Institute for Medical Research and Occupational Health

65 years of continuous research in the field of occupational and environmental health in Croatia

Jelena Macan, Ana Lucic Vrdoljak
• Institute for Medical Research and Occupational Health (IMROH) has from its foundation in 1949 been home to researchers who study the influence of the general and working environment on human health from numerous perspectives (biomedicine and health, natural and social sciences).

• As in previous periods, current IMROH research is in line with expectations and plans of World Health Organization, i.e. „WHO Global Plan of Action on Workers’ Health 2008-2017“.
RECENT RESEARCH RELATED TO WORKERS’ HEALTH

- Monitoring of hazards in occupational environments
- Biomonitoring
- Clinical assessment of health effects
- Experimental studies (*in vitro*, animal studies)
RECENT RESEARCH RELATED TO WORKERS’ HEALTH

• Multidisciplinary approach

• Ethical principles
  – Ethical Committee of the IMROH
  – Committee for the Ethics in Research and High Education, Croatian Agency for Science and High Education
MONITORING OF OCCUPATIONAL HAZARDS

- IMPROVEMENTS OF METHODOLOGY
- NEW FINDINGS ABOUT HAZARDS - LEVELS OF EXPOSURE

- PHYSICAL HAZARDS
  - LOW LEVELS OF IONIZING RADIATION
    - SECURITY STAFF AT AEROPORTS WORKING WITH X-RAY CABINET SYSTEMS
    - NEW APPROACH TO DOSIMETRY
    - LEVELS OF EXPOSURE

  - MEASUREMENTS CONFIRMED THAT AN INCREASE IN THE DOSE RATE, COINCIDING WITH RUSH HOURS, WAS CAUSED BY SCATTERED RADIATION PASSING THROUGH INCOMPLETELY CLOSED LEAD CURTAINS.
  - IF OBEYING WORKING PROTOCOL, SECURITY OFFICERS THAT OPERATE X-RAY CABINET SYSTEMS FOR THE CONTROL OF HAND LUGGAGE AND PERSONAL ITEMS, EVEN IN THE CASE OF A VERY INTENSE WORKLOAD, SHOULD NOT BE UNDER DOSIMETRIC SURVEILLANCE

(Surić Mihić et al. Radiat Prot Dosim 2012)
MONITORING OF OCCUPATIONAL HAZARDS

- **BIOLOGICAL HAZARDS**
  - COMPONENTS OF ORGANIC DUST IN SAWMILLS AND POULTRY FARMS:
    - ENDOTOXIN LEVELS
    - CONCENTRATION OF MOULDS
    - MOULDS AND MITES ALLERGEN LEVELS (*Dermatophagoides pteronyssinus* - Der p 1, *Alternaria alternata* - Alt a 1, *Aspergillus fumigatus* - Asp f 1)

<table>
<thead>
<tr>
<th></th>
<th>Poultry farm (Median (range))</th>
<th>Sawmill (Median (range))</th>
<th>Threshold limit values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total dust</strong> (mg/m³)</td>
<td>0,35 (0,2-0,5)</td>
<td>0.822 (0.089–5.15)</td>
<td>10</td>
</tr>
<tr>
<td><strong>Endotoxin</strong> (EU/m³)</td>
<td>233,75 (230-237,5)</td>
<td>269 (148–618)</td>
<td>125</td>
</tr>
<tr>
<td><strong>Moulds</strong> (CFU/m³)</td>
<td>1,27x10⁴ (4,90x10³-3,12x10⁴)</td>
<td>8,620 (820–14,400)</td>
<td>10⁴</td>
</tr>
<tr>
<td>Der p 1 (µg/g)</td>
<td>0.78 (&lt;0.10–3.30)</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Alt a 1 (µg/g)</td>
<td>0.37 (0.1-14)</td>
<td>&lt;0.12</td>
<td>7</td>
</tr>
<tr>
<td>Asp f 1 (ng/g)</td>
<td>17.9 (3.8-72.4)</td>
<td>49.4 (&lt;3.6–120)</td>
<td>-</td>
</tr>
</tbody>
</table>

- Rimac et al. Int Arch Occup Environ Health 2010;
- Prester et al. Arh Hig Rada Toksikol 2010
- Sabolić Pipinić et al. Arh Hig Rada Toksikol 2010
- Ljubičić et al. Int Arch Occup Environ Health 2013;
- Prester & Macan. Aerobiologia 2014;
BIOMONITORING OF OCCUPATIONAL EXPOSURES

- ASSESSMENT OF EXPOSURE THROUGH THE LEVEL OF HAZARD/METABOLIT IN BIOLOGICAL SAMPLES (BLOOD, URINE)

- CHEMICAL HAZARDS
  - ATRAZINE AND ATRAZINE MERCAPTURATE CONCENTRATIONS IN URINE OF AGRICULTURAL WORKERS
    - Atrazine was not detected in any of 27 analysed urine samples but traces of atrazine mercapturate were measured in about a third of pre-exposure and in all post-exposure urine samples
      (Mendaš et al. Toxicol Lett 2012)
BIOMONITORING OF EFFECTS

