ENNS: The French Nutrition & Health Survey
Exposure of the French population to lead

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Introduction

The French Nutrition & Health Survey was carried out by the French Institute for Public Health surveillance in 2006-2007. ENNS was launched in the framework of the National Program on Nutrition & Health implemented in France in 2001.

The main objectives of ENNS are:
- to describe food consumption, nutritional status and physical activity in the general French population (adults and children)
- to study nutritional biomarkers
- to **study pollutant biomarkers** (heavy metals: **lead**, cadmium, mercury, arsenic and other metals in urine, blood or hair, and pesticides: organophosphates, organochlorines and pyrethrinoids in urine or blood).

This poster presents the results on lead level distribution in blood and reference values estimation for the French adult population.

Methods

Population

Inclusion criteria to ENNS lead survey:
- adults 18 to 74 years old,
- living in an ordinary dwelling at least five days per week,
- able to understand the stakes of the study, not suffering from a pathology requiring an artificial feeding,
- agreeing to participate,
- without known occupational exposure to lead.

Sampling

Participants were sampled using a three-stage probability design (1st: aggregated municipalities; 2nd: households; 3rd: household's members) stratified by geographical areas (8 regions) and degree of urbanization (rural; < 20 000 inh.; 20 000 - 100 000 inh.; > 100 000 inh.).

Questionnaires

Subject characteristics

The physiological and socio-demographic factors included age, sex, body mass index, educational level, socio-professional category, marital status, tobacco status (smokers, ex-smokers, non smokers), grams of tobacco smoked

Environmental factors

The environmental factors studied included degree of urbanization, building date of the house, type of drinking water consumption, eating habits, occupational exposure, leisure activities exposed to lead.

Clinical and biological data

Anthropometric measurements (weight, height, waist and hip circumferences) and biological samples (blood, urine, hair) were collected using a unique standardized procedures at a health centre or at home by a nurse. After collection, blood samples were stored at -20°C.

Blood lead analyses were carried out in a central laboratory by atomic absorption spectrometry. Acceptable levels of detection, reproducibility, repeatability and uncertainty were obtained. The limit of quantification (LOQ) was equal to 10 µg/L.

Statistical analysis

All results were adjusted for survey sampling weights. The CALMAR (CALibration on MARginsins) software was used to perform calibration adjustment using a truncated logit method. The French census population was used for the calibration. Calibration variables were sex, age (18-39, 40-59, 60-74 yrs) and educational level (no certificate, secondary high school, high-school diploma - two-year university degree, bachelor degree or more). The finite population correction (FPC), which can be used in case of sampling without replacement and sampling rate ≥ 0.15, was taken into consideration for the first-stage sampling units.

Descriptive statistical analyse (median, percentiles, geometric mean) are presented unadjusted on variation factors (subject characteristics and Environmental factors).

Reference values are derived in analogy to the IUPAC guideline (around upper bound of the 95% CI of the 95th percentile). An estimate of the 95th population percentile with its 95% confidence interval was computed and used for reference value proposal. SAS and R software were used for statistical analyses.

Results

Description of the population

2,029 individual blood levels were available for the statistical analysis. Among them, 68 participants had occupational exposure and were removed. The final study sample included 1961 non-occupationally exposed participants. Women and men represented each around half of the study population. The weighted mean age was 45 years. 57% of the population was smoker or ex-smoker, 43% had never smoked. 25% of the population was living in houses built before 1948, when lead-based paint was still legally used inside. 25% of the participants took part in renovation works with dust emission in houses built before 1948.

Distribution of blood lead levels

Blood lead levels were consistent with a log normal distribution (figure 1). Sixty eight values (3.3%) were under the limit of quantification and thirty four values (1.8%) were above 100 µg/L.

Table 1 describes the distribution of the blood lead levels in the French population. Estimates in subpopulations are also presented for sex, educational levels, smoking status, residence in old dwelling, renovation works in an old dwelling. The median is 25 µg/L and the 95th percentile is 73 µg/L (95% CI [68-81]). The 95th percentile is higher for men (87 µg/L, 95% CI [75 - 99]) than for women (58 µg/L 95% CI [54-60]); it is also true for the median (respectively, 29 µg/L and 23 µg/L).

