HOW TO EXPLAIN THE IMPORTANCE OF HUMAN BIOMONITORING

JAK UZASADNIĆ WAŻNOŚĆ BIOMONITORINGU U LUDZI

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Summary

Biomonitoring, an important tool to support decisions in environment and health policy making, will become increasingly important in the next decade. In special cases, biomonitoring becomes important in individual diagnostic situations. A cooperative intitiative of 27 European countries (COPHES, a study to Coordinate and Perform Human Biomonitoring on a European Scale) is presently being launched. Interpretation of biomonitoring results requires biological, medical, and statistical education and knowledge; we demonstrate a recently developed tool incorporated into ALLUM (www.allum.de; http://allum.zsf.jcu.cz and polish-allum.zsf.jcu.cz) which may prove helpful in instruction of medical and lay people and in interpreting human biomonitoring results.

Keywords: Allum, Human Biomonitoring, COPHES

Streszczenie

Biomonitoring jest ważnym narzędziem wspomagającym decyzje w polityce środowiskowej i zdrowotnej, w następnej dekadzie jego znaczenie będzie wzrastało. W szczególnych indywidualnych przypadkach biomonitoring odgrywa ważną rolę w diagnostyce. Obecnie powołano wspólną inicjatywę 27 krajów europejskich w celu skoordynowania i przeprowadzenia biomonitoringu na skalę europejską (COPHES – badanie p.t. Coordinate and Perform Human Biomonitoring on a European Scale) Interpretacja wyników biomonitoringu wymaga wiedzy i wykształcenia biologicznego, medycznego i statystycznego. Obecnie przedstawiamy ostatnio wytworzone narzędzie umieszczone w sieci ALLUM (www.allum.de; http://allum.zsf.jcu.cz oraz http://polish-allum.zsf.jcu.cz), które może być pomocne w informowaniu medycznym społeczeństwa i lekarzy i w interpretowaniu wyników biomonitoringu u ludzi.

Słowa kluczowe: allum, biomonitoring ludzi, COPHES

An early example of biomonitoring: John Franklin's arctic expedition and the disastrous effect of lead

Sir John Franklin, a famous English admiral, experienced in polar expeditions, sailed with two well equipped ships off England in 1845 in a search for the North West Passage between Greenland and Canada. The ships became trapped in the ice, and before 1849, he and all his crew had died. When he did not return, rescue expeditions went searching to the polar regions in the North of Canada, and in 1850, first graves of members of Franklin's crew were found. Later, more remains were discovered. (Figure 1) What may have happened? Log books, referring to cold and hunger, of course, indicated mental disorientation, anxiety and paranoia of the authors.

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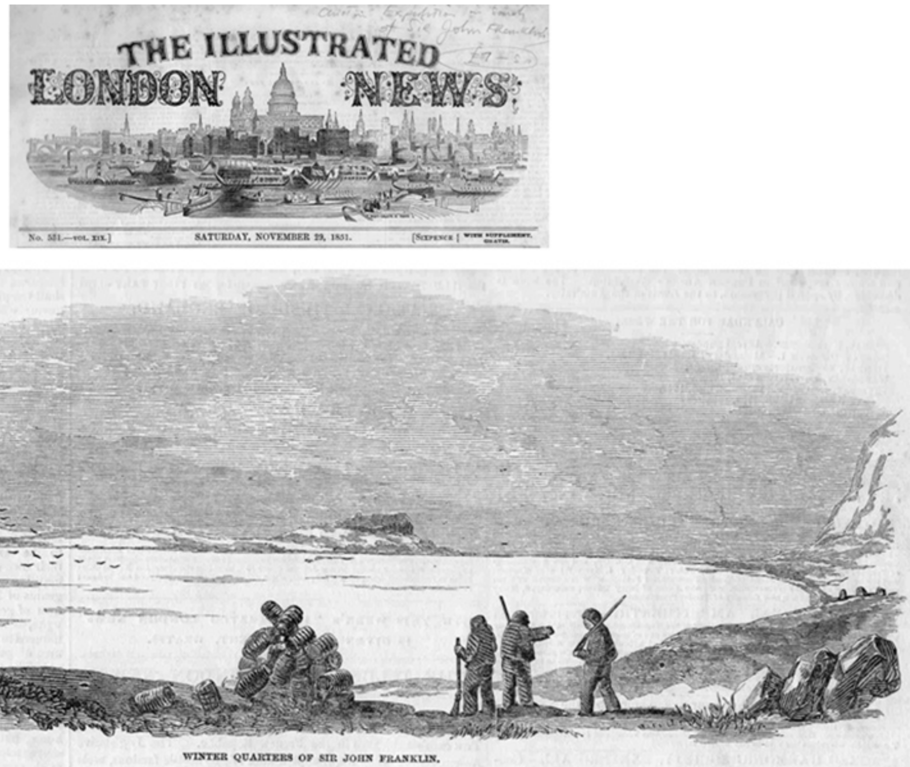


Figure 1. Site where the North West Passage expedition of John Franklin came to an end. Note the pile of tin cans. The lead in their soldering and the resulting lead intoxication have markedly contributed to the failure of the expedition.