• ASSESSMENT OF BIOLOGICAL EFFECTS OF OCCUPATIONAL HAZARDS

• BIOLOGICAL HAZARDS
  – Increased acidity of exhaled breath condensate in sawmill workers through the working week related to mould and endotoxin exposures above TLV, even in respiratory healthy non-smoking workers (Ljubičić et al. Int Arch Occup Environ Health 2013)

• PHYSICAL HAZARDS
  – Signs of increased DNA damage (comet and micronucleus tests) and oxidative stress (glutathione and malondialdehyde concentrations) in blood cells/blood of seamen exposed to non-ionizing radiation (pulsed microwave radiation originating from marine radars) in comparison with control group (Garaj Vrhovac et al. (Pažanin S). Int J Hyg Environ Health 2011)
BIOMONITORING OF EXPOSURE AND EFFECTS

- **ASSESSMENT OF CORRELATION BETWEEN BIOMARKERS OF EXPOSURE AND EFFECTS**

- **CHEMICAL HAZARDS**
  - Concentrations of Pb in blood positively correlated with the signs of DNA damage (micronucleus test) in Pb-exposed workers in battery manufacturing (Kašuba et al. J Appl Toxicol 2010)
  - Concentrations of BTEX (benzene, toluene, ethylbenzene, xylene) in urine of shipyard workers negatively correlated with the activity of NK cells-mediated cytotoxicity (innate immunity) (Bulog et al. Coll Antropol 2011)
CLINICAL ASSESSMENT OF HEALTH EFFECTS

• EPIDEMIOLOGICAL AND EXPERIMENTAL STUDIES
• NON-INVASIVE DIAGNOSTIC METHODS
• FOLLOW-UP STUDIES: PREDICTORS OF POOR DISEASE PROGNOSIS

• CHEMICAL HAZARDS
  – follow-up of patients with occupational and non-occupational allergic contact dermatitis;
  – occupationally acquired disease was the most prominent predictor of poor prognosis
    (Macan et al. Dermatology 2013)

• PSYCHOPHYSIOLOGICAL HAZARDS
  – assessment of arterial blood pressure (BP) and its response to thermal and physical strain during flashover training (FOT) in professional and volunteer firefighters
  – FOT induced only physiological cardiovascular responses
  – high prevalence of obesity and elevated BP values indicate the need for better physical fitness and BP control among firefighters.
    (Ljubičić et al. Applied Ergonomics 2014)
INTERACTIONS OF ENVIRONMENTAL HAZARDS WITH INDIVIDUAL FACTORS

• GENE-ENVIRONMENT INTERACTIONS, PERSONALITY TRAITS
  – Possibility to define subpopulations more susceptible to certain hazards and to improve prevention of occupational disorders

• PHYSICAL HAZARDS
  – healthcare workers exposed to low levels of ionizing radiation
  – signs of DNA damage (comet test) greater in exposed workers with polymorphisms of genes participating in DNA repair (hOGG1, XRCC1)
  – Defining subpopulations at risk for accumulation of DNA damage and neoplastic diseases
(Milić et al. Arh Hig Rada Toksikol 2010, 2015)

• COMBINED HAZARDS
  – symptoms of Sick building syndrome in office workers were predicted with neuroticism and subjectively estimated physical health as well as the artificial building ventilation
(Gomzi et al. Arch Environ Occup health 2007)
INTERVENTION AND EXPERIMENTAL STUDIES

• EXPERIMENTAL STUDIES

• CHEMICAL HAZARDS- IMPROVEMENTS OF THERAPY FOR OCCUPATIONAL POISONING
  – LABORATORY TESTING (IN VITRO, ANIMAL STUDIES) OF NEW ANTIDOTS (CONJUGATE OF PYRIDINE-4-ALDOXIME AND ATROPINE) FOR ORGANOPHOSPHATE POISONING
    (Lovrić et al. Biochimica Polonica 2011)

• INTERVENTION STUDIES

• COMBINED CHEMICAL HAZARDS
  – STRICT IMPLEMENTATION OF SAFETY AT WORK MEASURES (PERSONAL PROTECTION EQUIPMENT) IN PHARMACEUTICAL WORKERS EXPOSED TO MULTIPLE CHEMICAL EXPOSURE (MIXTURE OF CARCINOGENES-PHENYLHYDRAZINE, ETHYLENE OXIDE, DICHLOROMETHANE, 1,2-DICHLOROETHANE) LOWERED THE LEVEL OF DNA DAMAGE AND INCREASED SIGNALS OF TP53 GENE RESPONSIBLE FOR THE DEATH OF DAMAGED CELLS.
    (Želježić et al. (Huršidić Radulović). Toxicol Ind Health 2015)
RESEARCH NEEDS

• Intervention field studies aiming in improvement of the prevention of occupational disorders
  – Greater participation of occupational physicians from primary network in research activities
  – More published articles from the primary network (observational studies-case reports and series, cross-sectional studies)

• From 2013, IMI participates again in education of residents in occupational and sports medicine. This will hopefully increase their involvement in scientific work and further improve research activities on workers' health in Croatia.