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Final Plenary Conference

COST Action

Industrially Contaminated Sites and Health Network

21-22 February 2019

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Significance of surface water contamination with PCE for fish tissue PCE content

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Introduction

In the second half of 20th century chlorinated ethens (CE) were widely used as an industrial degreasers, cleaning detergents and extraction agents and therefore represent frequent groundwater contaminants in the Czech Republic (CR). The contamination of groundwater in the area of SAP Mimon factory and its surroundings by tetrachloroethylene (PCE) and its degradation products is one of the most extensive contamination of important waterwork´s collector in CR and it has negative influence on surface water quality in the river Ploucnice. The aim of our study was to determine influence of water contamination by PCE on PCE content in the muscles of fishes from the area of SAP Mimon and to asses the effectiveness of remediation technologies on PCE content in the surface water.

Results

The presence of PCE in fish muscle (Gobio gobio, Leuciscus leuciscus, Barbatula barbatula) was analysed in last few years. All together, six fish (aged 1-4 years of age) caught below SAP factory were subject to analysis. Concentration of PCE in fish is shown in table 1. The analysis clearly shows that all samples of fish caught under the source of pollution are PCE positive. From above the factory, only two out of six samples were positive. (17-53 µg/kg, mean 27 µg/kg, seven samples analyzed).

Methods

In last few years a hydro-biological research was made in order to evaluate the extent of contamination of the watercourse and to evaluate the efficiency of remediation system. During the research, samples of fish were taken from two different sections of the river Ploucnice (above and below SAP factory in Mimon) to determine the degree of PCE contamination in fish muscles. The old ecological strain was caused by the activity of the Veterinary Decontamination Institute s.p. Mimon, the predecessor of nowadays SAP Ltd. The factory was using PCE from processed recourses to extract fat from the first half of 60s until 1988. The total consumption of PCE during this period was estimated to more than 4000 tons. Due to the lack of discipline, there were frequent leaks of the used dissolvent and PCE was present in sewage leaking into the water meadow [1]. It is estimated that about 200 tons of PCE penetrated into water table and their basin. Contamination penetrated to the depth of 40m under ground. Those waterworks are 350m far from SAP factory. Since the waterworks is located on the other bank of the river Ploucnice in the vicinity of Hradcany, it was estimated that this is the cause of contamination. In 1993 a hydro-biological research of the Borecek waterworks surrounding and SAP factory was made. The results clearly proved that SAP factory Mimon is the origin of CE contamination. In terms of an emergency remediation, intensive remediation groundwater pumping and new remediation techniques (air sparing and venting) started in 1997 [2]. In the years 2005 – 2008 an after research was made in the same location. This research specified the geological structure of the locality. The emergency remediation was focused on the layer that is 8-15cm under the surface. This after research proved that those layers contain almost a negligible amount of contamination. Nevertheless, an extensive contamination of a collector was found, in which new epicenters of contaminations were discovered [1].



Figure 1. Monitoring in river Ploučnice

P1	P2	P4	P6	P7	P9	P10	P13	P14 nad	P14 pod	P14,5	P15	P16	P17
ND	5,7	5,7	4,605	3,2	2,9	2,3	1,4	0,6	0,9	0,49	0,37	ND	ND

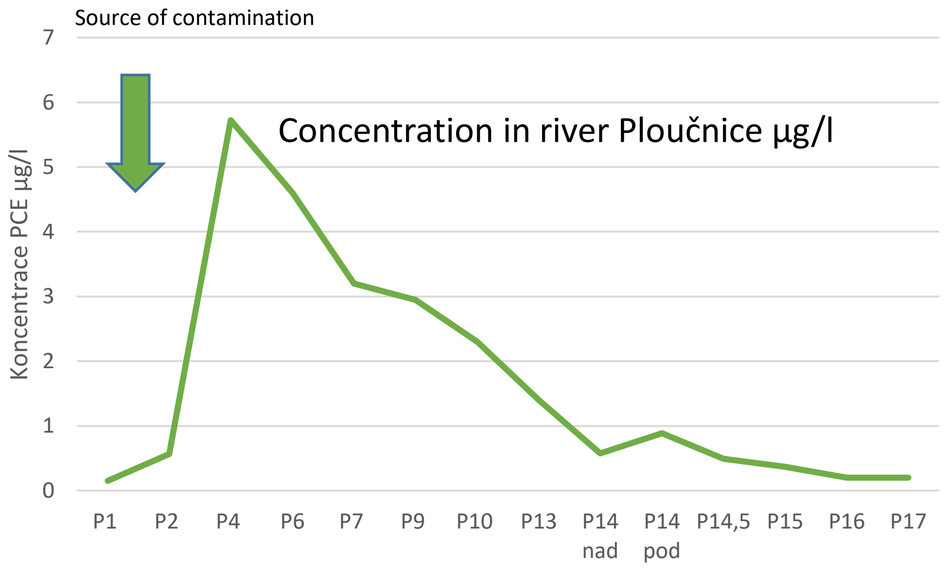



Table 1. Concentration of PCE in fish muscle

Place	Nr. of the sample	Species	Body length (Lc)	Total weight (g)	Age	Results (µg/kg)
Above SAP	2/1H	Gobio gobio	138	46	4+	59
	2/2H	Gobio gobio	97	11	2+	ND
	2/3P	Leuciscus leuciscus	121	30	2+	22
	2/4P	Leuciscus leuciscus	103	19	2+	ND
	2/5M	Barbatula barbatula	100	13	3+	ND
	2/6H	Gobio gobio	61	3	1+	ND
Below SAP	1/1H	Gobio gobio	117	28	2+	21
	1/2H	Gobio gobio	109	22	2+	23
	1/3H	Gobio gobio	105	16	3+	17
	1/4P	Leuciscus leuciscus	163	76	3+	47
	1/4Pd	Leuciscus leuciscus	163	76	3+	53
	1/5M	Barbatula barbatula	111	17	3+	12
	1/6P	Leuciscus leuciscus	113	21	2+	28
	1/7M	Barbatula barbatula	91	12	2+	16

Discussion

All samples caught below SAP factory were positive. Interestingly two samples out of six fish caught above the source of contamination were positive as well. Concerning Leuciscus leuciscus it may be considered that the reason for this might be migration. This is not valid for Gobio gobio, for it is a habitat species. PCE content in surface water in profile under the source (figure 1) indicates great improvement in surface water quality after clean-up commencement, but despite very low PCE contents in surface water, fish tissues still have measurable contamination content which is not aliquot to surface water contamination decrease. As a result of remediation, a significant reduction of PCE in the watercurrent has been achieved. It is apparent that the watercurrent is still being contaminated by CE for there is still cumulation of PCE in the observed fish. What may potentially endanger contribute to the worsening of the situation is a repeated drainage of CE into the watercurrent of Ploucnice or interuption and untimely termination of remediation works. Due to partial bioacumulation of PCE this substance would cumulated in water organism up to several mg/kg. PCE has the ability to cumulate in a food chain, which represents a potential risk for piscivore predators inhabiting this location. I tis impossible to estimate the degree of the risk, since there are no available date concerning the effects of CE on these organism. Bioaccumulation in fish from contaminated sites can provide information that can contribute to environmental monitoring programs designed for various aspects of environmental risk assessment.

Bioaccumulation of PCE in aquatic organisms is not expected to be important based on the bioconcentration factors of 39 for rainbow trout (Oncorhynchus mykiss) or 49 for bluegill (Lepomis macrochirus) but no other data that are usable are available concerning the accumulation of PCE by fresh water species [3], [4]. Given the limited date base the interpretation of the analytical results of the levels of contaminants found in the tissues of fish is generally difficult and limited by a variety of factors [3],[4]. Fish biomarkers are promising tools for environmental risk assessment (ERA), as supplements to existing chemical measures. Chemical monitoring alone is not fully sufficient for a reliable classification of water quality.

Conclusions

The remediation works declined CE concentration in the contaminated area of SAP Mimon and partially reduced the ecological risk for surface water ecosystem. We found out persisting contamination by PCE in analysed fish samples despite intensive remediation works during last 14 years. Regardless of lower concentration of PCE in newly analysed fish samples it is still necessary to continue with remediation in this area.

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Exposure assessment to air pollution due to onshore hydrocarbon exploration and exploitation activities: preliminary considerations

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Introduction

The reason of the STSM

About 36% of the territory of the Basilicata Region (Southern Italy) is interested by the presence of hydrocarbons reservoirs. The National Institute of Health (ISS) has been appointed to be partner of the Basilicata Region for the design and implementation of a research project on possible adverse health effects associated with oil and gas extraction in the Agri Valley. This area currently houses one of the biggest onshore European reservoirs (crude oil and gas) and the largest existing oil/gas pre-treatment plant (identified as **C**entro **O**lio **V**al d'**A**gri: **COVA**) in a populated area, Fig. 1. Exposure assessment to environmental factors associated with oil and gas extraction is the core issue of any epidemiological or risk assessment study to be done in this territory (1).

Main goal of the STSM

highlight some open issues on the most appropriate methodological approaches to air pollution exposure assessment to be applied in the oil and gas productive area of the Agri Valley

Background information

The COVA plant: oil hydrodesulphurization centre in which the fluid extracted from the currently active wells is transported and separated into three phases: crude oil, natural gas and water.

COVA emissions: conveyed, diffuse, fugitive, gas flaring

Main pollutants released: SO_2, NO_x, CO, H_2S, VOCs, PAHs, Particulate Matter

Figure 1. Location of the COVA plant (red polygon) and the 5 monitoring stations (red triangles) of the Regional Environmental Protection Agency (ARPAB).

Population involved

Nineteen municipalities fall under the "Agri Valley" concession (less than 50,000 inhabitants).
A low population density characterizes the territory reflecting its rural character.
Viggiano and Grumento Nova are the two municipalities nearest to the plant.

Key points

- ✓ Low level of outdoor air pollution (Fig.2);
- ✓ occasionally, concentrations peaks of pollutants coinciding with specific events (e.g. gas flaring events);
- ✓ plausibly more emission sources in the area in addition to the COVA plant (biomass and wood burning, Saharan dust long-range transport, heavy vehicles traffic, etc.…) ;

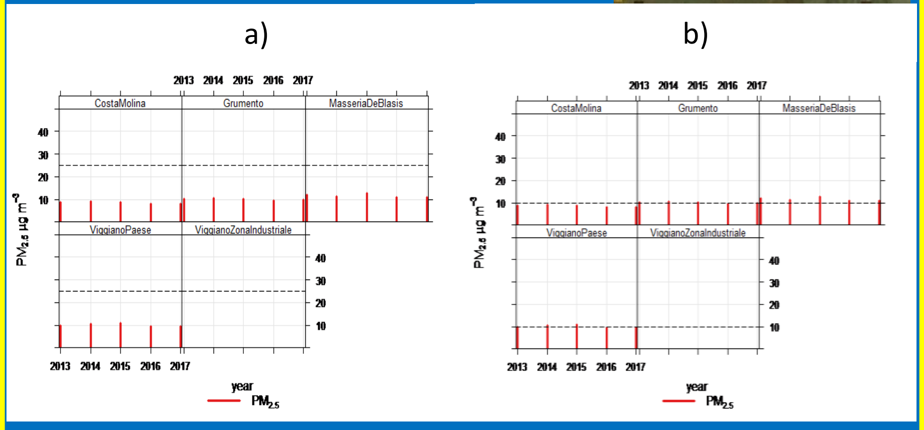

Figure 2. Annual mean $PM_{2.5}$ concentrations at ARPAB monitoring sites: the dotted line represents a) the national limit values and b) the WHO guideline values.

Key points

- ✓ the gradient of exposure to higher concentrations to the East of the COVA plant (Fig.3);
- ✓ entry into operation of a new thermodestroyer in the COVA plant in 2016;
- ✓ new areas interested by the emissions of the COVA plant (e.g. Municipality of Montemurro) (Tab. 1 and Fig. 4).

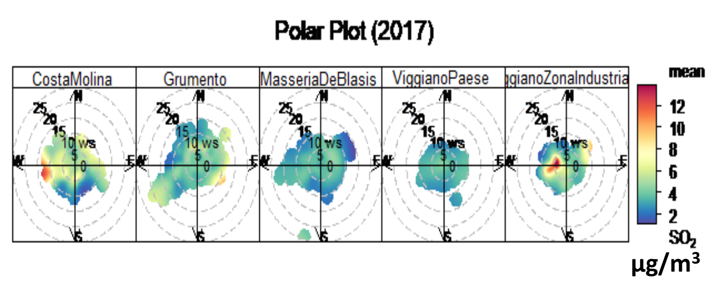

Figure 3. Hourly SO_2 concentrations at ARPAB monitoring sites.

December 14-15, 2016: black smoke release from the new thermodestroyer; at the Municipality of Montemurro concentration values have been recorded by ARPAB mobile laboratory

15/12/2016	Viggiano Zona Industriale	Costa Molina	Montemurro
SO_2	3,7 µg/m³	63,3 µg/m³	**139 µg/m³**

Table 1. Hourly SO_2 peak concentrations at different monitoring sites during the black smoke release event.

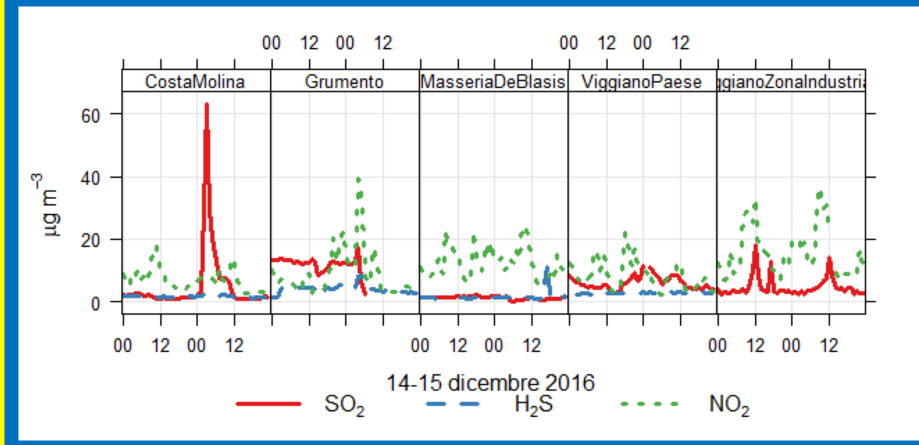

Figure 4. Hourly SO_2, H_2S, NO_2 concentrations at ARPAB monitoring sites during the black smoke release event.

Open issues

- **Large knowledge gaps exist regard to exposure and health impacts of contaminants emitted by onshore hydrocarbon exploration and exploitation activities (2).**
- **An air pollution dispersion modeling activity is necessary for the preliminary assessment of the areas more or less exposed to the plant's emission.**
- **There is a need to design an *ad hoc* air pollution exposure assessment strategy to analyse the health effects of:**
  - **short-term exposure to outdoor air pollution**
  - **long-term exposure to low level of outdoor air pollution (3)**

  for the populations living in the Agri Valley.
- **The exposure estimates can be refined by integrating several modeling and monitoring tools, as well as by using new technologies.**

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CONTAMINATED SITE IN SLOVENIA – CELJE BASSIN DESCRIPTION

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Background

The area of Celje has long tradition of heavy industry, more than 150 years of smelter of zinc tradition. The area lies in a basin with poor winds, where accumulation of heavy metals (Cadmium, Zinc, Lead) is very common.
There are 50.000 people living in a broader area and have strong NGO movement. Due to this environmental facts health assessment of the population has been needed.

Figure 1: Town Celje and location of contaminated site (now demolished)
(Foto: Wikipedia and Archives of Cinkarna Celje)

Environmental data

The main problem is contaminated soil with Cadmium, Zinc, Lead and other heavy metals which accumulated at upper level of soil. Out- and in- door air is polluted with PMs. The consequent impact on human health is through intake through respiratory and alimentary tract. Looking at environmental data: soil in broader area is still contaminated (first measurements are from 1989, other studies followed), exceeded values of Cadmium in some food vegetables were noticed (data from 1994, 2002, 2003), out-door air is still contaminated with PMs (continuous data of air pollution decades long), in-door air dust still accumulate indoors (combined data from 1996 to 2008).

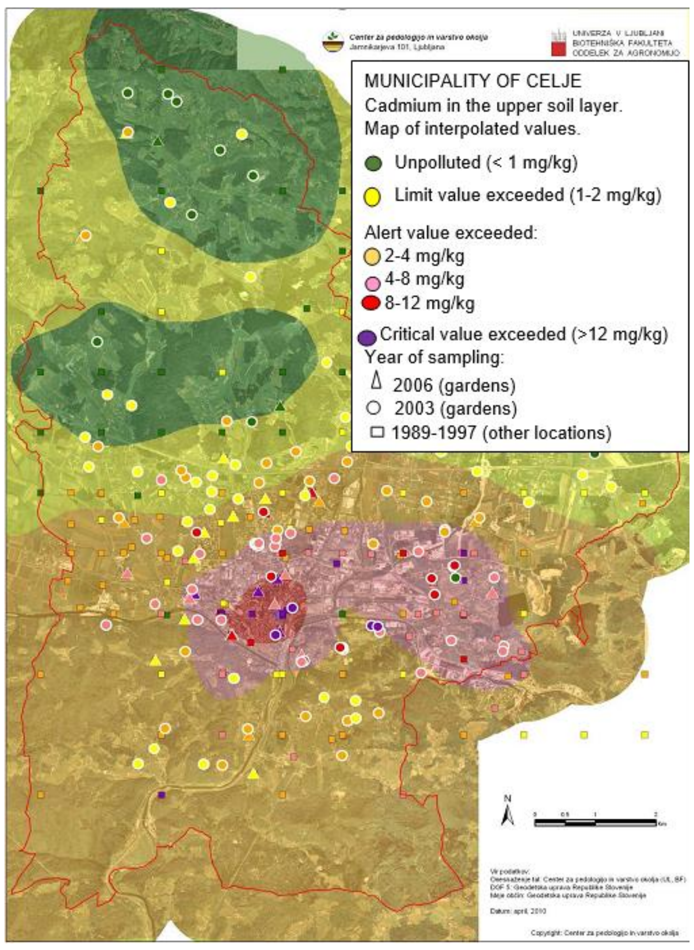

Figure 2: Soil contamination with cadmium in Celje
(Source: Reference No.2)

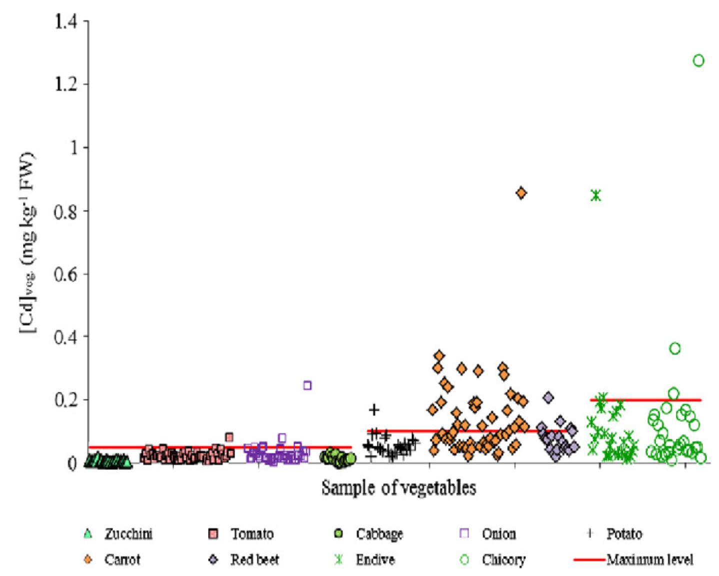

Figure 3: The concentration of cadmium (mg/kg FW) in 287 vegetable samples, with legislation maxi (Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs)mum levels (MV) of cadmium in vegetables

(Source: Reference No.2)

Public Health efforts

Short term activities have been implicated: rising awareness about harmfulness of heavy metals, giving population good information about pollution, hygiene of inner and outer environment. Long term activities have been started since the year 1992: recommendations for fruit and vegetables growing and use, planting the soil with grass and low vegetation, covering gravel roads with asphalt, replacing outer layer of soil with clean soil is in program for kindergartens area, decree for air pollution sanitation has been going on.