Rycina 1. Miejsce do którego dotarła ostatnia ekspedycja polarna sir Johna Franklina. Zauważ nagromadzone puszki cynowe. Ołów zawarty w spawach puszek i w rezultacie zatrucie ołowiem znacznie wpłynęły na niepowodzenie ekspedycji.

Between 1981 and 1986, Dr. Owen Beattie exhumed some of the graves. "The ground on top of the grave was cement-hard permafrost that had to be pickaxed to remove it. A metre down they found the coffin. … The corpse was frozen in a block of ice. By pouring water over it, the body was thawed out and proved to be well preserved after 138 years. It was emaciated and weighed less than 40 kg with a body-mass index of 15. … Analysis of his bones showed lead levels of 110–151 ppm. The lead level in the terminal part of his scalp hair was more than 600 ppm." In another corpse, lead levels in the hair ranged from 145-280 ppm. In other bones specimens lead contents ranged up to 228 ppm. Normal bone lead concentrations are ten to twenty times lower.

Bayliss [1], in his report of this expedition, concludes, commenting on this early example of human bimonitoring: "The chemical evidence of lead poisoning is almost certainly due to the soldering of the cans that contained preserved meats. The technology for preparing canned meat was new, having been patented in 1811, and the cans were sealed with a solder of tin and a high lead content." The ships had stored supplies for three years, including 8000 tins (meat, lemon juice). All or part of the expedition members might have survived had they not experienced the mental deterioration due to lead poisoning.

Ambient biomonitoring, human biomonitoring, and effect monitoring

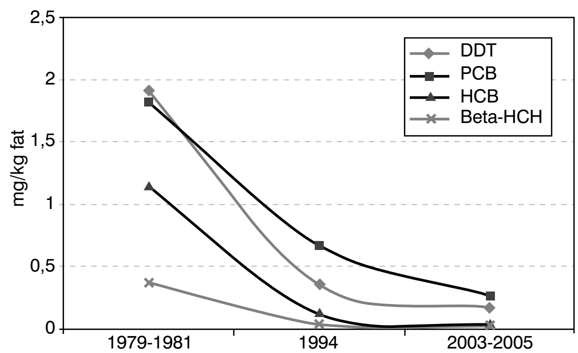
a) In most European countries, we have large data bases on quality and contaminations of air, water, soil, and food; there are laws regulating immissions and concentrations of pollutants, toxicants and contaminants. Quantification of toxicants in these media is called **ambient monitoring**, yielding a very rough approximation of what is dangerous, harmful to human health, or even possibly lethal. These matrices in most cases are easily accessible, and analyses can be done at moderate costs.
b) If it comes to potential health effects in humans, toxicant quantification in whole blood, serum, plasma, urine, exhaled air, fat tissue, bone and teeth give a much more precise picture of possible health effects. This process is termed **human**

biomonitoring (HBM). HBM requires more logistical efforts, and it is, generally, more expensive than ambient monitoring.

Longitudinal studies measuring contents of toxicants in human milk are very useful in demonstrating marked decreases, e.g. of persistent organic pollutants (POPs), but also increases (e.g flame retardants). (Figures 2, 3). Excellent work has been done in Poland in establishing the time trend and the decrease of the lead load in the population.

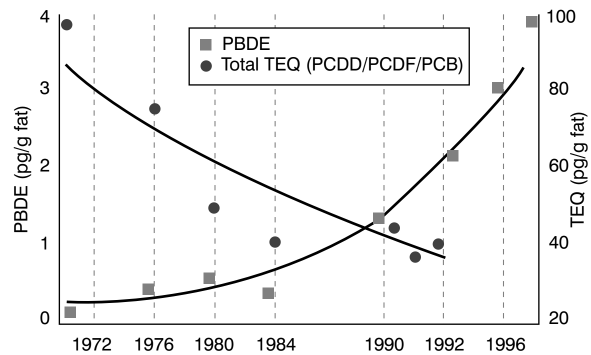
c) Still more significant is the analysis of effect markers, e.g. increased transaminases after absorption of substances toxic to the liver, or anemia after exposure to lead, or physical markers as tachycardia and hypertonus in mercury intoxication **(effect monitoring)**.

For diagnostic purposes, a combination of HBM and effect monitoring may be helpful. Epidemiologists, legislators, and executive bodies usually rely on ambient monitoring, and – only recently – on additional HBM data.



