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RISK OF INTOXICATION BY CARBON MONOXIDE AMONG DRIVERS OF MOTOR VEHICLES

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ABSTRACT

A biochemical, psychological and neurological study was carried out in 99 Havana City bus drivers and in 50 control subjects. In addition, air samples were taken in city buses to determine carbon monoxide concentrations. Slight differences between the exposed and control subjects were found in some indexes, such as serum iron, in Bender's test, in the loss of appetite, in disturbances in the digestive tract and osteomuscular system. A disturbed response to symmetric rotular scheme was found, but differences in changes in EEG between the exposed and control subjects were not statistically significant. Carbon monoxide concentrations in the air of bus pits were below the standard for eight working hours (20 mg/m^3). The results of this investigation suggest that isolated clinical changes should not be necessarily regarded as due to carbon monoxide induced chronic poisoning.

Some authors accept that air pollution produced by motor vehicles can achieve significant proportions in the areas with heavy traffic, as the waste gases of the vehicles contain from 0.2 to 12 per cent of carbon monoxide[3,5,11].

Acute intoxication is induced by exposure to high concentrations of carbon monoxide and is manifested by headache, dizziness, convulsions, loss of consciousness, asphyxia and, if exposure is long enough, it can even produce death. According to some authors[1,2,4,9,10] occupational exposure to low concentration of carbon monoxide may induce chronic intoxication after 1–3 months.

Literature records a number of biochemical, psychological and neurological disturbances which are due to chronic intoxication by carbon monoxide[2, 6,7,9,10]. Owing to their work drivers constitute an important part of the population exposed to the pollution produced by city traffic and, therefore, to the action of this gas.

SUBJECTS AND METHODS

Our investigation comprised 99 drivers from "Omnibus Urbanos" in the Havana City Province (Girón XI buses) and 50 apparently healthy individuals employed as controllers in the Ministry of Transport.

The workers' general data (age, experience in the present job, personal and family history of health) were taken, with special regard to the symptoms of chronic intoxication by carbon monoxide as listed in literature. Both the exposed and the control subjects were medically examined and electroencephalography was performed.

A psychological and social survey was carried out, and Bender's gestalt visuomotor test with a quantitative qualification criterion was applied both to the drivers and the controls.

The following laboratory tests were performed: haemoglobin, haematocrit, differential white blood cells count, blood glucose, cellulose acetate serum protein electrophoresis, serum iron, iron binding capacity, total protein. The workers had fasted before the blood was drawn.

Chemical examination of the working environment took place in 27 buses in Havana City. Altogether 162 air samples were taken in the driver's area at the breathing level and were analyzed for carbon monoxide.

For the statistical analysis the Student's "t" test and the modified χ^2 test were used.

RESULTS

Table 1 shows that most drivers were aged between 26 and 40 years and Table 2 that a number of workers worked as drivers for 6 to 15 years.

TABLE 1
Age groups.

Groups	Age (years)							
	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60
Exposed	2	24	28	18	12	7	4	4
Control	4	18	14	14	0	0	0	0

TABLE 2
Years of work as a driver.

	Years of work							
	<1	1–5	6–10	11–15	16–20	21–25	26–30	31–35
Number of workers	3	16	35	23	7	2	12	1

As shown in Table 3, significant differences were found only in serum iron concentrations and among detected symptoms significant differences were found only in appetite loss (Table 4).

TABLE 3
Results of the biochemical study and the complementary laboratory studies.

Test	Control group			Exposed group			P
	$\bar{X}$	S.D.	n	$\bar{X}$	S.D.	n	
Haemoglobin (g/100 ml)	14.3	1.21	50	14.0	1.18	98	NS
Transferrine (µg/100 ml)	30.7	9.80	50	33.4	10.39	86	NS
Serum iron (µg/100 ml)	104.9	29.75	50	119.3	30.53	97	<0.01
Iron capacity (µg/100 ml)	348.2	55.14	50	360.8	82.10	86	NS
Total protein (g/100 ml)	7.2	0.55	50	7.1	0.62	97	NS
Beta globulin (%)	9.9	1.65	42	9.8	1.58	84	NS
Beta globulin (g/100 ml)	0.72	0.14	42	0.71	0.14	84	NS
Glucose (mg/100 ml)	84.0	13.3	46	88.0	15.1	95	NS
Haematocrit	46.0	4.0	48	45.0	3.4	75	NS
White blood cells	7798	2115	35	7667	1800	77	NS

NS = not significant

TABLE 4
Symptoms in control subjects and exposed workers.

