

## Blood Mercury Concentrations in the Population of Rabat Area, Morocco

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Mercury is naturally present in the environment from mineral deposits, volcanoes, oceanic emission and crust degassing. Mercury is also released in the environment by human activities as burning of fossil fuels, mining activities, industrial and domestic use in batteries, electrical switches, thermometers, dentistry, paints, pesticides... (Agocs 1990, Langford 1999, Lebel 1998). For non exposed population, the main sources of contamination appear to be fish diet and mercury filling (Bergdahl 1998, Clarkson 1998, Grandjean 1992, Halbach 1992, Mahaffey 1999). Recently some adverse health effects have been observed at relatively low exposure levels (Lebel 1998, Mahaffey 1999).

An anomalous presence of mercury from natural sources and industrial development has been observed in the Mediterranean basin (Renzoni 1998, Gabrieleles 1995) but no data concerning the blood mercury concentration in the general Moroccan population is available. The aim of this study was to evaluate the level of mercury in blood of Moroccan people living in the Rabat area. As in a previous study concerning lead (Khassouani 1997) the results were compared to levels of French people.

### MATERIALS AND METHODS

The subjects were 377 adults, 297 men and 80 women, older than 18 years with a mean age of  $38.8 \pm 9.1$ , randomly selected from the Rabat Transfusion Center of Morocco. Subjects were enrolled in the study after informed consent. Factors that might influence mercury exposure such as urban or rural origin and professional occupation were analyzed. It was not possible in this study to submit the subjects to an examination by a surgical dentist. The French values used for comparison were obtained from 282 adults, 220 men and 62 women, older than 18 years with a mean age of  $46.7 \pm 14.2$ , randomly selected in the Hospital University Center of Angers.

Five ml of blood were sampled into heparinized tubes without detectable amounts of heavy metals. Samples were diluted to 1/2 with demineralized water containing 1 % of Triton-X 100 and stored at  $-20^{\circ}\text{C}$  until analysis.

Mercury determination in blood was performed by inductively coupled plasma-mass spectrometry (ICPMS) using an Elan 5000 from Perkin Elmer-Sciex. Blood and standard solutions were diluted 1/10 with a solution containing 1% nitric acid and 100 µg/L of europium, used as internal standard. These diluted solutions were introduced in the nebulizer using a peristaltic pump from Gilson. Mercury and europium were measured at masses 202 and 153, respectively. The limit of quantification of mercury in blood was estimated at 1 µg/L and the linearity was tested up to 25 µg/L. The samples with high concentrations were diluted for a second analysis. Analysis of variance and Tukey's test were used for the comparisons of mean values.

## RESULTS AND DISCUSSION

The mean blood mercury level of the Moroccan population was  $9.5 \pm 14.1$  µg/L. As expected from this high standard deviation, and as confirmed by the statistical Henry's test, concentrations of mercury were not normally distributed and the population was divided in two groups according their concentrations under and above 10 µg/L. The mean blood mercury concentration of the first group was  $5.8 \pm 1.6$  µg/L with  $5.6 \pm 1.5$  µg/L in men and  $6.9 \pm 1.7$  µg/L in women. In the second group, the mean blood mercury level was  $32.4 \pm 4.0$  µg/L, with  $32.0 \pm 4.4$  µg/L in men and  $34.3 \pm 9.3$  µg/L in women (table 1). There was no statistically significant difference between men and women. The distribution of people according to their mercury blood concentration shows that out of 377 subjects, 41 (11 %), had concentrations between 10 and 50 µg/L, and 11 (3%) above 50 µg/L (table 2). Among people having the highest values, 3 persons had professional activity able to contribute to mercury exposure : a house painter, 139 µg/L, an industrial worker, 92 µg/L, a farmer, 99 µg/L, but there was also a woman, 101 µg/L, without recognized risks of mercury exposure. The statistical analysis of data did not show any correlation between blood mercury levels and the socio-economic characteristics studied : sex, age, urban or rural origin, and professional occupation.

All French people had blood concentrations of mercury below 10 µg/L, the mean level was  $3.4 \pm 1.8$  µg/L (table 2), with the highest value of 7.5 µg/L. No statistical difference was found between men and women.

The common method for the determination of mercury is cold vapor atomic absorption spectrometry, but for the last ten years inductively coupled plasma mass spectrometry (ICP-MS) which is very sensitive and accurate, has been more and more employed. In this study, blood mercury was determined using ICP-MS.

According to the literature data, blood mercury level in populations not exposed to particular risk of mercury, is generally lower than 10 µg/L (Schweinsberg 1990). Mahaffey and Mergler (1998) reported a mean blood mercury level of 1.1 µg/L in residents of Quebec, Kroncke et al. (1980) 1.90 µg/L in subjects without amalgam-fillings and 1.80 µg/L in subjects having amalgam-fillings, Nixon et al.

(1996) 0 to 8 µg/L in American population and Soria et al. (1992) 6 µg/L in Spanish pregnant women.

**Table 1.** Mean blood mercury concentrations (µg/L) in French and Moroccan populations (group 1 < 10 µg/L, group 2 > 10µg/L; n = number of subjects).

	Moroccan participants			French participants
	all	group 1	group 2	all
men and women	9,5 ± 14,1 n = 377	5,7 ± 1,6 n = 322	32,4 ± 4,0 n = 55	3,4 ± 1,8 n= 282
men		5,6 ± 1,5 n = 252	32,0 ± 4,4 n = 45	3,4 ± 1,8 n = 220
women		6,2 ± 1,7 n = 70	34,3 ± 9,3 n = 10	3,4 ± 2,0 n = 62

**Table 2.** Moroccan subjects distributed according to their blood mercury concentrations (µg/L)

Blood mercury concentration	<10 µg/L	10 < Hg ≤ 50 µg/L	Hg >50 µg/L	Total
Nb of subjects	325	41	11	377
Percentage	86 %	11 %	3 %	100 %

French levels obtained using the same analytical method than that used for Moroccan samples, were all lower than 10 µg/L, the mean value being  $3.4 \pm 1.8$  µg/L, result in agreement with literature data.

The mean concentration of blood mercury of Moroccan people of Rabat area was clearly higher than those of French and than those reported in the literature. An important percentage of individuals (14 %), had more than 10 µg/L and 3 % had about 100 µg/L. Three persons could have a probable professionally exposure but the statistical analysis of data did not show significant correlation between professional occupation, urban or rural origin, and blood mercury concentrations. These data suggested that some particular Moroccan habits, unidentified by this study, may contribute to mercury burden and underline the importance of evaluating the magnitude of exposure to environmental mercury contaminants in Moroccan area (air, water and soil). This study will be extended taking into account dietary habits (fish consumption), personal hygiene, number of teeth fillings and occupational exposure to identify mercury exposure sources.

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