50 % of those 12 persons who used prescription drugs for nervousness or insomnia had an abnormal EEG, while among the other painters and concrete workers the EEG was abnormal for 15 and 26 %, respectively. The graded alcohol consumption did not correlate with the neurophysiological abnormalities.

The painters were divided into three exposure categories in such a way that all the groups were equal in size. On the whole the group with intermediate exposure had slower nerve conduction velocities than those with "high" or "low" exposure; the differences between the groups were usually not statistically significant. The motor distal latency of the ulnar nerve was the longest in the "high" exposure group, for which it was statisti-

cally significantly longer than for the group with "low" exposure ($p < 0.01$) and that with intermediate exposure ($p < 0.05$). The dSCV of the median nerve was the slowest in the group with "high" exposure during the last 5 a; for this group it differed significantly ($p < 0.05$) from that of the "low" exposure group and that of the referents. No differences in EEG abnormalities were found between the groups with different exposure levels during the last 5 a or during the total length of occupational solvent exposure.

According to the questionnaire the painters had feelings of nausea ($p < 0.02$) and drunkenness ($p < 0.001$), as well as irritation symptoms of mucous membranes ($p < 0.05$), more often during work than the referents (fig 1). Concerning chronic symptoms, the concrete workers had paresthesia of the hands ($p < 0.01$) and feet ($p < 0.01$) more often than the painters. Attacks of vertigo were complained of more often by the painters ($p < 0.02$) than by the concrete workers. The painters also complained of impairments in the sense of smell ($p < 0.001$) or of hypersensitivity towards smells ($p < 0.05$) more often than the referents.

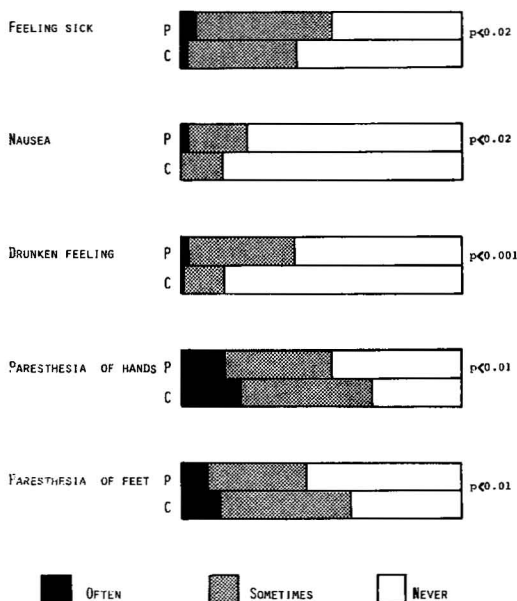


Fig 1. Symptoms according to a questionnaire filled out by 219 painters (P) and 229 concrete reinforcement workers (C). The first three symptoms were acute symptoms occurring during work only, and the latter two were chronic.

Discussion and conclusions

The age distribution was similar among the painters and referents, and no relevant ageing phenomena affected the neurophysiological findings within the age range studied. Neither did the painters differ from the referents with respect to alcohol or drug consumption or previous diseases. The painters' more common acute symptoms, as well as changes, in the sense of smell were thus probably due to their solvent exposure. Neuropathic symptoms, eg, paresthesia of the hands and feet, were not more prevalent among the painters; on the contrary, the concrete workers complained more often of paresthesia. The only statistically significant difference in conduction velocity measures between the groups was a poorer function of the distal portion of the ulnar nerve among the concrete workers, although the prevalence of slightly abnormal sensory conduction velocities in the arm nerves was also somewhat higher among the concrete workers. Slower-than-normal MCVs were found in 20 % of both the painters and the referents; this finding differs from that of a previous Finnish study (13), in which 12 % of 59 car painters had at least one abnormally slow MCV and 15 % had an abnormally slow MCV or SCV of the arm nerves in comparison to none with these abnormalities among 53 railroad engineers who acted as referents. Thus it is possible that a few of the painters and referents, may have had slight, work-related impairment of the peripheral nerves, but the solvent exposure of the painters was not high enough to cause an increased prevalence in comparison with the concrete workers, who may suffer various external injuries in their work.

Seventeen percent of the maintenance house painters of the present study had an abnormal EEG; this percentage is similar to that reported for a normal population (5). Among the concrete workers the EEG abnormalities were more often local, which would be compatible with minor injuries caused by an external force. On the other hand the EEG abnormalities among the painters tended to appear in larger brain areas, either diffusely or at least bilaterally. Diffuse and generalized EEG abnormalities have been the most

usual ones occurring among workers with solvent exposure or among patients with solvent poisoning (10, 14). Chemical injury usually affects the brain in a generalized manner.

Generally, actual findings suggesting chemical-related injuries of the peripheral or central nervous system of the maintenance house painters were minimal, if any; actually the painters never exhibited more impairment than their referents, the concrete reinforcement workers. The average concentration of 40 cm³/m³ of white spirit seems to be a noneffect level for sensitive neurophysiological methods.

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