Conclusions

Continuation with public health efforts is needed. Huge problem with sanitation is dispersed pollution which is a consequence of transport of materials in the past. The biggest task for the future is sanitation of Old Zincarine area which is situated in the town of Celje.

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CONTAMINATED SITE IN SLOVENIA – POLYCHLORINATED BIPHENYLS (PCB) IN SEMIČ

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Background

Semič was contaminated with PCB emissions and waste from the factory Iskra-Semič, during the period between 1962 and 1985. The authors assessed the safety of home-produced food (eggs, milk, poultry) and fish from the rivers Krupa and Lahinja, regardless of PCB content, and compared the findings with the results of biomonitoring in Slovenia in 2010. They also submitted proposals for measures to reduce risks to human health in the area exposed.

Methods

Samples of food acquired in selected farms of the municipality of Semič in four seasons of the year 2010 and the fish caught in the rivers Krupa and Lahinja at specific sampling sites. Samples were analyzed in the laboratories of the Institute of Public Health Novo mesto using in-house methods for determination of PCBs in foodstuffs by gas chromatography (ECD) considering the WHO guidelines.

Figure 1. Source of the river Krupa

Results

The burden of home-produced foods (eggs, milk, chicken, meat) in the municipality Semič was in 2010 above the action level for dioxin-like PCBs and in the majority of cases above the maximum level for sum of dioxins and dioxin-like PCBs in foodstuffs, expressed in toxic equivalents as laid down by commission regulation setting maximum levels for certain contaminants in foodstuffs.
The maximum level for fish from the rivers Krupa and Lahinja was several hundred times exceeded. Biomarkers in PCB load of volunteers from the community of Semič were higher in comparison with other areas (Ljubljana, Gottschee): in breast milk up to 9.2 times more than from unburdened (Gottschee) areas. The average total PCB concentration in serum of Semič county population was 650 pg/g serum and in unburdened (Gottschee) and moderately burdened (Ljubljana) areas there has not been found quantifiable concentrations of PCBs in serum.

Figures 2,3,4,5 : Food chain

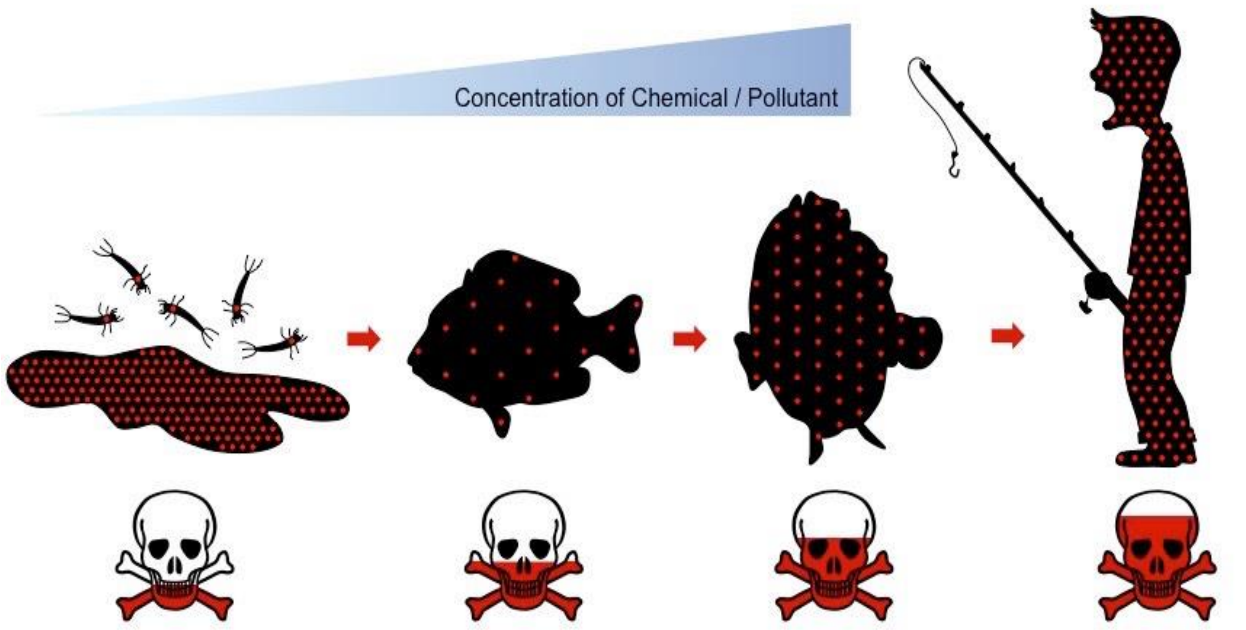

Figure 6. Principle of Biomagnification
Source: http://ib.bioninja.com.au/options/untitled/b3-environmental-protection/biomagnification.html

Conclusions

According to certain toxic equivalent values calculated from measured values of concentrations of dioxin-like PCB isomers in home-produced food, considering that possible harmful effects to human health due to consumption of locally produced milk, eggs and chicken meat can not be excluded. The consumption of fish from the rivers Krupa and Lahinja due to extremely high levels of toxic equivalents for dioxin like isomers of PCBs present a risk to health. The mentioned rivers are not suitable for fishing.

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Urinary Arsenic in Human Samples from Areas Characterized by Natural and Anthropogenic Pollution in Italy

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Introduction

Arsenic (As) is ubiquitous and has potentially adverse impact on human health. In Italy the health risk to exposures to low-to-moderate As levels in drinking water is a great concern in many areas affected by As pollution of a natural and/or anthropogenic origin. The Italian SEpiAs study (1), was carried out in four Italian areas to assess the relationship between human As exposure and biological markers of early health effects. In the framework of SEpiAs the relationship between the urinary concentration of inorganic As plus its methylated forms (uc(iAs+MMA+DMA)) and various exposures factors investigated by a questionnaire was assessed.

Results

Figure 1 shows high heterogeneity among areas, high variability within areas, and various differences between genders. Taranto and Gela have a greater internal variability than the other two sites. The ***Taranto*** sample showed a significant increase in GM values of uc(iAs+MMA+DMA) in consumers, compared to non-consumers, of some foodstuff, such as seafood (p=0.044), meat (p=0.06), bread, pasta and cereals (p=0.027), whole milk (p<0.001), coffee (p=0.018), and fruit/vegetables of own/local production (p=0.015). A statistically significant increase (p=0.002) in GM values of uc(iAs+MMA+DMA) was observed among subjects occupationally exposed to inorganic solvents and acids, compared with the non-exposed (Table 1). The ***Gela*** sample showed a significant increase in GM values of uc(iAs+MMA+DMA) in males exposed to occupational factors in the chemical industry (p<0.001), and among seafood consumers compared to non-consumers (p=0.023). A statistically significant decrease in GM concentration both among carriers of the null genotype of GSTT (p=0.008) and among coffee consumers (p=0.012) (Table 2) was found.

Table 2. Gela sample. Factors associated with u(iAs+MMA+DMA) concentration by stepwise multivariate regression.

Factors Selected (p < 0.2)	Class	GM Exp	90% CI	GMR	90% CI
GSTT	-	22.43	14.12–35.62	1 (reference)	
	+	9.68	7.65–12.25	0.43	0.26–0.72
Occupational exposure in chemical industrials	No	10.48	8.34–13.17	1 (reference)	
	Yes	36.67	23.15–58.08	3.50	2.09–5.85
Seafood	No	6.89	4.55–10.44	1 (reference)	
	Yes	13.37	10.48–17.04	1.94	1.21–3.12
Coffee	No	19.86	13.45–29.31	1 (reference)	
	Yes	9.81	7.66–12.57	0.49	0.31–0.78

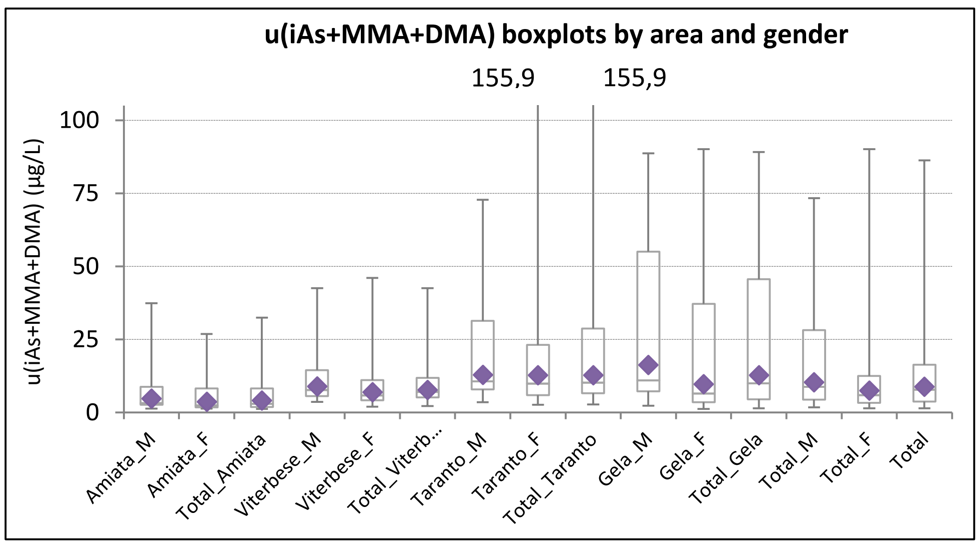
Methods

This study assessed the relationship between uc(iAs+MMA+DMA) and various exposure factors derived from a Human BioMonitoring (HBM) questionnaire in four Italian areas characterized by natural and/or anthropogenic As pollution. Here we will focus on results of the areas of Taranto (Apulia Region) and Gela (Sicily region) interested by anthropogenic As contamination.
A HBM study was conducted in 271 subjects (132 men) aged 20-44, randomly sampled and stratified by area, gender and age. Data on environmental and occupational exposure and dietary habits were collected through a questionnaire. As was speciated using chromatographic separation and inductively coupled mass spectrometry. Associations between uc(iAs+MMA+DMA) and exposure factors were evaluated using the geometric mean ratio (GMR) with a 90% confidence interval by stepwise multiple regression analysis.

Table 1. Taranto sample. Factors associated with u(iAs+MMA+DMA) concentration by stepwise multivariate regression.

Factors Selected (p < 0.2)	Class	GM Exp	90% CI	GMR	90% CI
AS3MT	No	5.64	3.59–8.87	1 (reference)	
	Yes	8.19	4.84–13.87	1.45	0.92–2.30
Tap water	No	3.48	1.43–8.47	1 (reference)	
	Yes	8.29	5.66–12.13	2.38	0.99–5.73
Exposure to inorganic solvents and acids	No	5.17	3.31–8.07	1 (reference)	
	Yes	14.81	8.28–26.50	2.86	1.69–4.84
Seafood	No	3.56	1.78–7.12	1 (reference)	
	Yes	7.34	4.83–11.15	2.06	1.15–3.71
Meat	No	4.78	3.20–7.14	1 (reference)	
	Yes	8.31	4.73–14.61	1.74	1.07–2.81
Bread, pasta, cereals	No	1.85	0.64–5.39	1 (reference)	
	Yes	6.61	4.34–10.08	3.57	1.40–9.10
Whole milk	No	4.81	3.11–7.45	1 (reference)	
	Yes	14.75	7.99–27.23	3.06	1.78–5.26
Coffee	No	3.43	1.97–5.97	1 (reference)	
	Yes	7.64	4.81–12.14	2.23	1.29–3.84
Fruit/Vegetables of own/local production	No	4.95	2.87–8.53	1 (reference)	
	Yes	11.17	7.92–15.77	2.26	1.31–3.88

Figure 1. Distribution of u(iAs+MMA+DMA) (µg/L) by area and gender.



Discussion

This study allowed the examination of the relationships between uc(iAs+MMA+DMA) in subjects living in areas with recognized low-to-moderate concentration of As pollution of an anthropogenic or natural origin. The results highlighted differences among the areas and between industrial and natural polluted areas, as reported in the literature. It seemed that As contamination led to higher uc(iAs+MMA+DMA) in the industrial areas of Taranto and Gela. The factors found to be associated with the urinary profile of As in the industrial areas are supported by the scientific literature: consumption both of seafood and contaminated tap water, occupational exposure and GSTT polymorphism.

Conclusions

Due to the widespread presence of As in the environment and its potential impact on health, the health system is often called into question. The study confirms the need for an environmental and health surveillance system in recognized areas with documented contamination. The results confirm that occupational exposure and consumption of tap water and fish, represent the main factors of exposure. The study also highlights the role of genetic susceptibility and indicates the need to study further exposure factors, such as the consumption of meat, milk, fruit and vegetables.
Recent advances in genomics and epigenetics offer additional insight into the toxicity of As and into the mechanisms of As carcinogenicity. Identifying polymorphisms, gene-environment interactions, and related effects on As metabolism, will provide important information on the mechanisms behind the biotransformation of As, and also facilitate comprehension of individual differences in As metabolism. This will help us to identify susceptible groups, and may provide better risk estimates for arsenic.

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Lead and cadmium exposure in preschool children living in Piekary Slaskie city, one of the ICSs located in Poland

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Introduction

Lead is one of the significant environmental hazard, numerous epidemiological evidence confirmed that even small level can results in serious health consequences in the youngest population. In Poland, like in other European countries, consumption of lead has decreased in the past two decades. Simultaneously, we observed significant decrease of average blood lead level in children [1]. However, higher value of PbB are still observed in children living in some regions of Poland, especially in the proximity of sources of emission or close to degraded sites. The Silesian voivodeship (south part of Poland) is a region exploited by industry, including coal mining and metallurgical production, in which are located landfills with heavy metals. One of most polluted cities in the region is Piekary Śląskie. About 1/4 of the city area include a large landfill containing lead, cadmium and zinc, making this one of the most polluted cities of the region [2]. Population of children aged 3-7 years living in the city Piekary was 2 196 in 2012. The average geometric value of lead and cadmium concentration in playgrounds were 293.1 mg/kg and 8.8 mg/kg, respectively.

Methods

In 2013 a cross-sectional study was conducted in the Piekary Śląskie city for a group of 678 preschool children (341 girls and 337 boys) living in the vicinity of a metallurgical slag heap, a gasoline station, industrial plants or busy roads [2]. Based on soil measurements and previous children exposure, lead and cadmium blood levels were measured. Preschool children were selected as study group since they spend a lot of time playing outdoor and they are not occupationally exposed. After the parental agreement for testing children's blood, parents completed a questionnaire about determinants of exposure, such as sources of pollution with heavy metals in the home environment and socioeconomic factors. Statistical analysis consisted of ANOVA Kruskall-Wallis or Mann Whitney U test and Stepwise regression models.

Figure 1. Distribution of PbB and CdB according to age of children

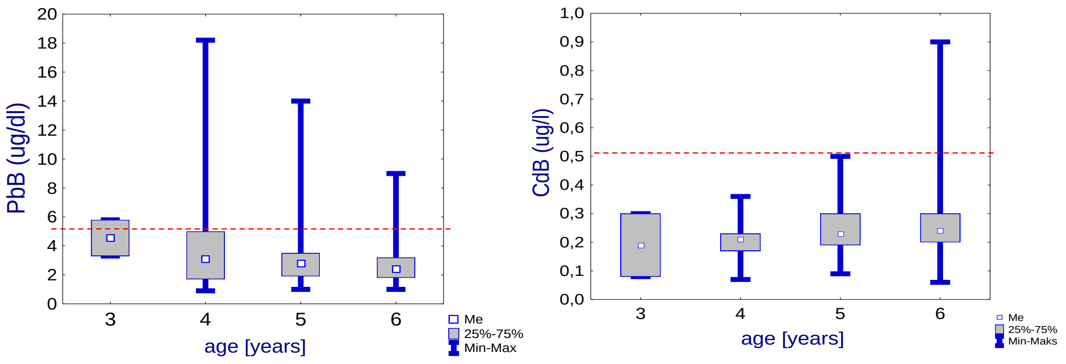
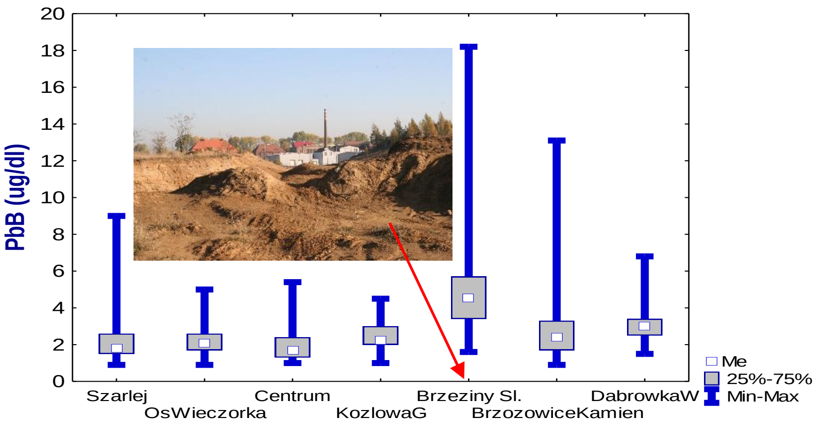


Figure 2. Lead in blood of children living in particular district of the Piekary city



Results

Results of study showed that preschool children living in Piekary Śląskie are exposed to lead and cadmium. Higher blood levels of lead were observed in younger children (Fig.1) and were associated with father's higher level of education, exposure to cigarettes smoke at home and living in the vicinity of any environmental hazard (Table 1). The highest blood lead concentrations were observed in children living near metallurgical heaps (Table 2).

Otherwise, higher cadmium levels in blood were associated with an older age and living near gas station. When compared to health based guidance values for lead in blood 32% (n=218) of the children exceeded the value of 2 µg/dl, 8.5% (n=58) exceeded the value of 5 µg/dl and 0.9% (n=6) exceeded the value of 10 µg/dl. The reference value for cadmium of 0.5 µg/dl was exceeded in 0.8% of the children. The highest risk was documented in children living in the vicinity of metallurgical slag heaps located in Brzeziny district (Fig.2), this region also had the highest concentration of both pollutants in the soil.

