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The Belgian Cadmibel Study
Environmental exposure to cadmium and lead - Health effects

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Belgium is an important producer of zinc and cadmium in Europe. The Meuse valley near Liège and the Northern part of the Limburg Province are polluted by cadmium mainly because of current and/or past emissions from nonferrous industries. The question remains debated whether, in the population at large, environmental exposure to cadmium influences renal function and blood pressure. The same is true for the possible influence of lead exposure on blood pressure.

The environmental exposure of the Belgian population to both lead and cadmium is rather high compared with other countries (1,2). In 1981, a WHO cooperative study (1) assessing human exposure to lead and cadmium through biological monitoring was implemented among ten countries including Belgium. For the sake of comparability, groups of teachers were examined in each participating country. Concerning lead exposure assessed by blood lead concentration (PbB), Belgium had the second most exposed population immediately after Mexico, with a median PbB of 152 ug/l (220 ug/l in Mexico); the lowest observed value was 60 ug/l in Japan. This was true not only for the whole population but also after taking into account sex and smoking habits. Regarding lead exposure it should however be stressed that in Belgium a decreasing trend is observed since several years : from 1978 to 1986 the median value of PbB dropped from 170 ug/l to 101 ug/l.

The cadmium exposure of the Belgian population assessed by blood cadmium concentration (CdB) is also relatively high. In the same study (1) when considering the whole population, Belgium occupied the first place with Japan : median CdB 1.2 ug/l. For the group of nonsmoker Belgian males it occupied also the first place with Israël : 1.1 ug/l. For the group of nonsmoker females (0.9 ug/l) it came just after Japan (1.2 ug/l). For the group of smoker males (2 ug/l) it came in 4th position after Mexico (3.9 ug/l) Yugoslavia (3.6 ug/l) and Peru (2.9 ug/l) and for the group of smoker females (2 ug/l) it also came in 4th position after Yugoslavia (2.7 ug/l), China (2.6 ug/l) and Mexico (2.1 ug/l). In contrast to lead no significant time trend of cadmium exposure was observed since 1981.

Moreover, three small scale studies carried out in the Liège area since 1978 have shown that environmental pollution by cadmium has lead to an increased cadmium body burden of the inhabitants and possibly also to health effects. One of these studies (3,4) indicated that on the average the cadmium body burden of elderly women from the Liège area was significantly higher than that of the women from the control area (Charleroi); the renal parameters, i.e. proteinuria, aminoaciduria and β_2 microglobulinuria were on the average higher in Liège than in Charleroi. In a retrospective mortality study (5), it was shown that death

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from nephritis and nephrosis was twice more prevalent in Liège than in Charleroi. Finally an autopsy study (G) showed that living in a Cd polluted area has resulted in a higher accumulation of cadmium in the body.

The Cadmibel study

Owing to the relatively high exposure of the Belgian population to both cadmium and lead and to the results of the above mentioned studies, a large scale morbidity study was initiated. In January 1985, four research groups (IHE, KUL, UCL, and ULg) designed such a study. The main objectives are (a) to evaluate the critical internal dose of cadmium (indirectly assessed by urinary excretion of cadmium) for the occurrence of renal effects in the general population and (b) to assess whether there is a relationship between cadmium body burden and blood pressure, since the role of cadmium in the etiology of hypertension is still controversial. The relationship between lead exposure and blood pressure is also being investigated.

Areas investigated.

Based on the available environmental data and the knowledge of the presence of cadmium emitting sources, past and present, the following areas were chosen :

- a) Two areas with confirmed environmental pollution by cadmium
 - one industrial-urban (Liège)
 - one industrial-rural (Noorderkempen)
- b) Three control areas with low cadmium pollution
 - one urban : Brussels
 - one industrial-urban without non ferrous metal plants (Charleroi).
 - one rural.

Population selection.

The selection of the study population is based on a random sampling of families in each area. All persons aged 20 to 80 years are considered. The sampling is performed in such a way that comparable number of subjects of either sex are included in each age group : 20-40 years, 40-60 years and 60-80 years. In other words the whole household will not be eligible if at least one member of that family belongs to an age-sex group where the desired number is already reached.

It is planned to examine 2300 people; from 1985 to May 1987 about 1600 subjects have already been examined. The field work will be completed by the end of 1988, whereafter the statistical analysis and the interpretation of the results will be finalized.

Experimental protocol.

All eligible subjects are visited at their home by trained observers (EUL, ULg) in order to obtain on each of 2 separate occasions 5 blood pressure readings, a pulse rate count, weight and height. A detailed questionnaire inquires about : present and past residence and professional activity, social status, education, present and past medication, present and past drinking and smoking habits, etc...

Blood samples, 24 h and spot-urine samples are collected to perform biological analyses on whole blood (Cd, Pb, ZPP), on serum (creatinine, alkaline phosphatase, γ glutamyltransférase, cholesterol, Ca, Zn, ferritin and β 2 microglobulin), on 24 h urine (pH, créatinine, Ca, Na, K, Cu, Cd, aminoacids, total proteins, β 2microglobulin, retinol binding protein, albumin and N-acetyl-B- glucosaminidase) and on spot-urine (pH, creatinine, Cd, β 2 microglobuline).

Quality assurance

The analyses are performed using internal calibration standards, and, when available, certified reference materials.

When available, the two laboratories (UCL, IHE) performing the biological analyses, participate to external quality assessment schemes :

- for heavy metals, participation in 3 different schemes, 2 organized in the United Kingdom and 1 by W.H.O.:
- for the other analyses such as GT, cholesterol creatinine, calcium etc..., participation in the Belgian quality control programme supervised by the Ministry of Health.

In addition, the two laboratories perform regular intercomparisons for most of the analyzed parameters.

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