Symptoms	Control group		Sample		P
	Frequency	%	Frequency	%	
Headache	10	20	33	33	NS
Sleep disturbances	11	22	32	32	NS
Neuralgia	5	10	10	10	NS
Dizziness	7	14	5	5	NS
Dyspnea	11	22	15	15	NS
Palpitation	9	18	22	22	NS
Sweating	5	10	14	14	NS
Fatigue	8	16	24	24	NS
Loss of appetite	2	4	25	25	<0.05
Noise feeling	5	10	4	4	NS
Bad odor feeling	1	2	6	6	NS
Perception disturbances	11	22	28	28	NS
Depression	21	42	24	24	NS
Memory	11	22	31	31	NS
Anxiety	21	42	36	36	NS
Language	3	6	7	7	NS
Apathy	1	2	5	5	NS

TABLE 5
Personal and family history.

History	Disturbance	Control		Exposed group		P
		Frequency	%	Frequency	%	
Personal	Cardiovascular	11	22	19	19	NS
	Mental	23	46	36	36	NS
	Neurologic	14	28	23	23	NS
	Digestive tract	3	6	18	18	<0.05
	Respiratory tract	1	2	7	7	NS
	Osteomuscular	6	12	25	25	<0.05
Family	Epilepsy	1	2	4	4	NS
	Mental	7	14	21	21	NS
	Endocrine	5	10	12	12	NS
	Circulatory	6	12	10	10	NS

TABLE 6
Results of neurological examinations.

	Examination	Control		Exposed group		P
		Frequency	%	Frequency	%	
Static tremor		–	–	2	2	–
Postural tremor		4	8	11	11	NS
Coordination	forefinger-forefinger	–	–	1	1	–
	heel-knee	–	–	2	2	–
	diadochokinesia	1	2	5	5	NS
Rotular reflex	symmetric	3	6	18	18	<0.05
	asymmetric	–	–	–	–	–
Achilles reflex	symmetric	3	6	14	14	NS
	asymmetric	–	–	1	2	–

Differences between the exposed and the control subjects relating to disturbances of the digestive tract and osteomuscular system were also significant, but there was no difference in the family clinical history (Table 5).

The neurological findings revealed statistically significant differences in the symmetric rotular osteotendinous reflexes (Table 6). Electroencephalograms showed abnormal activities in 14 per cent of control subjects and in 27 per cent of exposed subjects. However, the difference was not statistically significant.

The results of Bender's test showed statistically differentiated disturbances between the group of drivers and the control group.

Air analysis of the driver's breathing area showed a mean carbon monoxide concentration of 4.6 mg/m^3 with a maximum value of 23 mg/m^3.

DISCUSSION

The haemoglobin, globulin and glucose disturbances reported in the literature as induced by chronic carbon monoxide intoxication, were not found in our study. When compared with control subjects a moderate increase in serum iron was found in the exposed subjects, though individual values were within the normal levels in both groups, as were the other parameters studied.

Significant differences were found in loss of appetite and in digestive tract disturbances as revealed from their personal history. Osteomuscular system disturbances were also obvious from the personal history. Neurological examinations showed a significant increase in the number of workers with symmetric rotular osteotendinous reflexes. In the group of drivers anomalies found in the electroencephalograms were twice as frequent as in the control group, and their morphology conferred them a greater semiotic value, though focal disturbances prevailed. However, 15 per cent of this type of electroencephalographic anomalies can also be found in a healthy population.

Air concentrations of this gas were below the Soviet standard (20 mg/m^3) for eight-hour work thus indicating that drivers were exposed to low concentrations of carbon monoxide. Several authors who reported mild disturbances such as those in our study, associated them with exposure to low concentration of carbon monoxide[2,6,7,8,9,10].

It is concluded that the disturbances caused by carbon monoxide, however small, are an indication of the occupational risk of this contaminating gas.

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