Table 2. Lead and cadmium concentration in blood of children according to their place of residence in vicinity of hazardous sources

Pollutant	**PbB** and **CdB** concentration in children according to place of residence in vicinity of: busy road – yes	busy road – no	gas station – yes	gas station – no	metallurgical heap – yes	metallurgical heap – no
Lead (µg/dl)	2.9±2.2	2.7±1.4	3.0±2.2	4.3±2.5	4.4±2.5	3.0±2.2
Cadmium (µg/l)	0.26±0.14	0.26±0.14	0.25±0.08	0.22±0.07	0.22±0.07	0.25±0.08

Table 1. Stepwise regression coefficients for relationship between lead (PbB) and cadmium levels in blood (CdB) and statistically significant independent variables determined exposure of preschool children living in the vicinity of environmental hazards in Piekary Śląskie

Intercept **PbB**	0.699	0.595 ÷ 0.803
Living close to hazard (1=yes)	- 0.121	-0.150 ÷ -0.092
Age	-0.038	-0.054 ÷ -0.022
Father's education (1=higher)	-0.047	-0.082 ÷ -0.012
Mother ETS (1=no)	0.045	0.008 ÷ 0.082
Intercept **CdB**	-0.84	-0.922 ÷ -0.758
Living close to hazard (1=yes)	0.035	0.021 ÷ 0.049
Age	0.026	0.002 ÷ 0.049

Discussion

Comparing the measured levels with health based reference values showed that in case of 160 children aged 3-7 years is necessity to recognize potential environmental sources in their environment, moreover 6 children had blood lead levels above 10 µg/dl, which implies medical care should be implemented. The study emphases that improvements of environment quality in Piekary Śląskie are necessary to assure expected quality of health in children and local efforts achieve the desired goals are to be continued. To continue informing parents and nurseries about environmental hazards of heavy metals and how behavior and life style can interact with exposure is important. For many years (since 1992 year), parents of school and pre-school children living in study area constructive cooperate with the city office and the Miasteczko Śląskie foundation for the benefit of children exposed to heavy metals. This continuous cooperation is possible due to the parents' concern about children's health. Caregivers were informed about the need of repetition blood tests for children with elevated lead or cadmium concentration, moreover these children receive medical support

Conclusions

Obtained results confirmed that preschool children living in Piekary Śląskie, Poland, are still exposed to heavy metals (lead and cadmium) existing in environment. It must be concluded that improvements of environment quality in Piekary Śląskie is necessary to assure expected quality of health in children and it is local priority of public health. It is important to continue education of parents and nurseries teachers about environmental hazard of heavy metals and properly behaviours during normal life.

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THE IMPACT OF A NEW COPPER SMELTING TECHNOLOGY ON THE TOTAL ATMOSPHERIC DEPOSITION IN BOR, SERBIA

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Introduction

The largest copper mines, as well as the Copper Smelter in Europe, is located in the Municipality of Bor, Serbia. Equipment in the Smelter and Sulfuric Acid Plant has long since become outdated, since it has been in use for almost 50 years. The new smelter facilities were built and started to operate in 2016.

The main goal of this research was to investigate the influence of the new smelting technology, applied in the Copper Smelter in Bor on the quantity and chemical composition (As, Cd, Ni, and Pb) of the Total Atmospheric Deposition (TAD) in the Bor town urban areas.

In that aim, the results of measurements in the period 2014-2015 (old smelting technology) were compared with the results from the period 2016-2017 (new smelting technology).

Methods

Results presented here are obtained from the sampling campaigns conducted from January 2014 to December 2017 at three locations in the Bor town urban area (TF, TP, and IN) as shown in Figure 1. The TAD samples were collected continuously for the periods of 1 month.

The total of 144 monthly samples were collected, 48 samples per each sampling point. Sampling campaigns were conducted by the Mining and Metallurgy Institute Bor, Department for Chemical and Technical Testing, in accordance with the monitoring program, adopted by the competent Ministry and local government.

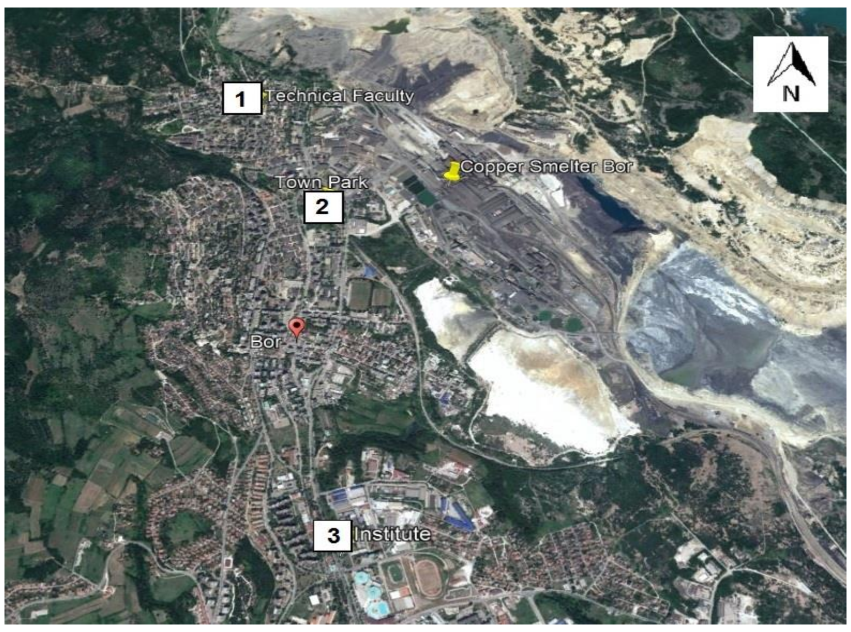

Figure 1. (Sampling locations relative to the Copper Smelter Bor (1. Technical Faculty in Bor -TF, 2. Town Park -TP, 3. Mining and Metallurgy Institute Bor- IN)

Results and discussion

The analysis showed that there are statistically significant differences (level 0.05) between the TAD concentrations at all sampling sites comparing the periods when different technologies were applied in the Smelter. The same stands also for the pH values of the TAD determined at all sampling sites, as well as for the Cd content in the TAD at the TF and As content in the TAD at the IN. TAD concentrations at the TF and TP are almost 2 times higher in the period 2014-2015 compared to the period 2016-2017. The lower TAD concentrations are a direct consequence of changes in the smelting technology and better treatment of waste gases in the Copper Smelter. Contrary to that, the As concentrations determined in the TAD at all sampling sites in Bor are higher in the period 2016-2017 compared to the period 2014-2015, as shown in Figure. 2.

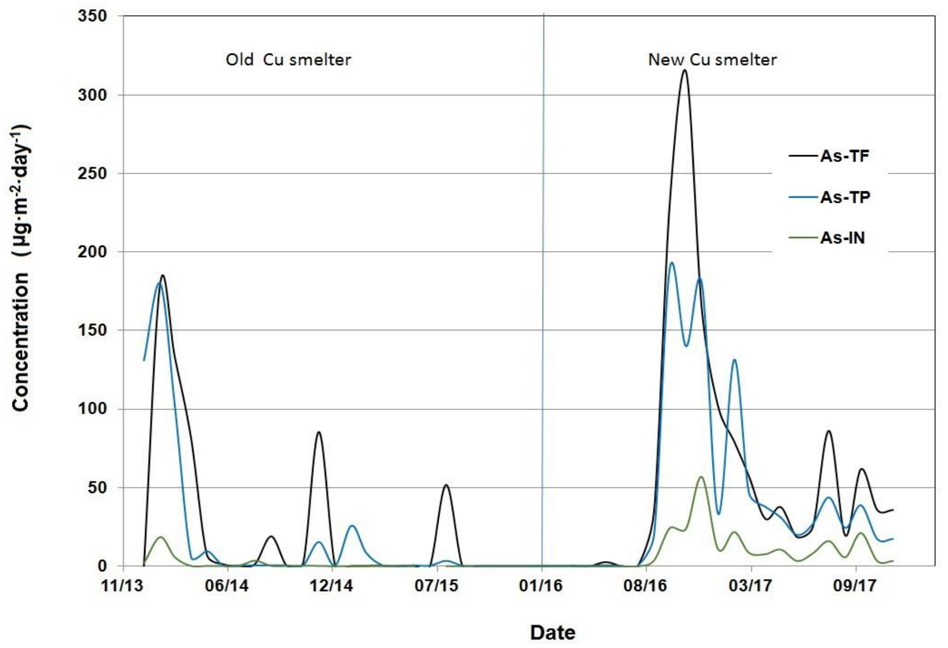

Figure 1. Average As content in the TAD in Bor in the period 2014-2017

Table 1. Annual TAD fluxes of Pb, Cd, Ni and As (mg·m^{-2}·year^{-1}) in different regions

Location	Period	Pb	Cd	Ni	As	References
TF, Bor, Serbia	2014-2015	31.3	1.8	2.2	8.6	This study
TF, Bor, Serbia	2016-2017	22.2	0.7	2.4	20.4	This study
TP, Bor, Serbia	2014-2015	24.7	1.1	2.1	7.4	This study
TP, Bor, Serbia	2016-2017	18.2	0.5	2.9	15.2	This study
IN, Bor, Serbia	2014-2015	7.2	0.2	0.5	0.5	This study
IN, Bor, Serbia	2016-2017	6.2	0.2	1.0	3.5	This study
Belgrade, Serbia	2002-2006	21.7	0.2	11.3		[1]
Tokyo Bay, Japan	2004-2005	9.9	0.4	6.8	2.9	[2]
Seine Estuary, France	2001-2002	18.0	0.4	4.1		[3]
Paris, France	2001-2002	4.2	0.2	0.6		[3]
Pearl River delta, China	2001-2002	13.0	0.1	8.4		[4]

Conclusions

The increase in the pH of the TAD in the period of operation of the New Smelter is due to the better processing of smelter waste gases (primarily SO_2). The increase in As content in the TAD in the operation period of the New Smelter can be attributed to a higher concentration of As in the copper concentrates processed in the Smelter, as well as to a higher production of copper. In general, the annual TAD fluxes of As, Cd, and Pb, recorded in Bor, are higher compared to the results of other available studies, while the annual TAD fluxes of Ni, recorded in Bor, are of the same order of magnitude or lower compared to the results of other studies.

The presence of the very strong (r> 0.8) and strong (0.8 >r>0.6) Pearson correlation between the heavy metals, determined in the TAD, was observed at all sampling points during the New Smelter operation period, as opposed to the Old Smelter operation period when these correlations were weaker. This unequivocally indicates that they come from the same source - the Copper Smelter.

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CONTAMINATED SITE IN SLOVENIA – MEŽA VALLEY

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Background

The valley of Meža has long tradition of mining industry, since the year 1665 when the lead mining production and lead processing begin. The area lies in the north of Slovenia in a narrow valley with poor winds, where accumulation of heavy metal like lead is very common.

There are about 3.500 people living in a broader area. Lead effect on human health, especially on children population has been well known.

Figure 1: Meža valley contaminated site (now demolished)

source:https://www.google.com/search?q=Me%C5%BEi%C5%A1ka+dolina&tbm=isch&source=univ&client=firefox-b&sa=X&ved=2ahUKEwjkufuYlLPgAhWEb1AKHSjYAwkQsAR6BAgGEAE&biw=1280&bih=915#imgrc=XTK0nglmZQKEyM:

Environmental and Health data

The main problem is contaminated soil with lead which has been accumulating at upper level of soil during this long period. The consequent impact on human health is through intake through respiratory and alimentary tract. Looking at environmental data: SO_2 emissions and PMs have been reduced during last four decades, but elevated concentrations of lead and cadmium in soil still remains a problem (study from 2007). In the year 2007, a decree about sanitation of Mežica valley begin. The project name is „Living with Lead" and it is financed from the State of Slovenia.

Looking at health data: The most common way of assessing the total burden of the population with lead is the measurement of lead in the blood. It is an indicator of the intake and binding of lead in the last one or two months before testing the blood. Since 2004, the blood of three-year-olds in the Meža valley has been monitored for the lead content. In the first years of the implementation of remediation measures, body burden of lead has improved rapidly but in recent years it remains at the same level.

Figure 2: Recycling and production of lead batteriesin Meža valley

Photo: Borut Peterlin. Source: https://www.mladina.si/95312/dolina-na-koncu-slovenije

Figure 3: Successful new covering with uncontaminated soil in kindergartens in Meža valley

Source:https://www.google.com/search?q=Me%C5%BEi%C5%A1ka+dolina&tbm=isch&source=univ&client=firefox-b&sa=X&ved=2ahUKEwjkufuYlLPgAhWEb1AKHSjYAwkQsAR6BAgGEAE&biw=1280&bih=915#imgrc=Czi3gpOBaGdGXM:

Public Health efforts

Activities have been implicated:

- Biomonitoring of lead in the blood of children
- Replacement of contaminated soil
- Covering gravel roads with asphalt and concrete
- Regular cleaning of public area
- New green spaces and safe gardens, fitomediation
- Assessment of pollution in the wide environment
- Subvention on locally grown food for people living in contaminated area
- Adaptation and cleaning of locally house facade, which were built with the contaminated materials
- Monitoring of PMs in the air
- Monitoring of the contaminated soil
- Coordination of the informational activities

Conclusions

Continuation with public health efforts is needed. Children who have been found to have high blood lead levels need individual treatment with the identification of sources of exposure to lead and directed individual counseling to reduce exposure and intake of lead.

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Correlation between meteorological data and air quality with the number of urgent interventions and patient visits to Clinic of Integrated Emergency Hospital Admission in City of Slavonski Brod, Croatia in 2018

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Introduction

Air quality is the suitability of air for breathing, often measured in terms of the levels of ozone, sulfur oxides, nitrogen oxides, carbon monoxide and particulates in the air. Considering that the impact of air pollution on human health is recognized in scientific literature, an epidemiological study was designed conducted in 2018 with the purpose of assessing the potential impacts of air pollution on health of the inhabitants of Slavonski Brod.

Methods

The analysis was conducted on data regarding Slavonski Brod in the period from January 1st to August 31st 2018 obtained from four sources:

1) System eHitna - emergency medical services interventions in Slavonski Brod.
2) Patient's visit to OHBP of the Slavonski Brod General Hospital.
3) Information from Meteorological and Hydrological Service regarding the maximum and minimum temperature, the mean value of the atmospheric pressure and mean values of relative humidity per day.
4) Data from the Environmental Protection Agency regarding air quality for $PM_{2.5}$ (gravimetric analysis), PM_{10} (gravimetric analysis) and H_2S from two measuring stations (SL1 and SL2) per day.

Picture 1. Oil rafinery near Croatian border

Results

Statistically significant weak positive correlation was shown between $PM_{2.5}$ and PM_{10} values on SL1 monitoring station and PM_{10} values on SL2 monitoring station and the number of patient who were provided with medical assistance for the period January 1st to August 31st 2018.

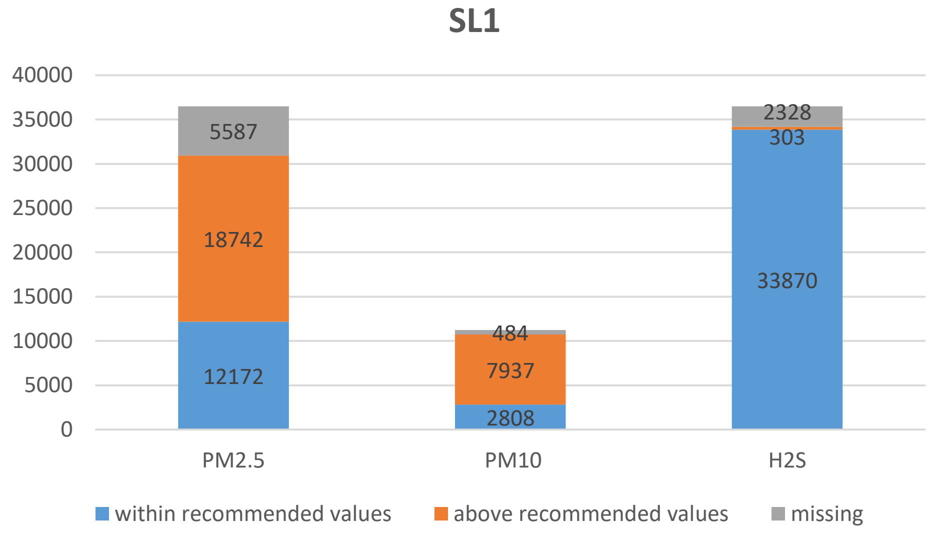

Figure 1
Number of patients on days within or above recommended $PM_{2.5}$, PM_{10} and H_2S limit values on measuring station Slavonski Brod 1 (SL1) in 2018.

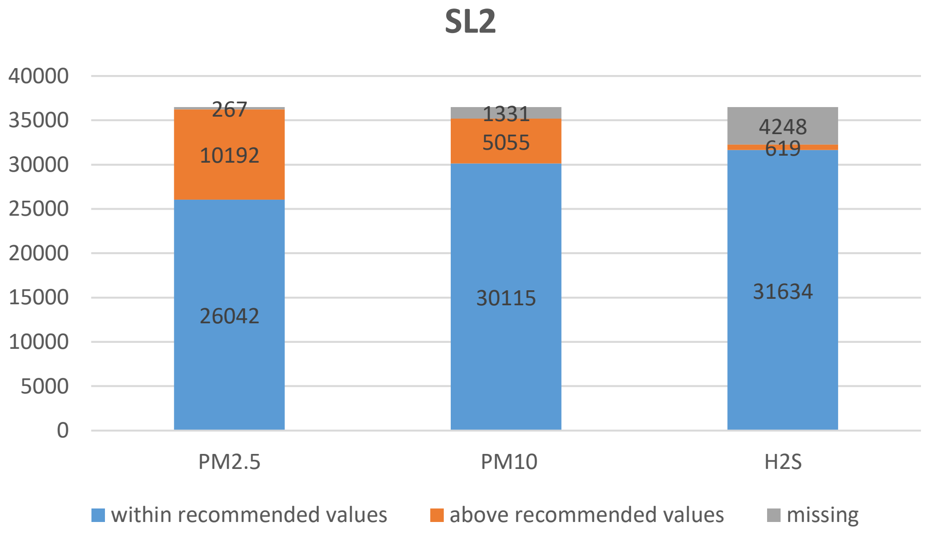

Figure 2
Number of patients on days within or above recommended $PM_{2.5}$, PM_{10} and H_2S limit values on measuring station Slavonski Brod 2 (SL2) in 2018.

Discussion

Oil refinery is one of the sources of air pollution in city of Slavonski Brod, in Brodsko-Posavska county, population of 149 769 residents. Due to public and media pressure within the context of air pollution and its potential on impacting the human health, an epidemiological study has been designed in 2016. The study was continuously conducted in 2017 and 2018. Although the study itself analyses the correlation between the meteorological data and air quality data with the number of emergency medical interventions, the final aim of the study is to deliver results represent valuable fraction of risk communication within the meaning of air pollution in the City of Slavonski Brod, both to the public and the media. Firstly, the pollutants from other sources such as heating system, especially wood burning stoves during winter and traffic must be taken into consideration. In addition to that, the oil refinery is located in Bosnia and Herzegovina near the Croatian border (Picture 1). Taken into consideration, the issue represents a matter of international scale.

Conclusions

Given the constraints (lack of data on residence) and specificity of the sample (the domain of emergency medicine and the way of keeping track on the number of visits), the strength of tests and generalising the conclusions to the entire population of Slavonski Brod could be limited. Future research and improvement of the study is needed in order to provide information and guidance in a form of practical and specific advice.