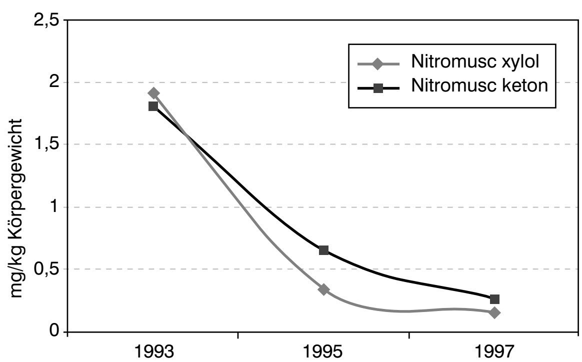
High concentration of POPs in the eighties, clearly declining

Wysoka koncentracja POP w latach osiemdziesiątych



PCDD and PCDF declining, flame retardants (PPDE) with massively increasing

PCDD i PCDF opadają, uniepalniacz PPDE znacznie podwyższa się



Nitromusc xylol and ketone concentrations clearly declining after banning

Koncentracja Nitromusc xylol i keton spada po zakazie stosowania

Persistent chlorinated carbohydrates (POPs) in human breast milk in Germany (µg/kg fat)

	1979/1980	1990	2002
DDT + DEE	1,19	0,051	0,274
HCB	1,14	0,281	0,035
beta HCH	0,38	0,075	0,018
PCB	1,82	0,929	0,443
PCDD/F		30	9

Figure 2. Sequential decrease of contaminants in human milk between 1980 and 2002, demonstrating the usefulness of HBM as a tool for ambient monitoring. During the same time, there has been a marked increase of polybromated flame retardants (PPDE) in human milk.

Rycina 2. Stopniowy spadek skażenia w ludzkim pokarmie matczynym w latach 1980 do 2002 przedstawia pożytek zastosowania HBM jako narzędzia biomonitoringu. W tym samym czasie wykazano podwyższanie się polibromowanych uniepalniaczy (PPDE) w pokarmie matczynym.

Remarks on the necessity of explaining the principle of human biomonitoring

Lay people and, quite frequently also medical personnel, have no clear insight into these three aspects of environmental monitoring, their individual values and weaknesses. When it comes to human biomonitoring – which will become increasingly important in the coming decade – a great deal of explanations and assistance in interpretations will be necessary.

The Kinderumwelt has recently developed a science-based, animated e-learning module on HBM. It is targeted at an interested public, health personnel and medical journalists who are seeking information on human biomonitoring. The didactical approach to the complex issue enables the use also in vocational training schools and secondary schools. In nine chapters, the project shows the principles of HBM, teaches toxicological fundamentals, illustrates the similarities and differences between HBM and ambient monitoring and explains the derivation of reference- and HBM values. The tool is based on Adobe Flash technology and can be used with any modern Internet browser. It is available in German and English language and is free of charge.

COPHES

Based on discussions and initiatives resulting from the Conferences of European Minsters of Health and of Environment (Helsinki, Frankfurt, London, Budapest, Parma) and the European Environment and Health Actions Plans, a Consortium to Perform Human Biomonitoring on a European Scale (COPHES) [3] has been launched and is presently developing activities. A Europe-wide coordinated program is being developed: HBM in 120 mother/child pairs in each country, to be monitored for cotinine, mercury, cadmium, phthalates, and bisphenol-A. Foreseeably, there will be many obstacles to be overcome before we can see the first results. Working groups are considering various aspects as recruitment and sampling, sample processing, data analysis and interpretation, ethical aspects etc. There exists a newly established website [3], where details of the concepts, not more, however at the time being, can be seen.

For the countries of Central Eastern Europe, the following institutes are partners:

CZ:	National Institute of Public Health	(NIHP)	Milena Cerna
H:	National Institute of Environmental Health	(NIHP)	Peter Rudnai
EE:	National Institute for Health Development	(NIHD)	Toomas Veidebaum
LT:	Vytautas Magnus University	(VDU)	Regina Grazuleviciene
PL:	Nofer Institute of Occupational Medicine	(NIOM)	Danuta Ligocka
RO:	Environmental Health Center	(EHC)	
SV:	Jozef Stefan Institute	(JSI)	Darja Mazej
SK:	Public Health Authority of the Slovak Republic	(UVZ SR)	Katarina Halzlova

More details informing on the participating institutes are available in
www.eu-hbm.info/cophes/project-partners

Figure 3. COPHES: some cooperating partners and aims of the project.
Rycina 3. COPHES – współpracujący partnerzy i cel projektu.

Literature

1 Bayliss R. Sir John Franklin's last arctic expedition: a medical disaster. J R Soc Med 95, 151-153, 2002
2 www.allum.de; http://allum.zsf.jcu.cz and http://polish-allum.zsf.jcu.cz
3 www.eu-hbm.info/cophes

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