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Neurotoxic Effects of Lead Exposure among Printing Press Workers

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Printing press industry is also one among the many, being associated with incidence of occupational lead poisoning (Krishnamurty 1988). As inhalation is the primary root of elevated lead concentration in human body, the exposure to air-borne lead released from various operations involved in the printing industries, may extend from chronic to severe lead poisoning (EL-Dalehakhny et al, 1972). Agency for toxic substances and disease registry has suggested recently that lead, even at low doses causes appreciable harmful effects on central nervous system (Report ATSDR, 1985). Lead exposure manifests behavioural symptoms and neurotoxic disturbances in the form of changes in mood and emotional experience (Hanninen et al, 1979). Long term effects of exposure to low doses of lead during childhood leads to deficit in central nervous system functioning which may persist into young adulthood (Needleman, 1990). In India, limited studies on neurotoxic effects of lead exposure among industrial workers, are available and they are confined to the comparison of psychomotor behaviours of two groups of non-exposed and exposed workers without ascertaining lead levels through monitoring of their biological receptors. (Saxena et al, 1987).

Elevated tooth lead contents were reported recently by us in an extensive work carried out among few residents of Agra city (Srivastava et al 1992). The present study describes a preliminary report on lead levels (ingested and inhaled) in hair samples with reference to the Neurotoxic effects of Lead exposure on psychomotor, visuo-motor and vigilance performance of printing press workers.

MATERIALS AND METHODS

Hair samples were collected from 80 volunteered subjects working in the different printing presses of Agra city (India). The subjects included the office-bearers, binders, pressmen, and compositors. Attempts were made to cut the hair samples close to scalp from nape region using clean stainless steel scissors and transferred to polythene bags using forceps covered with PVC tips. Hair samples were washed once with acetone, twice with deionized double distilled water and once again with the acetone with frequent stirring. Twenty ml of acetone was used each time. After each wash, solvent was decanted and the hairs were rinsed with same solvent. Samples were dried in oven at 60° C for 5-8 hours. One half gm of hair sample was digested with the mixture of 5 ml conc HNO_3 and 1 ml $HClO_4$ for one hour. Sample then was diluted in a 25 ml volumetric flask with the deionized water and analysed for lead using AAS (Perkin Elmer-5000).

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After ascertaining the hair lead level, screening was carried out on the basis of personal data sheet. For behavioural analysis, two groups were formed i.e. exposed (compositors and pressmen) and relatively less exposed groups (office bearers and binders) and matched for their socio-economic status, length of service, age and educational levels. The age of all the subjects studied ranged between 15 to 58 years while length of service was maximum upto 15 years. Those who were alcoholics and having some major brain injuries or some family pathology were excluded.

The subjects of both the groups were administered psychomotor and visuo-motor tasks, considered sensitive to control central nervous system. Two hand co-ordination task was used for measuring the right and left hand co-ordination behaviour of the subjects by observing their error time, while Bourdon Wiersma Vigilance test observed perceptual motor speed and fluctuation of vigilance (Hanninen 1976,1978). For ability of visual analysis and synthesis, Block Design test, a sub-test of Wechsler Adult Intelligence Scale was used (WAIS-1958). The information regarding subjective symptoms like fatigue, depression, absent-mindedness, irritability, neuro-vegetative, gastrointestinal etc. were also collected by providing questionnaire sheets to the subjects in a short interview.

RESULTS AND DISCUSSION

Hair lead levels were measured with different age of the workers engaged in different type of job in printing press and data are presented in Table I.

No significant sequential variations in lead levels with age was observed. Petering et al (1973) also noticed the decrease in hair lead levels of males and an increase in the case of females upto the age of 35 years and then a sharp decrease. Similar results were also observed by Reeves et al (1975). However, lead levels in hair samples of the printing press workers was found to be in the following order. Office-bearers < Binders < Pressmen < Compositors. It is well documented that lead intake through ingestion (gastrointestinal) is much less than inhalation. In case of binders, generally sitting outside the printing room, lead uptake is supposed to be through ingestion mainly, causing less accumulation of lead. Compositors and pressmen are relatively more susceptible to lead exposure via ingestion and inhalation resulting into higher lead levels.

In order to compare the psychomotor performance of the two groups (ie. exposed and relatively less exposed), it was found that the two groups did not differ on two hand coordination task as the t values were 0.627 and 1.49 for the error time and total time respectively. The two hand coordination task is much similar to eye- hand coordination task and in many studies no significant impairment in performance on this task was found. (Johnson et al, 1980, Valciukas et al, 1978). Vigilance task was found to be effected by lead exposure by causing fluctuation of vigilance higher for the exposed group than the less exposed group. ($m = 10.36$ vs 6.98; $t = 5.24$, $p > 0.01$). Hanninen et al (1978) have reported high correlation between lead uptake and fluctuation of vigilance. Various studies show that exposure to lead results in deficits of visuo-motor integration (Winnike and Kraermer,1985), attention concentration (Jayaratnam et al, 1986) and perceptual accuracy (Saxena & Saxena, 1987). The perceptual motor speed was not found to be statistically different between the two groups ($t=0.178$, $p > 0.05$). Mean difference in ability of visual analysis and synthesis of two groups under study was significant ($m = 26.48$ vs 20.39, $t=3.12$, $p < 0.01$). Various subjective symptoms measured in the two groups differed significantly on the neuro-vegetative symptoms ($t=2.92$, $p < 0.01$). The observations are in conformity with the results obtained by Repko et al (1978).

Table 1. Concentration of hair lead within different age groups of printing press workers (mean = ± SD).

Age Years	Office-bearers ug/g	Binders ug/g	Pressmen ug/g	Compositors ug/g
15-25	8.54 ± 4.32 (N=5)	16.32 ± 6.25 (N = 6)	25.94 ± 5.88 (N = 4)	30.39 ± 6.98 (N = 5)
25-35	9.03 ± 7.87 (N = 4)	18.88 ± 5.89 (N = 6)	27.86 ± 3.26 (N = 6)	38.37 ± 5.34 (N = 6)
35-45	8.65 ± 4.31 (N = 4)	19.38 ± 3.21 (N = 5)	26.88 ± 3.02 (N = 5)	37.98 ± 2.08 (N = 6)
45-58	9.03 ± 1.33 (N = 4)	17.93 ± 1.02 (N = 4)	27.37± 3.25 (N = 5)	35.99 ± 1.33 (N = 5)

The present study indicates that lead exerts toxic effects on nervous system causing intellectual impairments in lead exposed groups of workers and thus tend to reduce the intellectual potential of effected persons.

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