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CYPRUS INTERNATIONAL INSTITUTE FOR ENVIRONMENTAL AND PUBLIC HEALTH

water and health laboratory

Brain cancer cluster around a factory emitting dichloromethane in a residential area in Cyprus

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2 Ministry of Labour and Social Insurance, Cyprus

Background

Site: Shoe sole producing factory in the residential area of Latsia, Nicosia, Cyprus


[2]

Operation time: 1980- 2009

Study population: 2290 people

DCM was classified as a probable carcinogen (2A) in 2014 [1]

Exposure:

- DCM stack measurements made in 2005 and 2006 by the Department of Labour Inspection showed that mean emissions of DCM of 88 mg/Nm^3 and flow of 850 g/hr exceeded the permissible DCM limits established for industrial zones (20 mg/Nm^3 and 100 g/hr) (EU Directive 1999/13)
- Based on factory operating hours, the mean annual DCM emission rate was calculated to be 30670 mg/min (6.9 tonnes /year)

Objective: Investigate the possible presence of cancer cluster in 500m radius of the factory with a retrospective comparative population study

Methods

- Inclusion criteria:
  Living or working in the selected area ± 5m away from the borders of the selected zip codes and diagnosed with any cancer between the years 1998-2008
- Population data were based on census data (2011)
- The study was approved by the National Bioethics Committee (EEBK/OP2013/01/28)
- Crude cancer incidence rates of the study area were compared to two different municipalities of Nicosia, the city of Nicosia, and whole Cyprus between the years 1998 and 2008
- Standardized incidence ratios (SIR) and 95% CI for the study population were calculated based on mean age-standardized brain cancer rates in Cyprus from 1998-2000

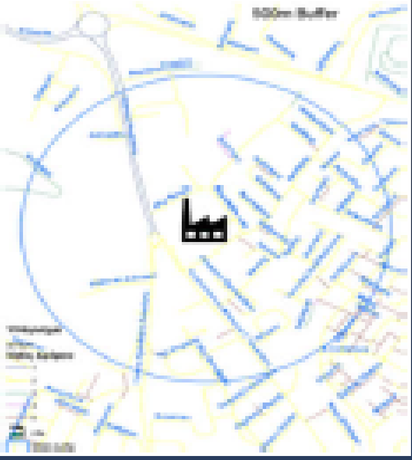
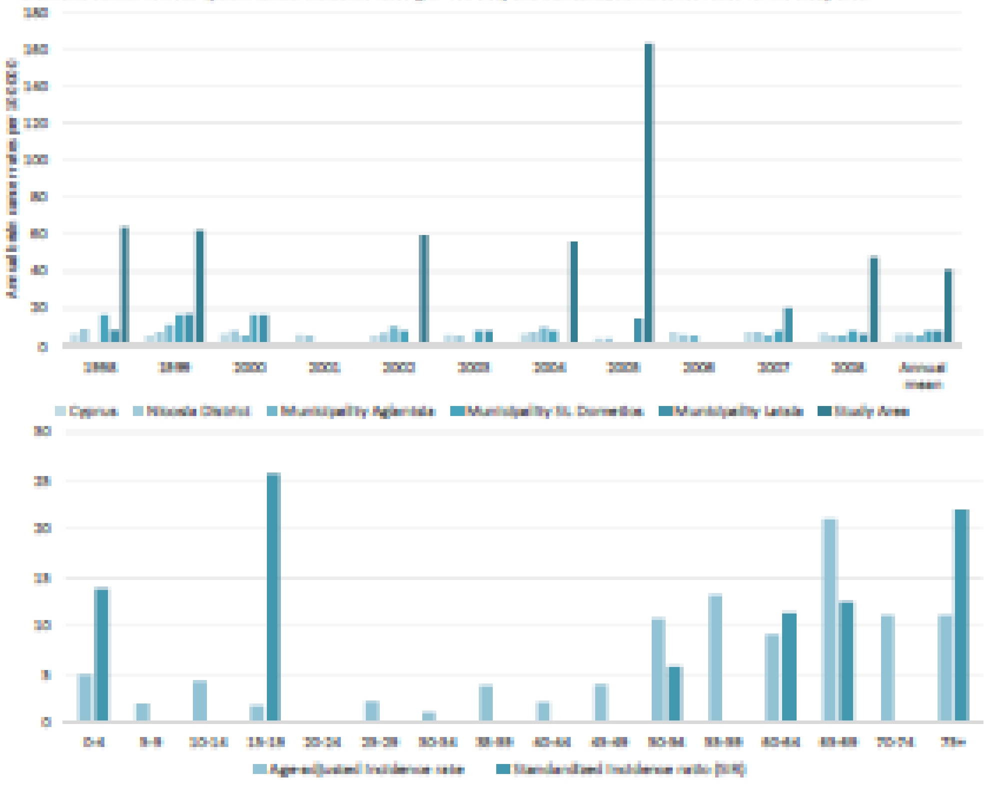


Figure 1: Study area

Results

Figure 2: A) Crude annual brain and central nervous system cancer incidence rates in different areas of Cyprus; B) Age-standardized brain and central nervous system cancer incidence rates (per 100 000) and standardized incidence ratios for the study area



- A total of 82 cancer cases of >90 participated residing or working in the study area
- Similar age distribution of study and control populations
- Crude incidence rate revealed a significant (*p <0.001*) increase in the incidence of new cases of brain and central nervous system cancer in the study area (Figure 2A), while incidences for leukemia, breast cancer and prostate cancer were elevated, but not significantly (*p>0.05*)
- The SIR =6.5 (95% CI 3.0-12.3) for brain and central nervous system cancer in the study area was significantly (*p<0.001*) elevated (Figure 2B)

Discussion

- Epidemiological evidence for an association between DCM exposure and brain and central nervous system cancer is not clear, and mainly originates from occupational settings [3-7]
- DCM exposure has been also associated with other cancer sites, such as liver cancer and biliary tract cancer, Non-Hodgkin's lymphoma, and multiple myeloma [8]
- The combination of the facts, namely, a) the rarity of this cancer site and b) a statistically significant increase in the SIR in the area of a 500m radius, coupled with the biological plausibility of DCM carcinogenic potential suggest the existence of a meaningful brain and central nervous system cancer cluster around the factory

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Long-term exposure to industrial air pollution and mortality in a cohort of people living in an area of South Italy

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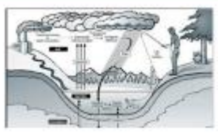
Epidemiological studies in industrial areas and contaminated sites

- ✓ Multiple sources
- ✓ Different pathways
- ✓ Variable time of contamination



- ✓ Popolation size (and size of the exposed groups)
- ✓ Socioeconomic status (environmental justice)
- ✓ Occupational exposure

- ✓ Outcomes definition and data collection
- ✓ Enviromental worries and media pressure

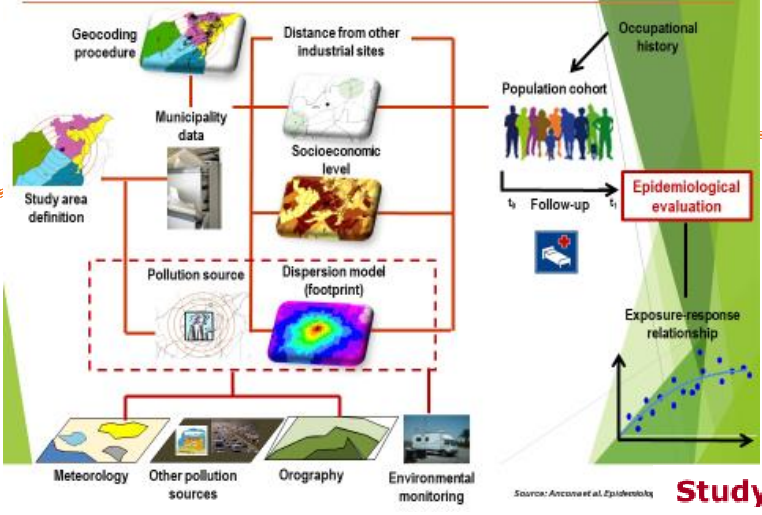
Study area

Environmental stressors:
- Thermoelettric power plants
- Petrochemical complex
- Harbor
- Airport
- Landfills and Incinerator
- Other plants
- Traffic and biomass heating

Objective

To evaluate the effects of power plants industrial emissions on mortality in a cohort of people living in the area of Brindisi

Study design – Residential cohort approach

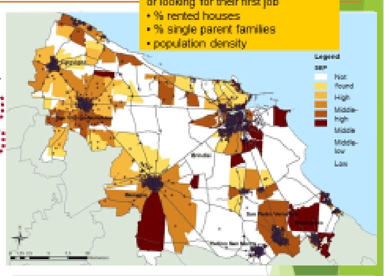


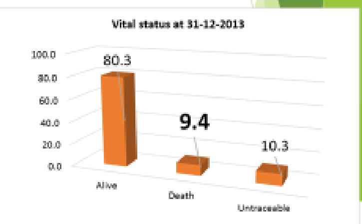
Study popolation

223.934 people (2000-2013)

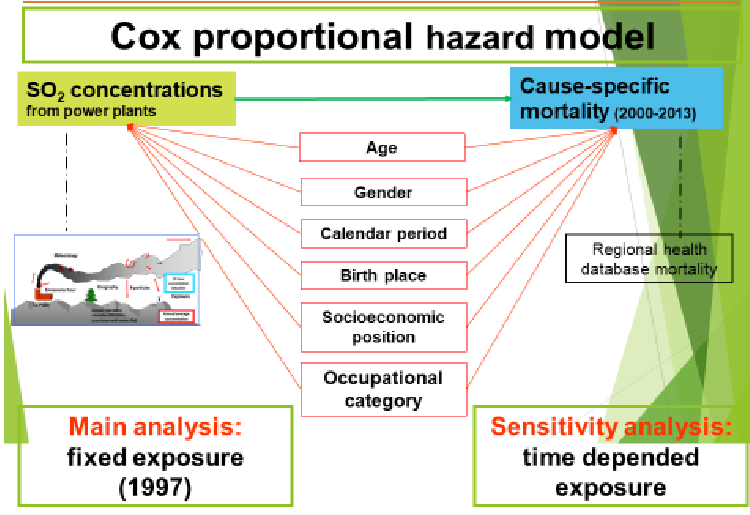
Occupational categories		
Ever worked	83240	*37.2*
Services industry	27641	*12.3*
Agricolture	33144	*14.8*
Constructions industry	10109	*4.5*
Naval and Mechanical constructions	9270	*4.1*
Chemical-Pharmacutical-Rubber	4343	*1.9*
Plastic	3098	*1.4*
Transports	2024	*0.9*
Electric construction	1607	*0.7*
Aeronautic	1476	*0.7*
Mineral processing	1145	*0.5*
Gas and power industries	893	*0.4*
Iron and steel industry	1147	*0.5*
Dock worker	752	*0.3*
Others	4564	*2.0*
Socio-economic position (SEP)		
High	23484	*10.5*
Middle-high	50647	*22.6*
Middle	62155	*27.8*
Middle-low	50671	*22.6*
Low	32880	*14.7*
Not found	4097	*1.8*

- % population with educational level <= primary school
- % active population unemployed or looking for their first job
- % rented houses
- % single parent families
- population density

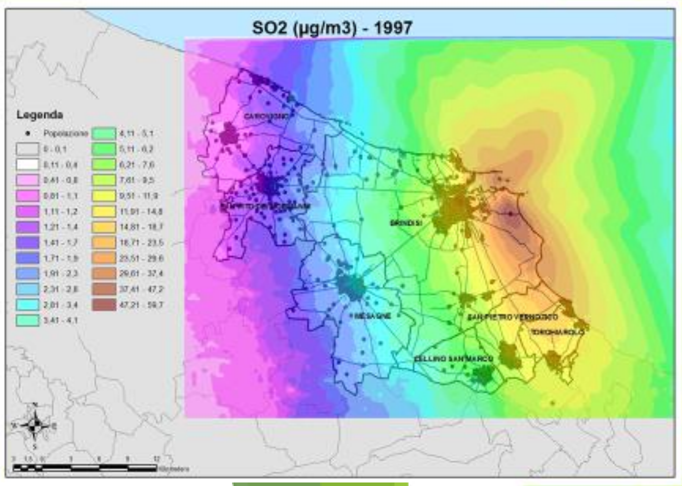




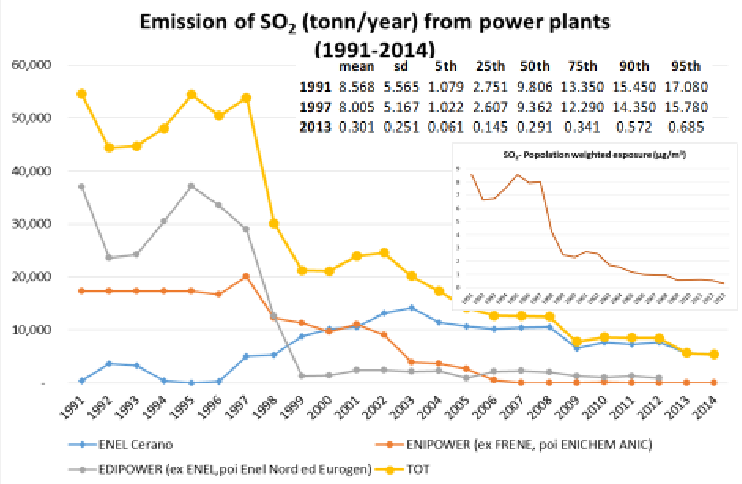
Statistical analysis



SO_2 concentrations from power plants



Exposure



	mean	sd	5th	25th	50th	75th	90th	95th
1991	8.568	5.565	1.079	2.751	9.806	13.350	15.450	17.080
1997	8.005	5.167	1.022	2.607	9.362	12.290	14.350	15.780
2013	0.301	0.251	0.061	0.145	0.291	0.341	0.572	0.685

Association between SO_2 from power plants and cause-specific mortality. Adjusted hazard ratios (HRs and 95% CI)

CAUSE	N	SO_2 EXPOSURE at 1997 (95°p - 5°p = 14.758) HR*	Low	Up	SO_2 EXPOSURE LAG 0 (95°p - 5°p = 3.639) HR*	Low	Up
Natural mortality	19653	1.00	0.96	1.05	0.98	0.92	1.04
Malignant cancers	5375	**1.15**	**1.05**	**1.25**	**1.12**	**1.00**	**1.24**
Stomach	229	0.93	0.61	1.42	1.20	0.72	1.98
Colon and rectum	484	0.98	0.73	1.30	1.04	0.73	1.48
Liver	400	1.02	0.74	1.40	0.98	0.68	1.40
Pancreas	267	**1.55**	**1.04**	**2.29**	**1.61**	**1.01**	**2.58**
Larynx	53	0.80	0.33	1.93	1.11	0.40	3.05
Trachea, bronchus and lung	1103	1.14	0.94	1.38	1.01	0.81	1.27
Pleura	41	1.08	0.38	3.10	1.25	0.37	4.21
Brest	305	1.19	0.83	1.73			
Bladder	209	**1.52**	**0.98**	**2.36**	1.24	0.75	2.05
Kidney	98	1.12	0.59	2.15	1.41	0.64	3.09
Brain and other parts of CNS	214	1.08	0.69	1.67	1.03	0.60	1.76
Lymphatic and hematopoietic tissue	427	1.21	0.89	1.64	1.13	0.78	1.62
Cardiovascular diseases	7695	0.88	0.82	0.94	0.91	0.83	1.00
Cardiac diseases	5417	0.95	0.87	1.03	0.97	0.87	1.08
Acute coronary events	530	1.24	0.94	1.63	**1.45**	**1.07**	**1.96**
Respiratory diseases	1590	**1.22**	**1.04**	**1.43**	1.08	0.87	1.34

*Hazard Ratio (HR) stratified by follow-up period (three classes) and gender and adjusted for age (time axis), SEP, region of birth, occupation.

Conclusion

Exposure to SO_2 from power plants is associated with *increased bladder and pancreatic cancer mortality risk* in the cohort of people living in Brindisi

Final Plenary Conference - ICSHNet COST Action – Rome, 21-22 February 2019

The contaminated petrochemical site of Gela (Sicily, Italy): mortality temporal trends and cancer incidence profiles.

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Introduction

In 2000, a vast area in Gela (Sicily) was defined as a national priority contaminated site due pollution from a petrochemical complex active since 1960. The aim of this study is to assess the influence of the petrochemical complex on the health profiles of residents in Gela.

Results

Mortality rates for men and women in Gela were decreasing over time, but they were always higher than the Sicilian ones (Fig. 1).

The trend of mortality due to malignant cancers was increasing for man in Gela, especially from 1980 to 1986, (JoinPoint regression estimated an Annual Percentage Change (APC) of 13.5) then, from 2000, started to decrease. The trend for women was increasing too but less than in men (Fig.2 and Table1). The estimates of Standardized Incident Ratios were higher than 1 for all the diseases analyzed and for both sexes, although credibility intervals contained the unit. The analysis of ranks highlighted that *a priori* diseases of interest had higher ranks than the control ones (Fig.3).

Table 1. Malignant cancer mortality, Joinpont regressions, 1980-2014

	Years	APC	CI (95%)
Men, Gela	1980-1986	13,5 ***	(3,4 – 24,7)
Women, Gela	1980-2005	0,9 *	(0,1 – 1,7)
Men, Sicily	1980-1990	1,8 ***	(1,3 – 2,2)
Women, Sicily	1980-1990	1,0 ***	(0,4 – 1,6)

Methods

Evaluations was carried out at municipal level. A trend analysis was carried out for mortality due to all diseases and to all malignant cancers, in the period 1980-2014, using directly standardized mortality rates and JoinPoint regression models. In addition, for some malignant cancers, Standardized Incidence Ratios (SIR) were computed using a hierarchical bayesian model that allows to estimate posterior ranks of diseases. We considered on one side some neoplasms as diseases of *a priori* interest (lung, stomach and colon) because associable to the main pollutants found in the area; on the other side some control neoplasms (pancreas and larynx) since they have the same main risk factors associated to life style (smoke and alcohol consumption) but are not associated to the environmental risks.

