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MONITORING OF PERSONAL EXPOSURE TO AIR POLLUTANTS. SUBJECTS' EXPERIENCE

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Seventeen volunteers, employees of a scientific institute, were involved in the monitoring of personal exposure to lead and cadmium in the ambient air. Thirteen of them answered a questionnaire concerning own behaviour and difficulties encountered while wearing a personal sampler. Most subjects admitted that wearing the sampler and especially the noise produced by the pump made them avoid certain activities. This confirms our earlier observations that the application of personal samplers for surveying exposure of the general population might be not only costly but also tedious and unreliable. Therefore modelling based on pollutant concentrations and time spent in basic microenvironments is recommended for assessing human exposure of large population groups along with personal monitoring of a limited group of reliable subjects to validate the model.

Key terms:
exposure assessment, personal sampler

Within the WHO/UNEP Human Exposure Assessment Locations (HEAL) programme (1) an international pilot study on exposure monitoring of lead and cadmium was carried out in four cities: Beijing, Stockholm, Yokohama and Zagreb (2). The study comprised total exposure measurement of a limited number of subjects (non-smoking women 23-53 years of age) over seven consecutive days.

In Zagreb seventeen subjects, employees of a scientific institute took part in the study. After the monitoring was over, they were asked to answer a questionnaire on their experience and to offer suggestions concerning measurement of personal exposure. Analysis of their answers is presented in this paper.

EXPERIMENTAL DESIGN

Exposure monitoring

The exposure to lead and cadmium through air was monitored by analysis of daily samples of total suspended particles that were collected by means of personal samplers in the subject's breathing zone. The samplers consisted of a battery operated pump connected to a filter holder with 37 mm ϕ membrane filters as sampling surface (Figure).

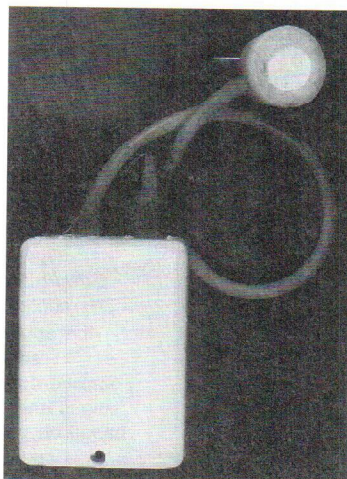


Figure Personal sampler

The filter holders had to be worn close to the breathing zone whereas the pump could be put in a handbag or in the pocket. The subjects were required to wear samplers while moving around, but they were permitted to lay them aside on a desk or on a cabinet when sitting or resting.

In addition they had to keep record of their daily activities and sampling.

Questionnaire

After completing the monitoring exercise the subjects were administered a questionnaire consisting of three questions:

1. Did your behaviour change while you were wearing a personal sampler, and if yes, in what way?
2. What was the most difficult part of exposure monitoring?
3. What are your suggestions for future personal exposure studies?

RESULTS

Out of seventeen subjects thirteen filled in the questionnaire. The results of the poll are presented in the summarized form in the Table.

Table Summarized questionnaire data

ANSWERS TO QUESTIONS	SUBJECT NUMBER												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. CHANGES IN BEHAVIOUR													
a) avoiding activities which were not urgent													
- indoors:													
visiting friends	+	+											
going to theatre, cinema	+												+
shop, bank	+			+				+					+
- outdoors	+			+									
- commuting by public transport				+				+			+		
- only over weekend	+	+		+									
b) no essential change							+				+		
c) no change at all			+		+	+			+	+			
2. MOST DIFFICULT PROBLEM													
- carrying the pump					+		+		+				+
- noise produced by the pump	+	+					+	+				+	+
3. SUGGESTIONS FOR													
- more detailed instructions					+							+	
- informing the public	+												
- finding a more suitable sampling instrument							+				+		

The results show that five out of thirteen subjects did not report change in daily activity pattern during the monitoring period. Two subjects claimed that the changes were not essential (e.g. subject No 11 used her own car for commuting throughout the study period). Three subjects claimed that they changed their activity pattern only over weekend. Most changes applied to indoor activities like visiting other people, shopping or going to the bank, cinema or theatre, but two subjects avoided outdoor activities as well.

The most tiresome part of exposure monitoring concerned the sampler pump. Six out of thirteen subjects complained about being inhibited in normal behaviour by the noise produced by the pump (especially in silent environments and over night) and four were annoyed by having to carry the pump.

When considering future studies subjects were in favour of more detailed instructions; one suggested a one-day "rehearsal" to take place before starting the actual monitoring. One subject proposed that the study be announced through radio and TV in order to prepare the public for meeting people with personal samplers. Two subjects suggested that a more suitable sampling instrument be

developed for future studies. The others likewise were not happy with the samplers as one can see from their complaints under question 2, but they probably did not expect that such a change could be suggested.

DISCUSSION AND CONCLUSIONS

The questions were not composed so as to provide quantitative graduation and therefore the answers could only be considered as indicative. The fact that the number of subjects was small and that the sample was biased could only influence the results of the poll in the positive direction. Namely all subjects were female employees of a scientific institute. As some of them were directly involved in the HEAL pilot study or had previous experience in personal monitoring, it could be expected that even greater resistance and more complaints would be encountered in the general population. Therefore the results of the poll can be considered to confirm our previous observations (3) showing that the monitoring of personal exposure to air pollutants, using samplers with battery operated pumps (known as active samplers) is not suitable for large scale surveys.

The situation is much more favourable with gaseous pollutants for which passive samplers are available. They operate without a pump since they are based on diffusion or permeation of polluted air to the sampling surface. But even then personal sampling cannot always be applied to all population groups (4). Therefore indirect assessment of exposure is the way out. It is based on models which take into account concentration levels in microenvironments people stay in or move through, and the amount of time spent in each of the essential microenvironments (5). Personal exposure monitoring involving a limited number of reliable subjects remains, however, an unavoidable reference procedure for model validation.

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Sažetak

PRAĆENJE OSOBNE IZLOŽENOSTI ONEČIŠĆENJU ZRAKA. ISKUSTVA ISPITANICA

Sedamnaest ispitanica koje su nosile osobne sakupljače uzoraka u prethodnoj studiji osobne izloženosti olovu i kadmiju u okviru WHO/UNEP programa »Lokacije za ocjenu ljudske izloženosti« (HEAL), zamoljeno je nakon završetka praćenja da ispune upitnik o svojim iskustvima i teškoćama pri nošenju osobnog sakupljača, kao i da dadu svoje prijedloge za buduća takva istraživanja. Iako su ispitanice bile suradnice znanstvenog instituta, neke od njih uključene u ovu studiju ili s ranijim iskustvom u nošenju osobnog sakupljača, većina je izjavila da su izbjegavale neke aktivnosti zbog toga što su morale nositi sakupljač, a osobito zbog zujanja pumpe. To potvrđuje naša ranija opažanja da se direktan način mjerenja izloženosti teško može provesti na širokoj populaciji, pa se treba služiti procjenama koristeći se modelom kojim se izloženost računa na osnovi koncentracija izmjerenih u pojedinim mikrookolinama u kojima ljudi najčešće borave i vremena provedenog u tim mikrookolinama. Direktno mjerenje na maloj skupini pouzdanih ispitanika nužno je za provjeru modela.

Ključne riječi:
ocjena izloženosti, osobni sakupljači

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