Reference values

Based on the preliminary results of this study, it is possible to propose a reference value equal to 80 µg/L for the French population. For men, the reference value is higher than for women (100 µg/L against 60 µg/L). We observed that the higher level in men is partly due to the residence in an old dwelling (lead paint or/and lead pipe) or renovation of an old dwelling. This observation deserves further studies.

The distribution of lead for the French population (Median, GM, P25, P75, P95) were the same whether or nor people with occupational exposure were included.

Comparison with other countries

Distribution of blood lead levels from the population of Germany (18-69 yrs), the Czech Republic (18-58 yrs), the United States (≥ 20 yrs) are compared to the French levels in table 2. The median in France (25 µg/L) is lower than in Germany (31 µg/L) and Czech Republic (33 µg/L). The 95th percentiles are quite similar in France, Germany and the Czech Republic (respectively 73 µg/L, 71 µg/L and 72 µg/L). Parameters of the distribution from the United States are systematically lower.

Figure 1 Distribution of blood lead level in the French population

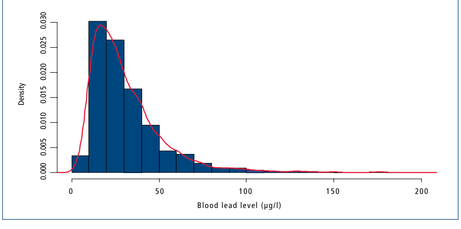

Table 1 Description of blood lead levels and proposed reference value (design-based results)

Groups		N	Weighted percentage	P25	P50	GM	P75	P95	95% CI of P95	Proposed Reference value
Total		**1961**	**100%**	**17**	**25**	**26**	**39**	**73**	**68 - 81**	**80**
Women		1251	50.8%	15	23	22	33	58	54 - 60	60
Men		710	49.2%	19	29	30	48	87	75 - 99	100
18 - 39 years old		587	41.8%	12	19	19	27	50	46 - 62	
40 - 59 years old		949	39.6%	19	29	29	44	73	66 - 87	
60 - 74 years old		425	18.6%	27	39	39	56	99	86 - 115	
Smokers or ex-smokers	Yes	1049	56.9%	17	27	28	44	81	73 - 93	
	no	911	43.1%	15	25	24	37	62	58 - 67	
Leaving in old house (<1948)	yes	493	25.2%	19	29	30	50	91	76 - 104	
	no	1356	75.8%	17	25	25	39	73	66 - 77	
Renovation work in old house (<1948)	yes	448	23.8%	21	29	31	48	84	72 - 93	
	no	1513	76.2%	17	23	24	37	69	64 - 78	

Table 2 Comparison of blood lead levels in France with Germany, the Czech Republic and the United States

Groups	Country	Year(s) of data collection	N	P50	GM	P95	95% CI of P95
Adults	France	2006 - 2007	1961	25	26	73	68 - 87
	Germany	1998	4646	31	-	71	-
	Czech republic	2001 - 2003	1188	33	33	72	69 - 80
	US	2001 - 2002	4772	16	16	46	42 - 49
Women	France	2006 - 2007	1251	23	21	58	54 - 60
	Germany	1998	2303	27	-	62	63 - 67
	Czech republic	2001 - 2003	325	25	26	64	50 - 74
	US	2001 - 2002	4606	11	12	36	30 - 38
Men	France	2006 - 2007	710	29	30	87	75 - 99
	Germany	1998	2342	36	-	79	78 - 83
	Czech republic	2001 - 2003	863	37	37	76	70 - 85
	US	2001 - 2002	4339	17	20	53	50 - 55

Conclusion

Method of the French Nutrition & Health Survey part "Exposure of the French population to lead" and first results have been presented.

The distribution of blood lead levels in France is quite similar to those observed in other European countries.

Proposed blood lead reference value for French population is 80 µg/L, 100 µg/L for men and 60 µg/L for women. According to our results, the higher levels observed in men are probably mainly due to living in an old dwelling.

Reference

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July 2008