Figure 1. Comparison of mortality for all diseases between Gela and Sicily, 1980-2014

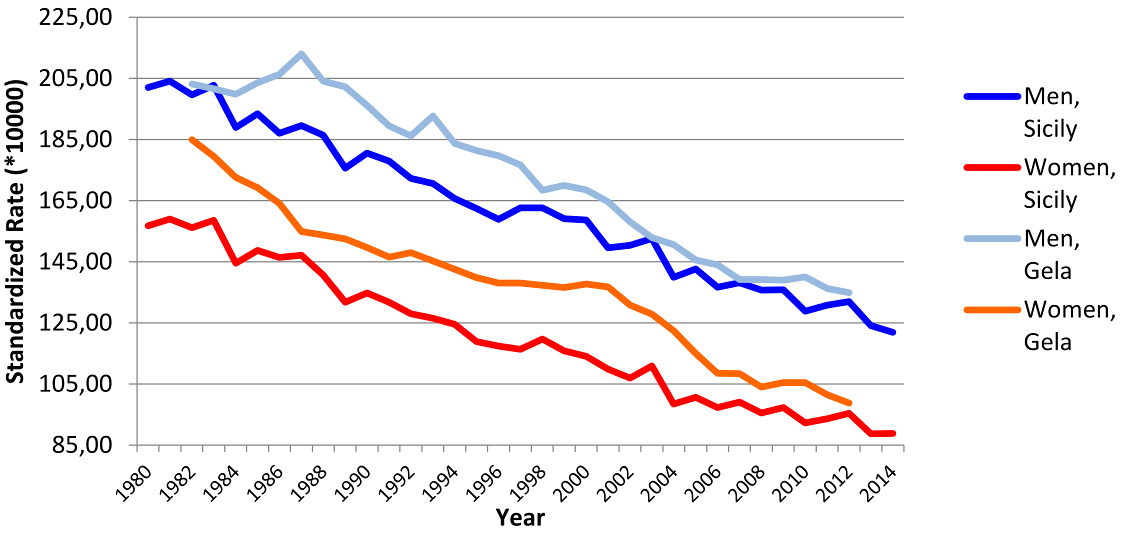


Figure 2. Comparison of mortality for all cancers between Gela and Sicily, 1980-2014

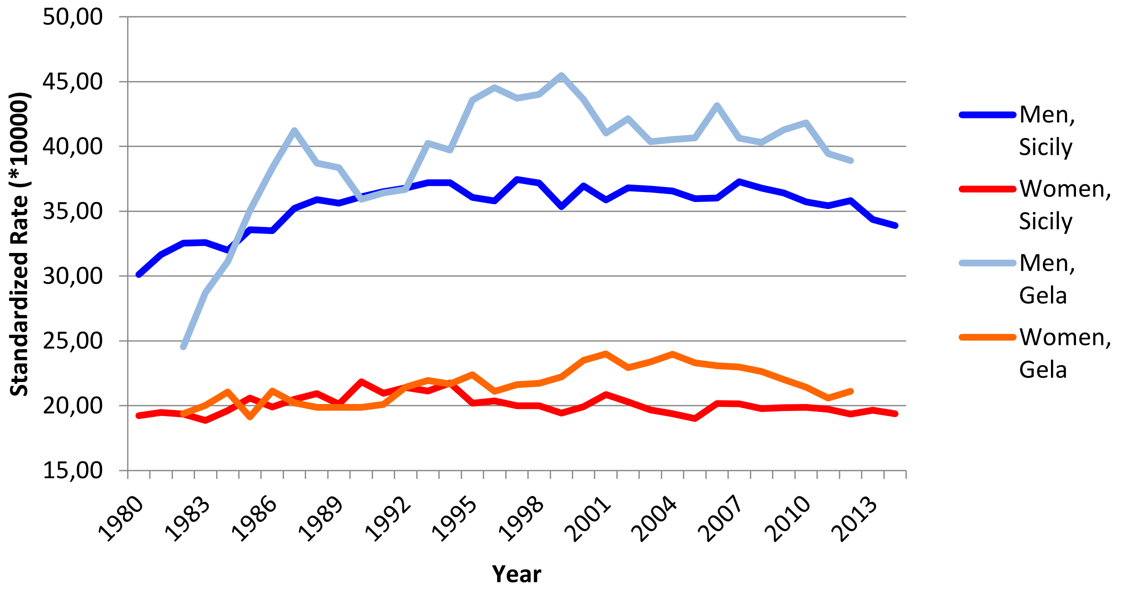
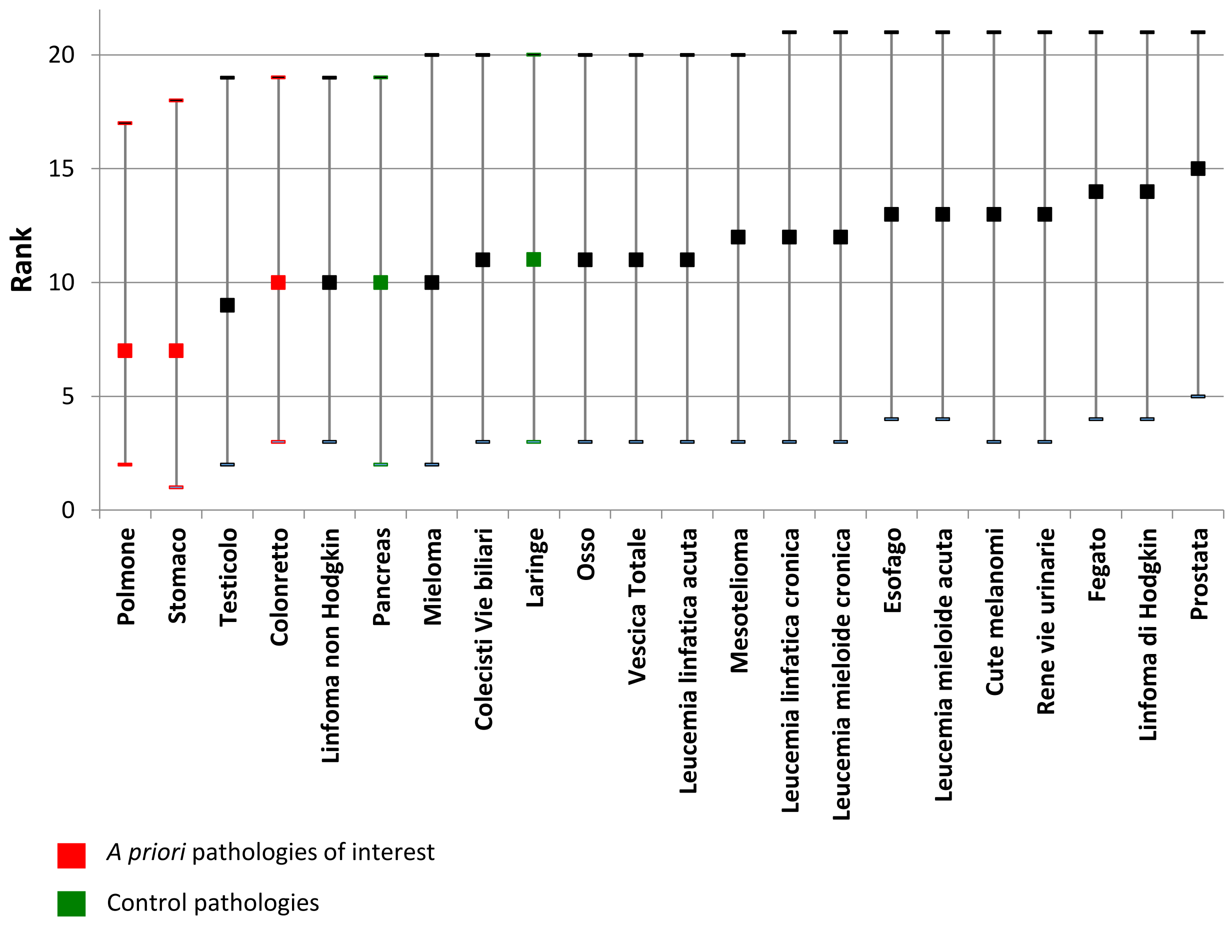


Figure 3. Ranking of ranks of SIR, men in Gela, 2007-2012, credibility interval level: 80%.



Conclusions

Results highlight that the health profile of residents in Gela is worse than the one of the reference population. Moreover, all cancers are in excess and have a trend consistent with a cumulative impact due to petrochemical contamination. The analysis of incidence ratios ranks suggests an higher risk for diseases associable to the main pollutants in the contaminated area.

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The case study of Panasqueira mine (Central Portugal): ecosystems and human health

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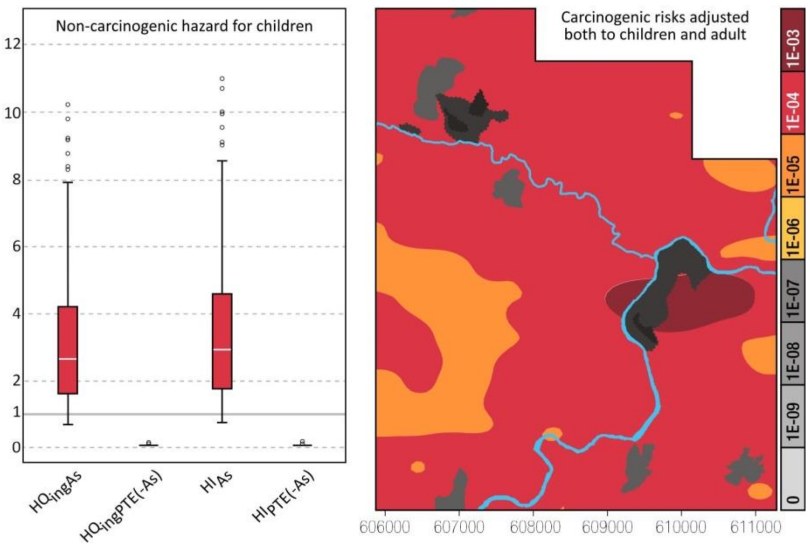
Introduction

Mining despite being vital for the economy is one of the most dangerous industries, both in terms of environmental and occupational health. This activity has problems associated not only by short term damage but also by long term impacts on the environment and human health by direct or indirect exposure through soils, food chain, dusts and superficial and/or ground waters.

This study developed on the context of Medical Geology employs the source-pathway-receptor approach and aims to assess human health problems emerging from the contamination of soils, sediments, waters, dusts and plants on the vicinity of mining areas.

Results and Discussion

Soils: 122 topsoil samples were collected for superficial contamination characterization. Contamination Factor classified 92.6% of the soil samples with a moderate to ultra-high degree of pollution. Potential Ecological Risk Factor also considered the soil samples with very high risk. Figure presents Risk Index.



Outdoor dusts and Plants: Four villages were selected: S. Francisco de Assis (SFA), and Barroca (Bar), both directly impacted by the mine; Unhais-o-Velho (UV) and Casegas (Cas), located in non-impacted area. Outdoor dusts (Table 1) and plants (Table 2) were collected in private houses.

Daily intake and health risk index of heavy metals by consumption of these plants indicate that the inhabitants of the four villages are exposed to some potential health risks, mainly, through the intake of As.

Table 1. Mean, minimum and maximum concentrations in outdoor dusts (mg kg^{-1}).

	As		Cd		Cr		Cu		Pb		Zn	
	mean	range	mean	range	mean	range	mean	range	mean	range	mean	range
SFA	827	62-3565	5.5	0.3-19	20	9-30	346	52-766	45	14-128	462	110-1262
Bar	174	35-519	1.0	0.2-2.3	14	8-21	135	33-243	17	10-23	157	101-267
Cas	513	12-2288	2.5	0.1-10	17	9-31	269	27-879	46	12-153	320	73-707
UV	614	29-1777	4.8	0.2-15	13	9-20	590	62-2379	15	6-25	448	45-1028
RVR	2-20		0.1-1		10-50		5-20		0.1-20		10-50	
ARV	20		3		100		50		100		300	
MAV	na		3		100		100		100		300	

RVR - Reference Value Range; ARV - Acceptable Risk Value; MAV - Maximum Acceptable Values (Sezgin et al. 2003).

Table 2. Mean, minimum and maximum concentrations in edible parts of the plants (mg kg^{-1}).

	As		Cd		Cr		Cu		Pb		Zn	
	mean	range	mean	range	mean	range	mean	range	mean	range	mean	range
SFA_C	1.4	0.2-2.9	0.2	0.1-0.4	2.4	1.6-3.7	5.1	3.7-7.7	0.4	0.1-1.5	64	25-115
Bar_C	0.4	0.3-0.6	0.4	0.1-0.8	1.2	1.0-1.4	18	3.4-51	0.7	0.2-2.0	53	24-102
Cas_C	0.2	0.1-0.4	0.1	0.02-0.1	1.2	0.8-1.5	7.4	2.3-41	0.4	0.1-1.6	41	16-108
UV_C	0.2	0.01-0.4	0.2	0.001-0.7	1.2	0.9-1.5	3.4	1.2-4.7	0.2	0.03-0.5	60	13-111
SFA_P	0.8	0.2-1.4	0.1	0.04-0.13	1.8	1.4-2.5	8.9	7.8-9.9	0.5	0.1-1.5	23	17-30
Bar_P	0.1	0.002-0.2	0.1	0.03-0.3	1.1	0.9-1.3	6.9	4.0-10	0.001	0.001-0.001	21	14-33
Cas_P	0.2	0.1-0.2	0.1	0.03-0.13	0.9	0.8-0.9	6.9	6.8-6.9	0.001	0.001-0.002	25	23-26
UV_P	0.01	na	0.1	na	0.9	na	5.6	na	0.001	na	26	na
Bar_L	0.6	0.6-0.7	1.3	0.6-2.3	1.8	1.1-2.4	38	6.9-92	1.4	0.2-3.6	92	48-145
UV_L	0.4	0.2-0.6	0.2	0.2-0.4	1.3	1.1-1.7	14	6-26	0.5	0.3-0.7	43	20-54
Guid	0.1^a		0.1^a		2.3^b		30^a		0.3^a		40^a	

C - Cabbage leaves; P - Potato tubers; L - Lettuce Leaves; Guid - guidelines; (a) FAO/WHO, 2001; (b) DHFCD, 2003; na - not applicable.

Study area

The active Panasqueira mine, exploited since 1888, is located in Central Portugal being considered to have the largest Sn-W deposit of the Western Europe having significant amounts of wolframite [$(Fe,Mn)WO_4$], arsenopyrite [FeSbS], chalcopyrite [$CuFeS_2$] and cassiterite [SnO_2]. The long history of exploitation result in large tailings (Rio 1.2 Mm^3 - arsenic (As) 12 000 mg kg^{-1} and Barroca Grande 7.0 Mm^3 - As 7 142 mg kg^{-1}) and mud dams (Rio 0.7 Mm^3 - As 73 649 mg kg^{-1} and Barroca Grande 1.2 Mm^3 - As 44 252 mg kg^{-1}) exposed to atmospheric conditions. On the top of Rio tailing an arsenopyrite stockpile (9400 m^3 - As 210 000 mg kg^{-1}) is deposited. The villages around the exploration site have historical dependence on soil, water (drinking and irrigation), vegetation, cattle rearing, fishing and forestry.

Biological study: A biological survey was conducted: 121 individuals (40 male workers from the Panasqueira mine - group occupationally exposed; 41 individuals from SFA and Barroca villages, in the vicinity of the mine - group environmentally exposed; 40 individuals without environmental and/or occupational exposition living in areas - group non-exposed). Results from the quantification of metal(loid)s in the biological matrices showed significant differences between the study groups for most of the elements (As, Cr, Mn and Pb). Table 3 present only significant results.

Results revealed that exposed populations, specifically the environmentally exposed group, are experiencing genotoxic effects (higher frequencies on the Micronuclei (MN) test and Chromosomal Aberration (CA) assay) leading to an increased risk of developing several diseases. The study indicate that this is directly related to the metal(loid) contamination (mainly As, Mn and Pb) derived from Panasqueira mine activities.

Table 3. Effect of exposure on concentration of metals.

		Controls		Environmentally Exposed		Occupationally Exposed	
		mean ratio	[95%CI]	mean ratio	[95%CI]	mean ratio	[95%CI]
As_B (uμg L^{-1})	overall	1.00		1.38	[1.03;1.86]*	1.15	[0.84;1.58]
As_{FN} (μg g^{-1})	overall	1.00		5.65	[1.8;17.76]**	9.20	[3.09;27.36]**
As_{TN} (μg g^{-1})	overall	1.00		3.42	[1.37;8.52]**	4.39	[1.78;10.80]**
Cr_{TN} (μg g^{-1})	males	1.00		1.34	[0.62;2.92]	1.09	[0.55;2.19]
	females	1.64	[0.77;3.47]	2.85	[1.39;5.85]** §		
Mn_U (μg g^{-1} creat)	overall	1.00		1.86	[1.20;2.90]	0.92	[0.56;1.52]
Mn_{TN} (μg g^{-1})	males	1.00		1.25	[0.56;2.78]	1.41	[0.73;2.70]
	females	1.49	[0.67;3.28]	4.07	[1.93;8.59]** §§		
Mn_H (μg g^{-1})	overall	1.00		1.12	[0.65;1.92]	1.88	[1.17;3.03]**
Pb_H (μg g^{-1})	overall	1.00		1.27	[0.73;2.21]	2.17	[1.27;3.71]**

comparison versus reference level (control group or males control group): *$p<0.05$; **$p<0.01$; comparison versus females control group: § $p<0.05$; §§ $p<0.01$; creat: creatinine.

Conclusions

Overall, results emphasize the need to implement preventive measures, remediation and rehabilitation plans by competent authorities to act in this area and the application of strategies aimed to protect exposed populations and ecosystems.

Acknowledgments

This monitoring effort was carried out with the support of the Portuguese Foundation for Science and Technology (FCT) under the grants SFRH/BD/63349/2009 and SFRH/BD/47781/2008, project PTDC/SAU-ESA/102367/2008 and unit UID/GEO/04035/2013. Biological studies were carried out in INSA - National Health Institute Dr. Ricardo Jorge. Geochemical characterization was carried out in the University of Aveiro (UA) and LNEG - National Laboratory of Energy and Geology.

Trend and Geographical Distribution of Human Health Risk Assessment Studies at Industrially Contaminated Sites

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Background: Industrially contaminated sites (ICSs) are a serious problem worldwide. Health risk assessment –methods are used to characterize and quantify the health impacts on nearby populations and to guide public health interventions. In a recent systematic review we identified 92 peer reviewed original studies.

Objective: The main aim is to analyse the geographical and temporal distributions of the identified studies, grouped into four methodological categories.

Methods: The original studies were identified from PubMed and Web of Science from papers published between January 1989 and December 2017. We divided risk assessment methods used in the papers into four groups: 1. semi quantitative (hazard quotient (HQ) and index (HI)), 2. quantitative (life time cancer risk), 3. health impact (incidence) and 4. health burden (years of life lost, YLL).

Results: Geographically leading continents are Asia (methods 1-2) and Europe (in addition, methods 3-4) (**Fig.1a**). Most studies addressed soil contamination (**Fig.1b**). Number of hazard quotient and cancer risk studies has been growing steadily (**Fig.2**) while the number of incidence-based studies (method 3) has been more constant. Trend of publications increases rapidly since 2014 (**Fig. 3**).

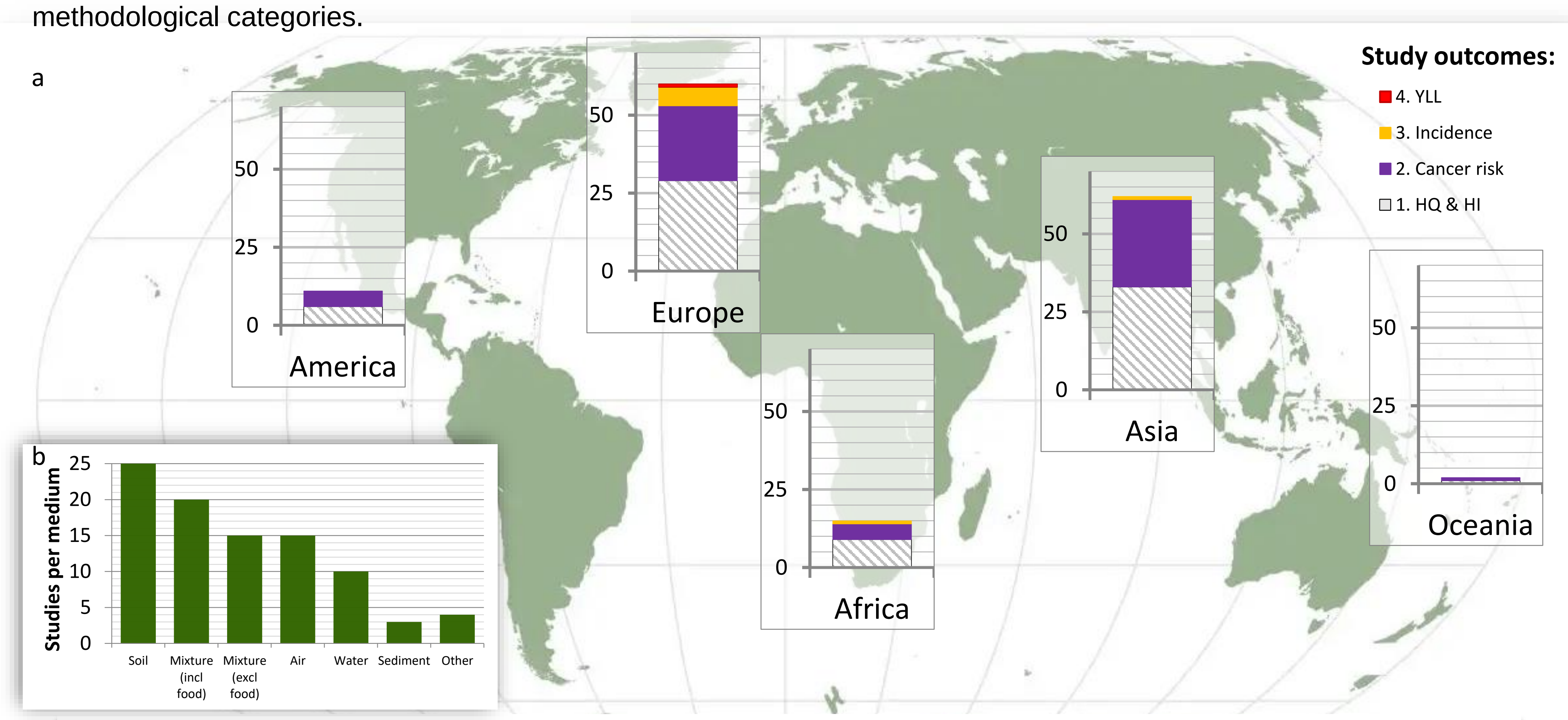

Fig 1. Geographical distribution of the human health risk assessment studies (a) and coverage of environmental media (b) identified in a systematic review from 1987 to 2017 [1]. (see Methods-section for the definition of groups 1-4)

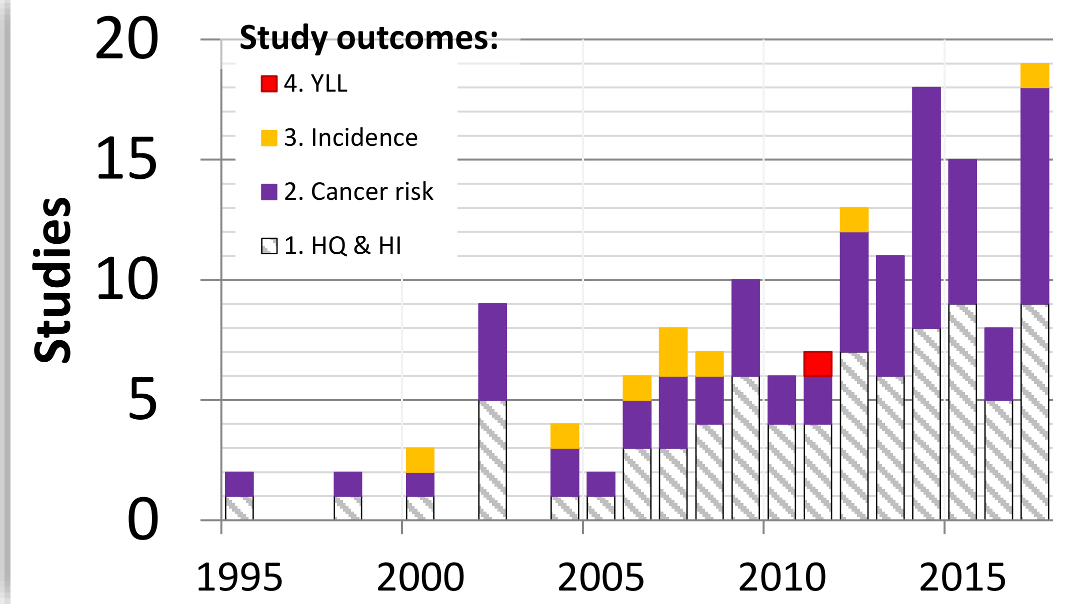

Fig 2. Temporal distribution study years, by the human health risk assessment study method 1-4, from 1987 to 2017.

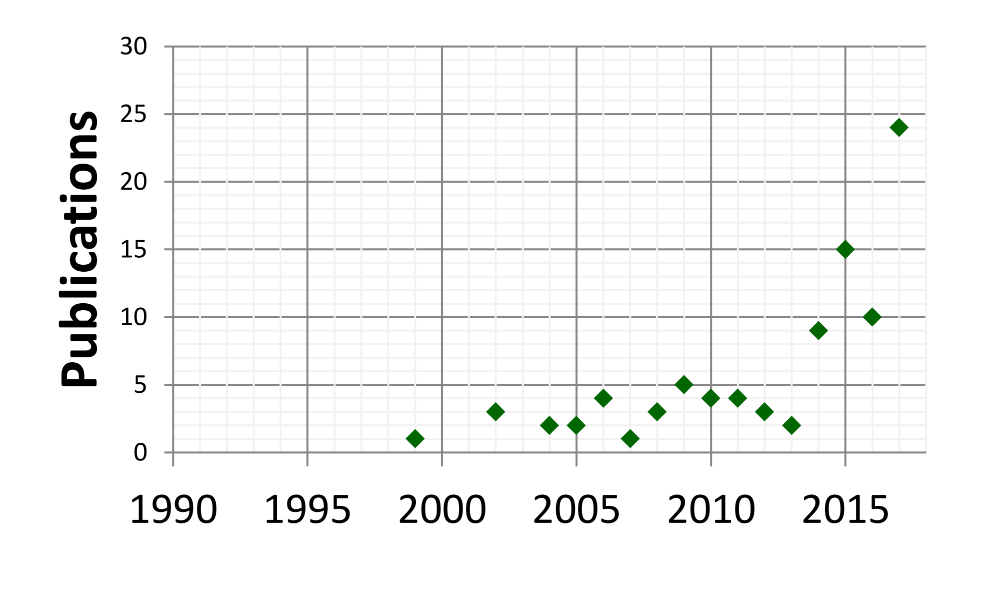

Fig 3. Temporal distribution publication years on human health risk assessments at industrially contaminated sites.

Acknowledgements

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Approaches to Environmental Health Risk Characterization

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Background: Industrially contaminated sites (ICSs) pose serious problems worldwide. Health risk assessment methods are used to characterize the risks on nearby populations and to guide public health interventions.

Objectives: The aim of this work is to present an overview of approaches available to (i) characterize health risks and (ii) quantify health impacts.

Methods: Using the US NAS (1983) risk assessment paradigm (**Fig. 1**) and original studies identified in a systematic review **[1]** we divided risk assessment methods used in the papers into four groups: (i) semi quantitative, (ii) quantitative probability, (iii) health impact and (iv) burden. Mathematically these methods require

(1) Risk characteristic = *f*(exposure, toxicity)
(2) Health impact = *f*(exposure, toxicity, population info)

Toxicity (exposure-response, dose-response) in each case needs to represent the used exposure indicator (**Fig.2**)

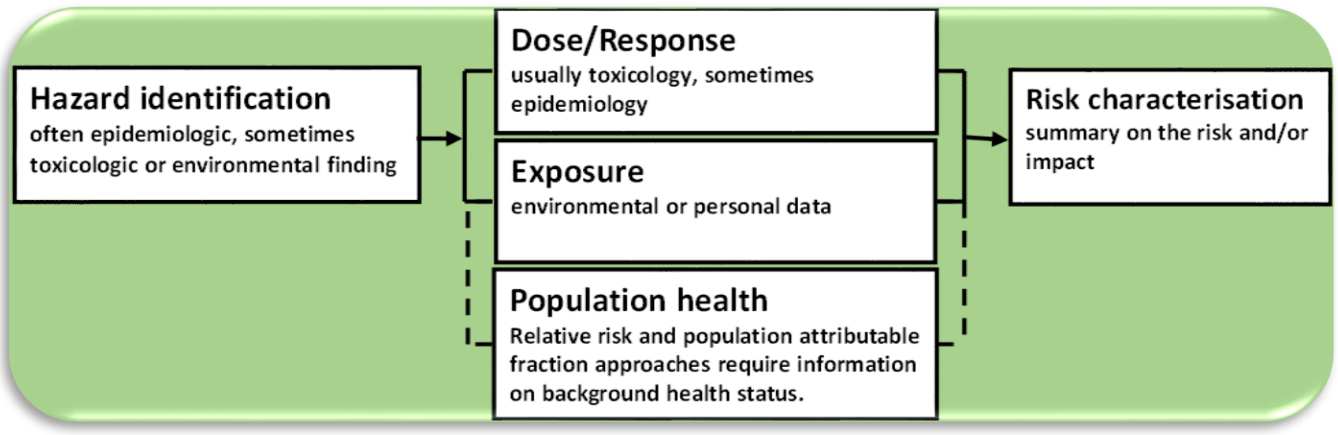

Fig. 1. National Acacemy of Sciences (1983) risk assessment paradigm, supplemented with additional health data.

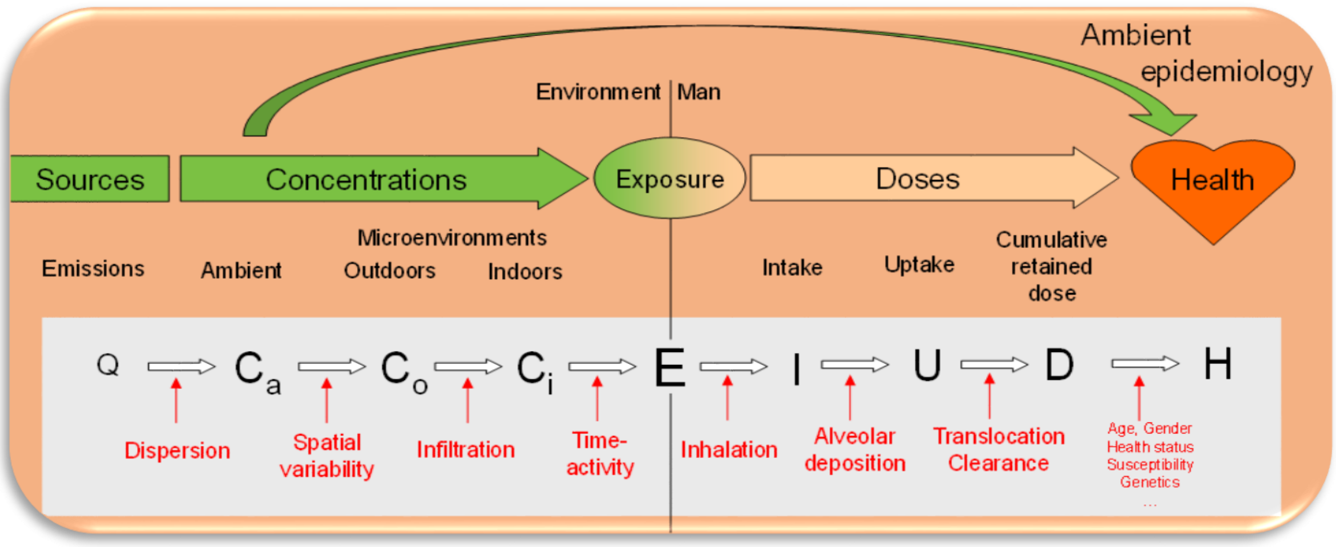

Fig. 2. Exposure indicators used in risk assessment, using air pollution as example (based on **[2]**).

Results: Various approaches found in the reviews **[1,3]**, and supplemented by those seen in related literature to characterize human health risks, are represented with hypothetical examples in **Fig 3**.

Risks can be characterize semi-quantitatively (hazard quotient and h. index); as probabilities (life time cancer risk; relative risk; excess risk; population attributable fraction); and as public health impact (number of cases, DALYs) .

All alternative ways for risk characterization provide different valuable views to the human health risks related to exposures to environmental pollutants. Depending on the data needs and the phase of the decision making process alternative approaches can be utilized.

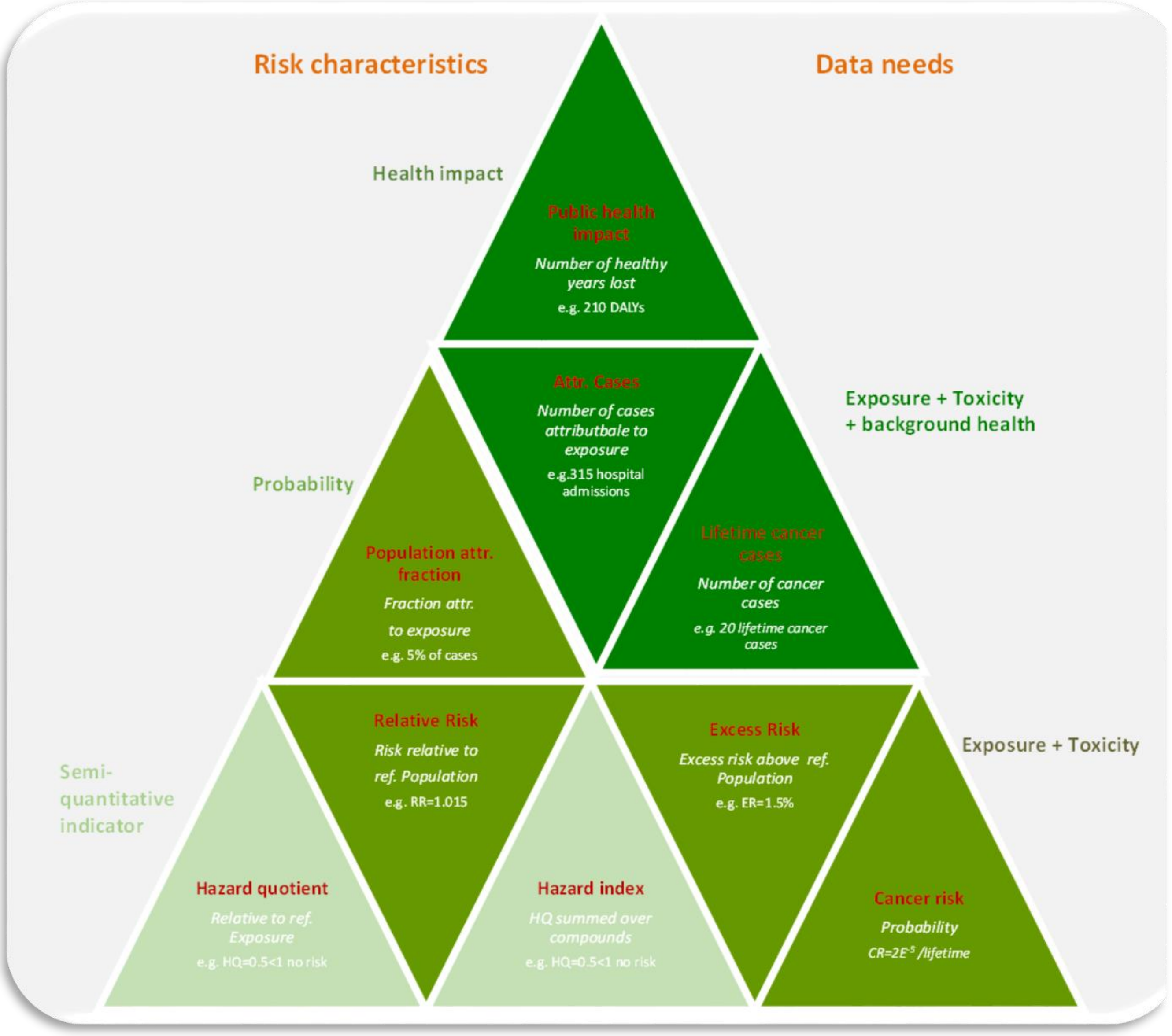

Fig. 3. Pyramid of approaches used to characterize human health risks in HRA and HIA studies.

Acknowledgements

This work was supported by National Social Science Foundation of China (grant number 17BXW104), the COST Action IS1408 grants for short term scientific missions, the Juho Vainio Foundation (201710136), personal grant for IKR from the Finnish Cultural Foundation North Savo Regional Fund (grant number 65161550), EU LIFE Index-Air project (LIFE15 ENV/PT/000674), and intramural funding by the participating institutes.

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THE PSYCHOLOGICAL IMPACT OF LIVING IN CONTAMINATED SITES (CSs): A SYSTEMATIC REVIEW

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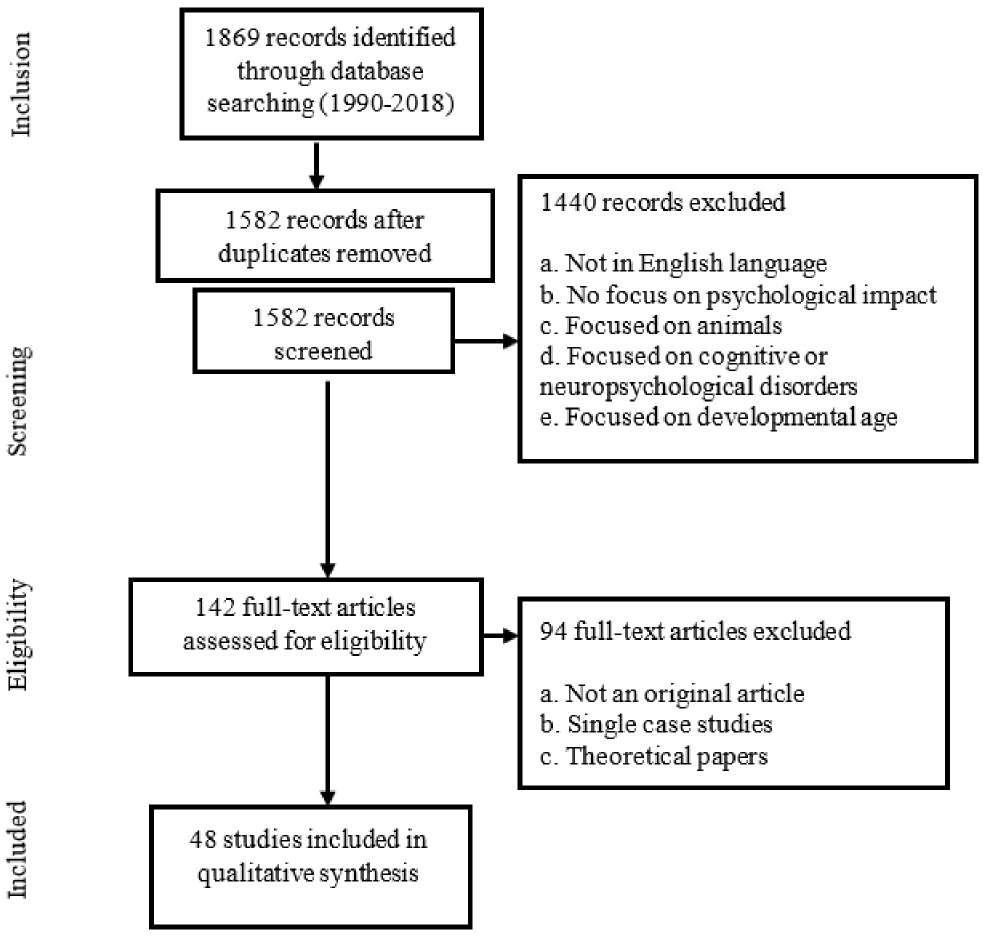
Introduction

According to World Health Organization (WHO), «health» is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity [1]. All over the European Union the health of thousands of citizens is threatened by industrial facilities, which play a pivotal role in the environmental contamination with several consequences on human lives [2]. Thus, resident populations living in Contaminated Sites (CSs) could be considered a specific group exposed not only to a major risk for physical health, but also more vulnerable to mental diseases.
However, despite the concern of scholars, clinicians and policy makers, the psychological and social impact derived from living in these sites seem to be poorly considered compared to physical health consequences. For this very reason we decided to review the literature regarding the psychological and relational impact of living in CSs.

Methods

A systematic literature review was performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines [3]. In order to identify relevant studies we employed a combination of the following keywords: («contaminated site» OR «contaminated area» OR «contaminated soil» OR «contaminated water» OR «polluted site» OR «polluted area» OR «polluted soil» OR «polluted water» OR «environmental contamination» OR «environmental pollution» OR «technological disaster») AND («psychological impact» OR «psychic disorder» OR «mental disorder» OR «psychological effect» OR «distress» OR «psychopathology» OR anxiety OR depression OR anger OR aggress* OR suicid* OR «fear of death» OR dysthymia OR «adjustment disorder» OR ptsd OR «relationship deterioration» OR «bad relationship» OR «disthymic» OR «disphoric»). Studies were identified by searching the following databases: ProQuest, PsycInfo, PubMed, Scopus and Sage Journals. Peer-reviewed original articles published in English language within the given time interval (01/01/1990-23/11/2018) were included. Suitable articles were evaluated by 3 independent judges. Overall, 48 articles were included in the review (Fig. 1).

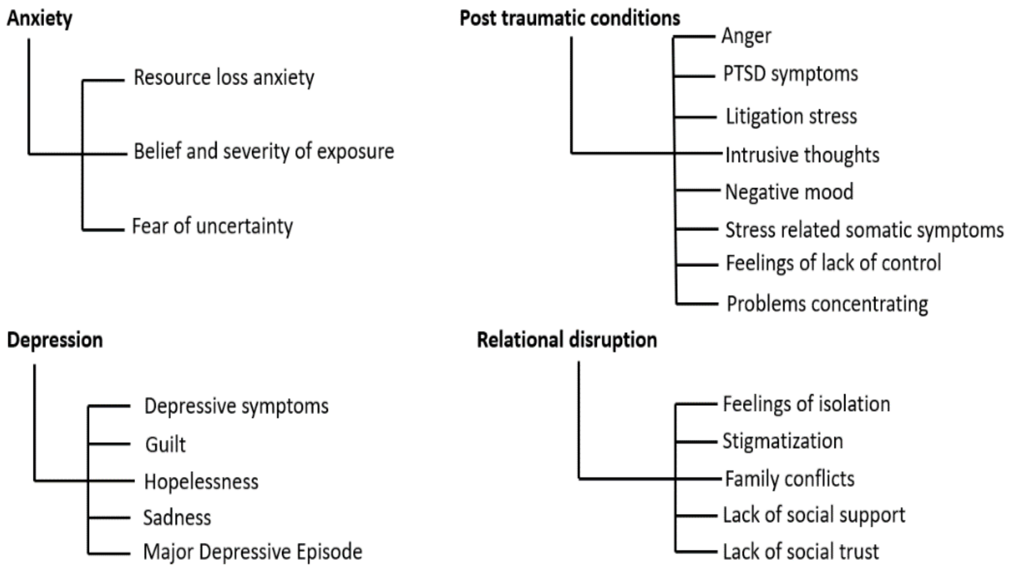
Figure 1. Literature review process



Results

Articles were classified into 4 categories according to their focus: anxiety, post traumatic conditions, depression and relational disruption. For every domain subfacets were identified (Fig.2).

Figure 2. Domains and subfactets identified in the study



Discussion

Findings suggest that environment contamination negatively impact on mental health. CSs residents seem to suffer from a broad spectrum of emotional disturbances. Mainly the severity of the exposure to contamination, the perception of the risk, along with the loss of economical and interpersonal resources, play a pivotal role in the rise of anxiety, depression and post traumatic stress-related disorders. Depression and anxiety are strongly associated with physical health, increasing the risk of incurring in diseases and chronic physical conditions [4]. Negative emotional aspects are also a trigger for social and relational life. Some people living in CSs could be dismissive of them, leading to a vicious circle of aggressiveness and social withdrawal which compromise family and relational ties [5].

Conclusions

Physical and mental conditions are deeply embedded. For a comprehensive and in-depth understanding of the « CSs phenomena» it is important that every aspect of health is included when considering the impact of polluted areas on a community. Policy makers, clinicians and researchers have the moral imperative to recognise all the forms of suffering in CSs developing specific interventions to help communities which face a disaster that endangers life as a whole.

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Public health in Croatia - active emergency management stakeholder and risk communicator

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Introduction

Public health sector in the City of Zagreb, Croatia, represents one of the first line emergency respond representives. Identified brownfield locations, along with the non-declared and declared orphan sites, still represent significant burden for the sustainable governing and transparent risk communication in case of the disasters or accidents on the ICSs. Environmental monitoring of the ICS locations is implemented partially, although it is envisaged according to the National Legislative Framework of the Health Care Act.

Results

In the period 2014. to 2018 several accidents took place on the possible or confirmed ICS, orphan site locations in Zagreb, Croatia. Planning, on-site assessment and measurements of the possible contaminants in various environmental samples, according to the capacities, were conducted (Table 1.). Risk communication was based on the limited meteorological, environmental and health indicators.

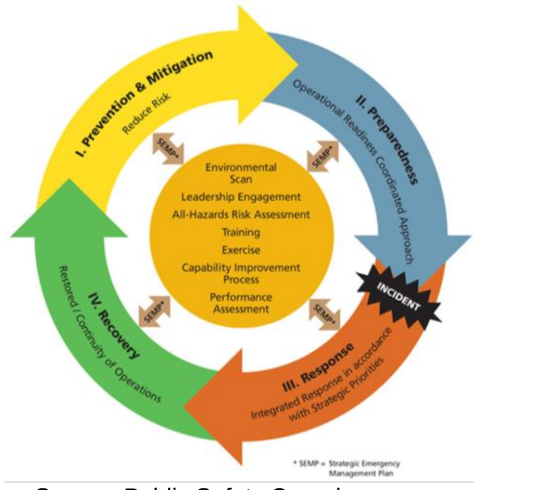
Table 1. ICS Case insight

Industry and accident type	Emergency measurements (samples, technique, chemical parameters)	Brownfield location (Zagreb brownfield atlas https://geoportal.zagreb.hr/Karta)	Orphan site	Risk commnunication, year, No (written, oral)
Paper industry, fire	Air, Dräger, CO, CO2; GC-MS, Total hydrocarbons, BTEX, xylene, aldehyde, trimethylbenzenes, BPA	No	Yes	2018 (20)
Metal scrap processing and waste management site, fire	Air, soil, vegetables, Dräger CMS, CO, CO_2; GC-MS, Total hydrocarbons, BTEX, xylene, aldehyde, trimethylbenzenes, BPA	No	No	2014 (26) 2017 (4) 2018 (2)
Meat industry, ammonium leakage	Air, Dräger CMS, CO, CO_2; ammonium	No	Yes	2014 (0)

Methods

Evaluation of the institutional LIMS system, the public relations data base and the institutional projects data base was reviewed. National and EU legislative framework and a literature search was conducted in PubMed following a structured approach to identify aspects relevant to the comprehensive emergency management of the ICSs.

Figure 1. Emergency management Continuum



Source: Public Safety Canada

Figure 2. Water Q project infographic – crowdsourcing for water safety

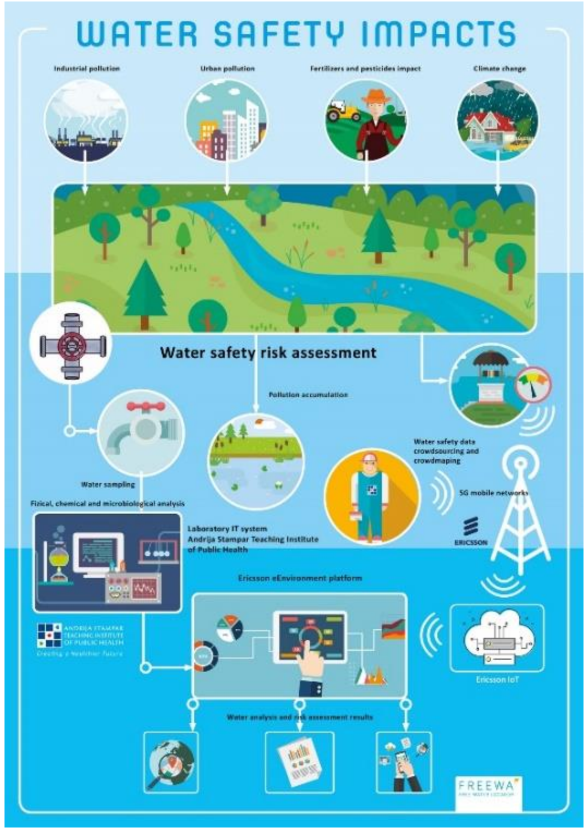
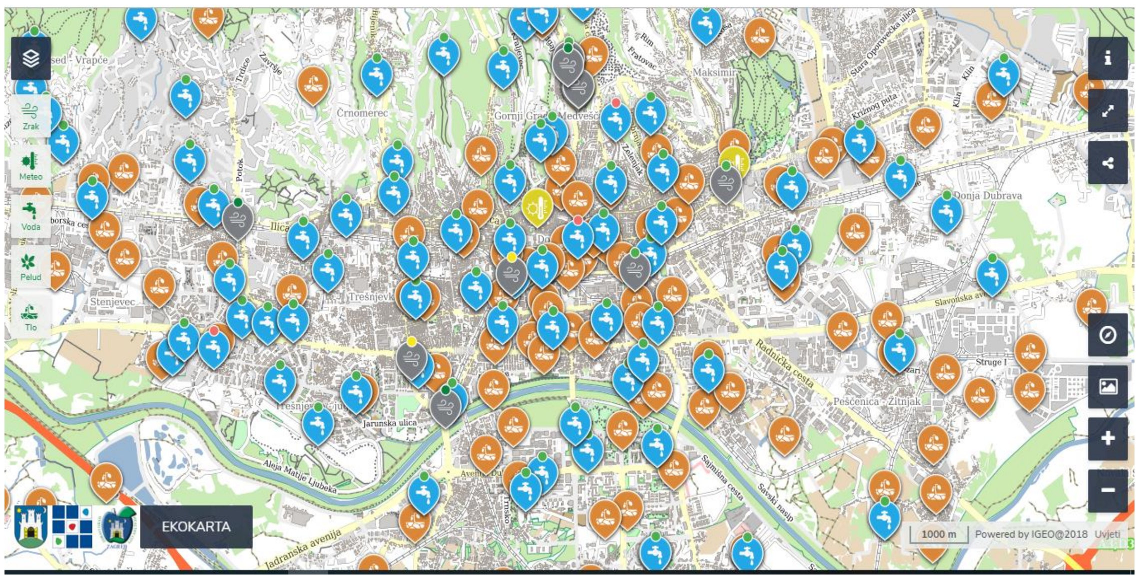


Figure 3. Zagreb eco card web GIS application (https://ekokartazagreb.stampar.hr/; https://youtu.be/siyL2abcyiY)



Discussion

First line respond is key step in case of the disaster or accident on ICS. But, emergency sanation only, the without available previous site burden information, significantly reduces the likelihood of proper exposure and risk assessment, and the recommendation of appropriate corrective and preventive measures (3.). According to the disaster management cycle, all those elements are integrative and continuous processes of the effective emergency management (Figure 1). New tools provide better visualisation of the multiple measurements, allow better understanding of the „big data" in spatio-temporal mode, promote use of environmental monitoring results in the exposure assessment process and allow development of the various softwares for the for assessing the correlation between environmental and health indicators.

Conclusions

Pilot project - Zagreb city Ecological Map, established in 2018, represents useful GIS based tool for further development of the association between environmental and health data (Figure 3). It represents the basic ground for the for the collection and dissemination of information regarding the urban „hotspots" (4). Since challenges for the healthy urban living are continuously emerging, public health and response systems will have to upgrade further the use of technology and evaluate the benefits of citizen participation or other sources, like crowdsourcing data bases (Figure 2., 5). This increase of the formal and informal education in the public's understanding of complex environment and health issues is in line with the Declaration of the Sixth Ministerial Conference on Environment and Health (3). Although, IT tools represent significant help during the risk communication, other factors such as the nature and duration of accident, availability of the environmental monitoring results, media attention or legal and economic facts affect the risk communication outcome.

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Questionnaire for teachers on environmental education focused on environmental contamination

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Introduction

A wide range of chemicals can contaminate our water, air, and soil impacting the environment and people health (Pena-Fernandez et al. 2017). Most contaminants enter the environment from industrial and commercial facilities; oil and chemical spills; non-point sources such as roads, parking lots, storm drains and wastewater treatment plants and sewage systems. Many hazardous waste sites and industrial facilities have been contaminated for decades and continue to affect the environment.

One goal of environmental communication is to educate the public so it is better informed in problems regarding pollution, whether it comes from industry, agriculture or from homes (Varela-Losada et al. 2015). The communication strategy is important in implementation of information: "How communicate the contaminated environment"? Getting basal information and forming attitudes to the environment takes place as early as childhood. Therefore, it is important to include themes as the contamination of water, air and soil in the environmental education (EE) in schools. There is little known how the children in schools are educated about environmental contamination in local area.

The aim of our work was via questionnaire to find out the range and the way teachers educates their pupils about environmental issues. We studied if there is enough information about the state of the local environment at primary schools.

Methods

An evaluation of the transmission of information on environmental pollution was conducted through questioning (Deutskens et al. 2004, Hendl 2012). Questions were created and questionnaire was built according to ten rules (Table 1):

At first, a pre-questionnaire containing 25 questions (3 open and 22 closed ones) was put together in 2016. This questionnaire was divided into three sections: 'Pedagogical work', 'Contamination' and 'Personal'. There were questions focused on the basic education area of teacher in the section of 'Pedagogical work'. The 'Contamination' section was focused on the possibilities of using learning substance of contaminated environment. Air, water, soil, and other possible pollution (light, noise, radiation atc.) were understood as environmental constituents. The purpose of the 'Personal' section was to get personal data about the respondent.

The evaluation of respondents replies and comments was the ground for compiling the final version of the questionnaire. The final-questionnaire contains 40 questions (quenching questions for simplicity), 13 open and 27 closed ones, and it is prepared for on-line application.

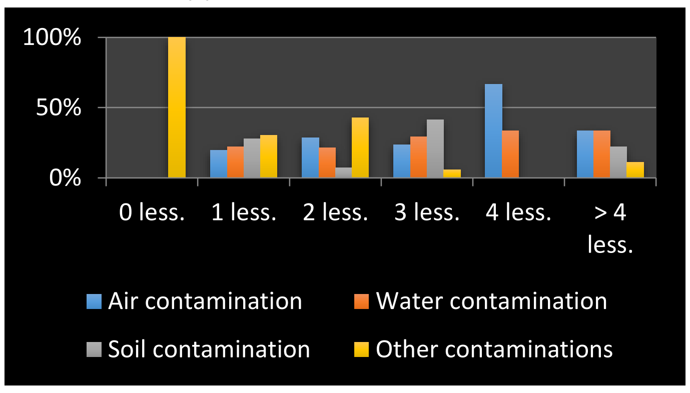

Figure 2. Answers to the question: "How many hours do you have the opportunity in one class to teach the following subjects per year?"

Results

The pre-questionnaire was used for a pre-test at 15 elementary schools (50 respondents) in the Klatovy region. The interview was conducted through a personal meeting, by phone and in writing form. Total return on the questionnaire was 40% (written form had the lowest return) (Papayova 2019). Some selected results are shown in Figures 1-5.

According to the pre-test it was found, that no differences exists among amounts of information given from teachers to pupils about contamination of soil, water and air. The results shows that environmental contamination should be discussed more at the schools and the teachers should pay more attention to this issue not only on natural science lessons (Papayova 2019).

Elementary schools in Slovakia were alerted to this questionnaire survey which was conducted through the on-line system (https://docs.google.com/forms) in the spring-summer of 2018. The data obtained is now processed and analyzed.

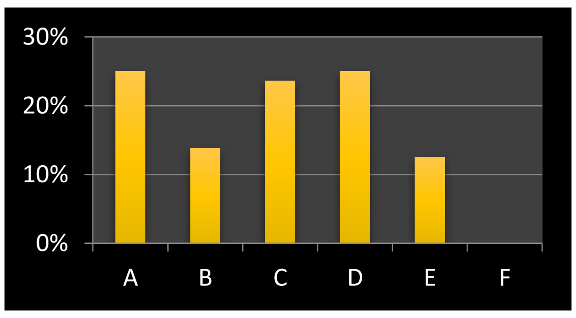

Figure 3. Answers to the question: "What do pupils learn about soil contamination during your lessons?"

A – which chemicals cause soil contamination
B – biological degradation of the soil
C – landfilling or discharges of industrial waste
D – the use of pesticides, herbicides, ...
E – radioactive soil contamination
F – other – what?

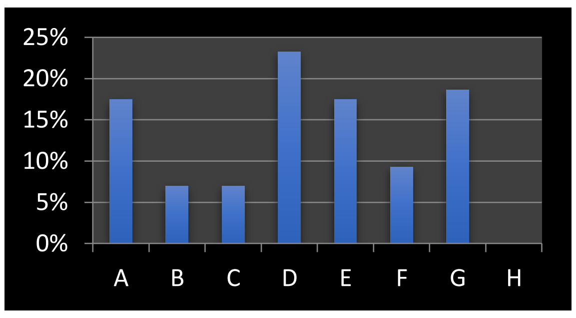

Figure 4. Answers to the question: "What pedagogical principles do you use to teach soil, water, and air pollution?"

A – environmentalism from the perspective of everyday life
B – the superiority of the positive over the negative
C – the development of critical synthetic thinking
D – respect for life and inanimate nature
E – focusing on the future of the individual and humanity
F – use of activating methods in teaching
G – personal approach of the educator
H – other – what?

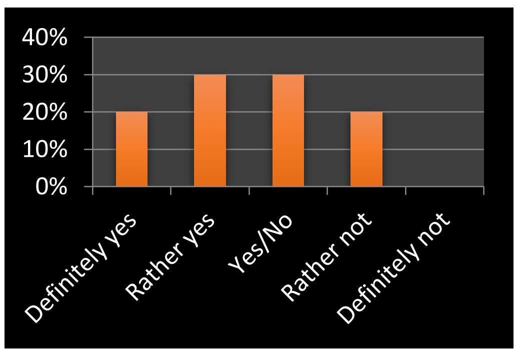

Figure 1. Answers to the question: "Do you have the possibility to include topics in your own lessons at your own discretion? "

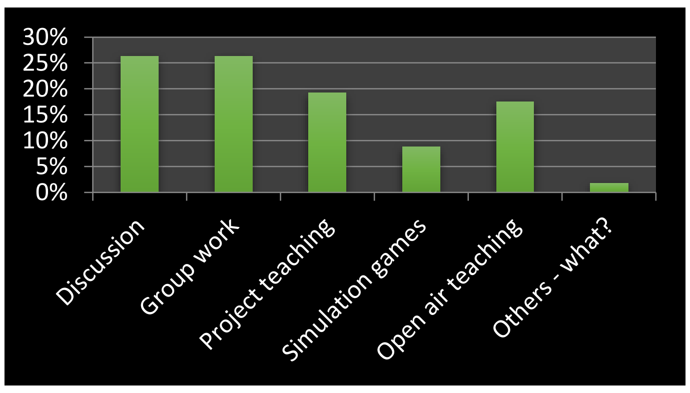

Figure 5. Answers to the question: "What didactic forms and methods you use for contamination soil, water, air?"

Discussion

Conclusions from our data are likely to reflect generalized patterns of EE in the schools. The realized questionnaire is very easy (but quite long) and it may be used in other countries of Europe to obtain a great deal of information and a comparison among the countries.

Conclusions

Results of final version of questionnaire will provide description of the EE focused on environmental contamination in elementary schools in Slovakia. The questionnaire is common useable in EE research.

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COMMUNICATION IN INDUSTRIALLY CONTAMINATED SITES - LINES OF ACTION FROM THE ITALIAN SENTIERI PROJECT

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Introduction

In the last decade, international and national organizations in the WHO European Region have proposed theoretical approaches and practices for adopting effective communication strategies in contaminated areas.

In this poster, we summarize and present the outcomes of two papers recently published in the *WHO Public Health Panorama* Journal (Marsili et al, 2017) and in *Epidemiologia & Prevenzione* Journal (Marsili et al, 2019-a) as a part of the activities carried out by the Project Communication group in the Italian SENTIERI Project (National epidemiological study of populations residing in contaminated sites).

The two papers rely on the bi-directional communication approach, which involves public health authorities and affected communities and represents a key lesson learnt from scientific international literature and tested in communication activities undertaken in contaminated areas in Italy and elsewhere in Europe.

Recommendations

In the paper by Marsili et at. (2017) "*Communication plans as prevention tools for informed policies*" we propose recommendations aimed at strengthening the decision-making chain for adopting effective communication plans in contaminated areas.

These recommendations concern the international, national and local frameworks, as follows:

INTERNATIONAL. Consolidate interactions among WHO and/or national organizations in the WHO European Region in order to collect and make available information on practices for communicating environmental risk and health impact in contaminated sites.

NATIONAL. Plan national initiatives to foster the adoption of communication plans in areas affected by major environmental contamination by sharing a communication plan prototype.

LOCAL. Promote the adoption of the communication plan prototype and its implementation, taking into account the specificity of the local context.

Key aspects for building a communication plan

Elaboration of a communication plan should consider the following aspects:

- Severity of the possible health impact related to environmental contamination;
- Attention to vulnerable groups living in the pollutes site;
- Identification of stakeholder categories and target audiences;
- Feasibility of the communication plan.

Lines of Action for communication

SENTIERI project has also proposed Lines of Action in for communication in contaminated sites of national interest for remediation in Italy (Marsili et al, 2019-a) with the goal to be shared and adopted by multi-disciplinary teams in local contexts involving health, environment and social sciences experts.
The proposed Lines of Action are summarized below.

- **CONSTRUCTON** of a communication process requires the existence of effective procedures adopted by national and local authorities capable of harmonizing different stakeholders viewpoints and socio-economic interests in order to facilitate informed decision making.
- **ACCESSIBILITY** to epidemiological data has to be ensured making them comprehensible to different stakeholders for creating trust towards the involved researchers and the health and environmental institutions. Trust means perceived competence, objectivity and coherence.
- **COMPLEXITY** of scientific contents has to be taken into account in selecting the information and in communicating scientific evidence and uncertainty in lay language to the people living in contaminated sites.
- **TRASPARENCY** is an unavoidable requisite of any communication process in order to recognize the authoritative role of scientific institutions involved in the study of contaminated sites and in epidemiological surveillance.
- **INTERSECTORIAL RELATIONSHIPS** among national and local institutional actors as well as among scientists and local environmental and health prevention operators in charge of undertaking the interventions have to be strengthened. An effective communication process constitutes the framework to build an affective network.
- **LOCAL MEDIA** have the essential function of mediators of scientific information since they contribute to information dissemination and to increase environmental health literacy. The relationships between involved scientists and local media have to be long-lasting and should not solely rely on occasional meetings.
- **LOCAL EDUCATIONAL SYSTEMS** in contaminated areas should include environmental health issues in annual educational programs and envisage students' engagement in related activities.
- **ASSESSMENT** of communication activities has the goal of verifying the appropriateness and effectiveness of communication in each contaminated area.

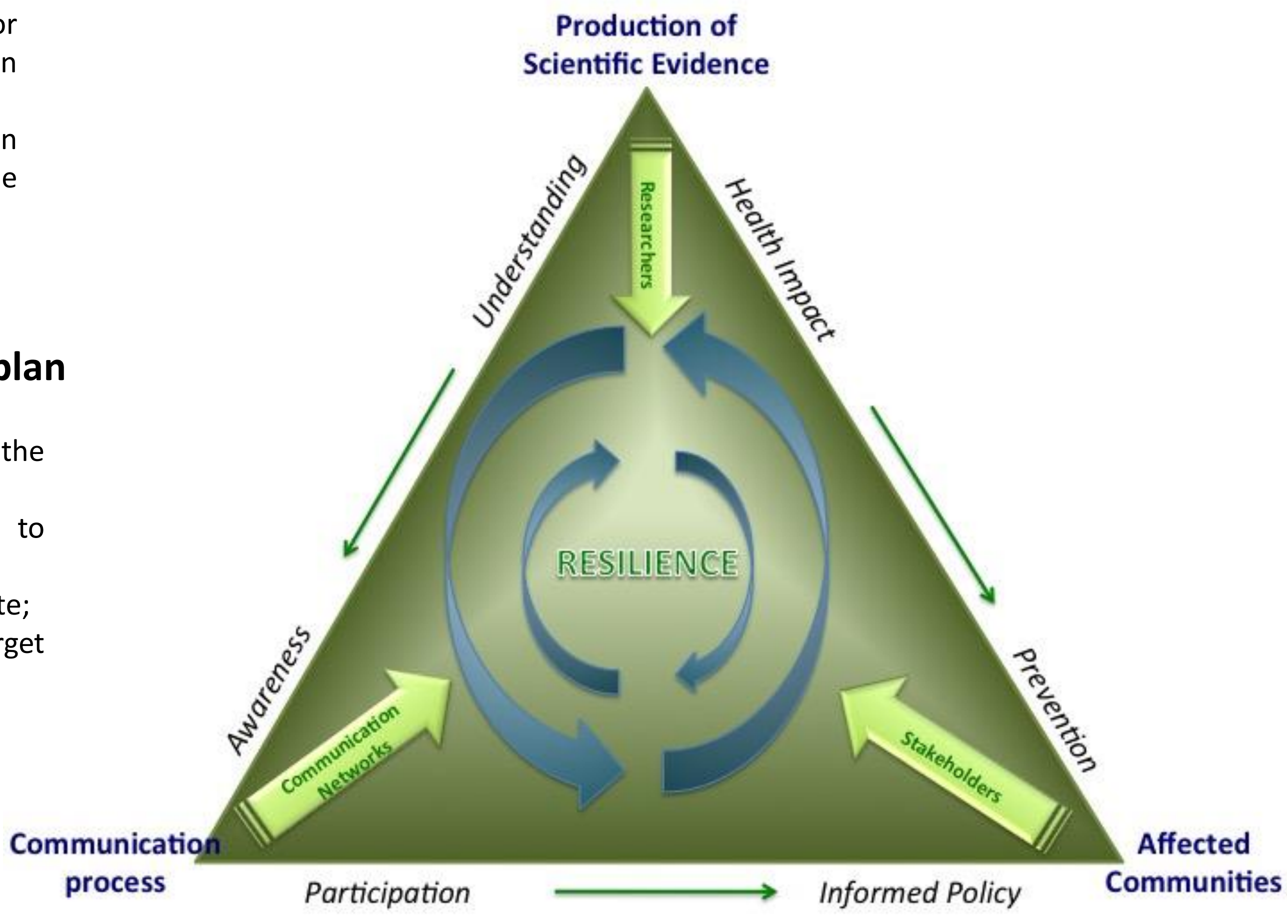

Figure 1. Role of communication process to strengthen resilience (Marsili et al, 2019-b)

Conclusions

Effective communication in contaminated areas can contribute to increase the resilience of the affected communities and to decrease its social vulnerability through the improvement of social capacity building. Sharing responsibilities for strengthening social capacity building requires the commitment of relevant stakeholders in the communication process.

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Active and meaningful youth participation in the policy decision making strikes again!

European Environment and Health Youth Coalition

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Why does industrially contaminated sites matter for young people?

Young people comprise a significant proportion of the European population (1, 2), and can therefore play an important, positive role in responding to present and future environmental contamination patterns, as well as providing societal support for health arrangements. Although commitments were made by all Member States of the World Health Organization (WHO) European Region in the Parma Declaration on Environment and Health in 2010 (3), only about a quarter have reported meaningful youth engagement (1).

In June 2017, fifty-three Member States of the WHO European Region assembled at the Sixth Ministerial Conference on Environment and Health in Ostrava, Czech Republic. The main outcome of the Conference was the adoption of the Ostrava Declaration (4) lead by the adoption of **Ostrava Youth Declaration** (5) (Box 1).

Box 1. Time to continue acting now – youth inputs in the policy decision making

Prior and during the Sixth Ministerial Conference on Environment and Health (2017) young people strongly proved that they are more cohesive than ever not just in going through the challenges, but in defying it with real action, in making a difference by presenting and adopting the Ostrava Youth Declaration which represents a direct input of more than 70 international youth delegates from across the European Region. Young people committed to act on environment and health by eliminating threats to human health in transition to circular economy and reducing waste and pollution in Europe.

Young people need special consideration, given their high sensitivity to environmental agents. Thus, policy-makers are faced with the ongoing challenge of making good decisions while remaining responsive to the young people affected by their decisions. Challenges associated with industrially contaminated sites in the environmental health policy arena are often technically complex and value-laden, with multiple affected groups and stakeholders operating in an atmosphere of mistrust. Another relevant issue is intergenerational justice because unsustainable waste management practices leave a toxic legacy that will adversely affect future generations (6).

Benefits of ensuring active youth participation

Young people can engage in research without any prior research skills training (including designing their own experiments, analysing data and reflecting on results) by applying their own scientific and political knowledge, which is meaningful within their own societal context (6).

The overarching objective should be to support youth-initiated, youth-directed and youth-controlled practices so that young people can become autonomous learners and think critically about their actions and decisions regarding scientific practice and policy. Most of these skills, values and attitudes (e.g. critical thinking, individual responsibility, ability to work as part of a team) are recognized as being important for citizens to acquire so that they can participate effectively not only in scientific research but also in their daily life activities (7).

What can policy makers do about it?

Expand meaningful youth participation in national and international decision-making and policy development processes related to the environment and health in all WHO European Member States (6).

Promote formal and non-formal education programmes on environmental health issues at every level of educational facility for raising awareness among children and young people in the WHO European Region (6).

Policy officers and decision-makers should not judge what young people have to say about research using the same scientific and policy standards and the same criteria used to determine the credibility and trustworthiness of professional researchers; relationships and interactions should be transparent and aimed at building trust (6).

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Association between odor pollution from industrial sources and human health: a systematic review.

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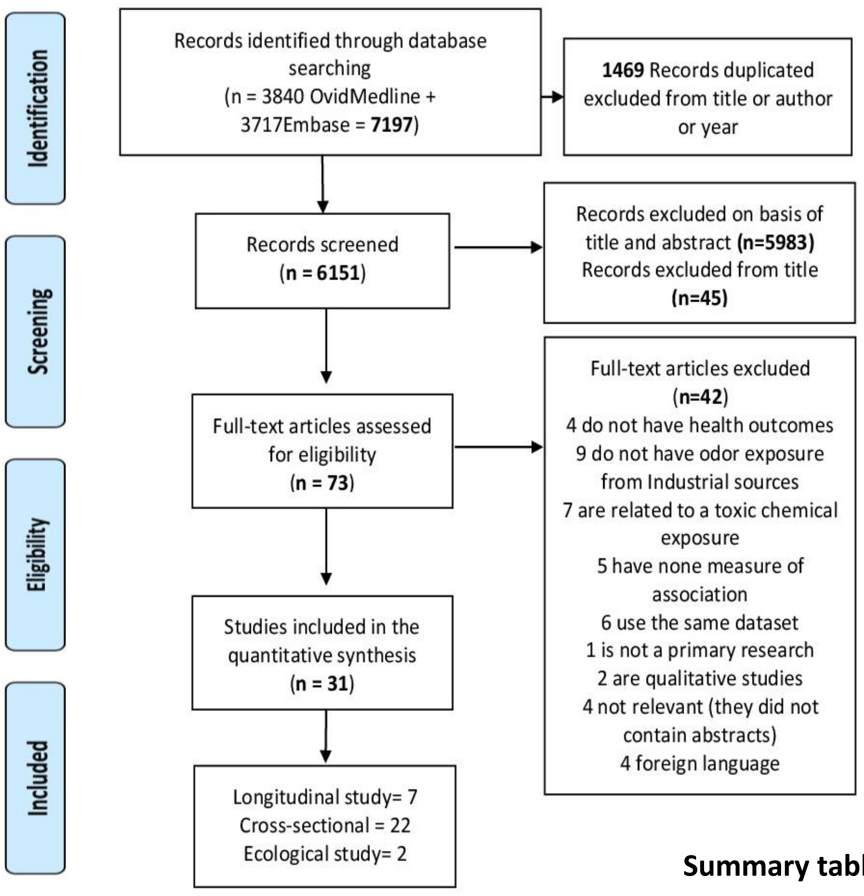
Preliminary results of a systematic review

Objective

To evaluate the association between residential or occupational short- and long–term exposure to odor pollution from industrial sources and the health status of the exposed population

Figure 1. Flow diagram for the selection of the studies



Methods

The protocol has been registered with PROSPERO 2018 (registration number: CRD42018117449). We developed a search strategy to identify studies on malodor from industrial sources and its impact on health. The search strategy included a combination of MESH terms and free text terms.

Population

We considered population (any age) living near industrial sources or workers exposed to odor pollution in their workplace.

Exposure

Studies would have been included if they had captured any measure of exposure (odor perception, proximity…) to an environmental odor from industrial sources.

Outcomes

We considered all health outcomes for which there was *a priori* association with the exposure, such as respiratory, cardiovascular or stress-related outcomes, sleep disorders, although novel outcomes were considered as well.

Identification and selection of studies

Search was not limited by date or study design. Only studies published in English, Italian, French or Spanish were included. We uploaded search results into a reference management software (EndNote, Clarivate Analytics).

Summary table of the studies included

Reference	Country	#	Industrial source	Exposure	Outcomes
Kret et al. 2018	USA	343	Waste sites	Distance	Respiratory diseases, physical and psicological symptoms
Tjalvin et al. 2017	Norway	486	Chemical Industry	Perception	Health perception
Boers et al. 2016	Netherlands	582	Animal feeding operations	**Measurement	Odor annoyance
Baldacci et al. 2015	Italy	1407	Waste sites	Perception	Respiratory and cardiovascular diseases, physical and psicological symptoms
Blanes-Vidal 2015	Denmark	454	Waste sites	**Measurement	Odor annoyance, physical and psicological symptoms
Hooiveld et al. 2015	Netherlands	753	Animal feeding operations	Perception	Physical and psicological symptoms and health perception
Tjalvin et al. 2015	Norway	284	Animal feeding operations	Distance	Subjective Health Complaints (SHC) score, physical and psicological symptom
Blanes-Vidal et al. 2014	Denmark	454	Animal feeding operations	**Measurement	Odor annoyance
Wing et al. 2014	USA	431	Sewage Sludge Animal feeding operations	Distance	Physical symptoms
Axelsson et al. 2013	Sweden	4201	Chemical Industry	Distance	Odor annoyance
Claeson et al. 2013	Sweden	722	Petroleum Industry	Distance	Physical symptoms
Wing, et al. 2013	USA	101	Animal feeding operations	Perception	John Henryism Active Coping (JHAC) scale ; systolic (SBP) and diastolic (DBP) values
Blanes-Vidal et al. 2012	Denmark	180	Animal feeding operations	**Measurement	Odor annoyance
Aatamila et al. 2011	Finland	1142	Waste sites	Distance	Physical symptoms
Heaney et al. 2011	USA	23	Waste sites	Perception	Physical and psicological Symptoms
Schinasi et al. 2011	USA	101	Animal feeding operations	Perception	Physical symptoms and lung function
Dzaman et al. 2009	Poland	108	Sewage sludge and wastes	Distance	Smell and taste perception
Herr et al. 2009	Germany	641	Waste sites	Perception	Physical symptoms
Horton et al. 2009	USA	101	Animal feeding operations	Perception	Psicological Symptoms
Sucker et al. 2008	Germany	1434	Industrial sites	Perception	odor annoyance and physical symptoms
Radon et al. 2007	Germany	5556	Animal feeding operations	Perception	Measures for early detection of respiratory diseases and physical symptoms
Avery et al. 2004	USA	15	Animal feeding operations	Perception	Measures for early detection of respiratory diseases
Radon et al. 2004	Germany	3112	Animal feeding operations	Perception	Physical SF-12 score; Emotional SF-12 score
Herr et al. 2003	Germany	797	Waste sites	Distance	Odor annoyance, physical and psicological symptoms
Segala et al. 2003	Canada	2867	Animal feeding operations	Distance/perception	Physical symptoms
Georgieff et al. 1999	Bulgaria	538	Paper industry	Perception	Physical and Psicological symptoms
Steinheider et al. 1998	Germany	322	Animal feeding operations	Distance/ perception	Physical and Psicological symptoms
Van Den Hazel et al. 1992	Netherlands	142	Paper industry	Perception/**measurement	Odor annoyance
Lipscomb et al. 1991	USA	127	Waste sites	Distance	Physical and Psicological symptoms
Shusterman et al. 1991	USA	1931	Waste sites	Perception	Physical symptoms
Deane, M. et al. 1977	USA	157	Paper industry	Distance	Physical and Psicological symptoms

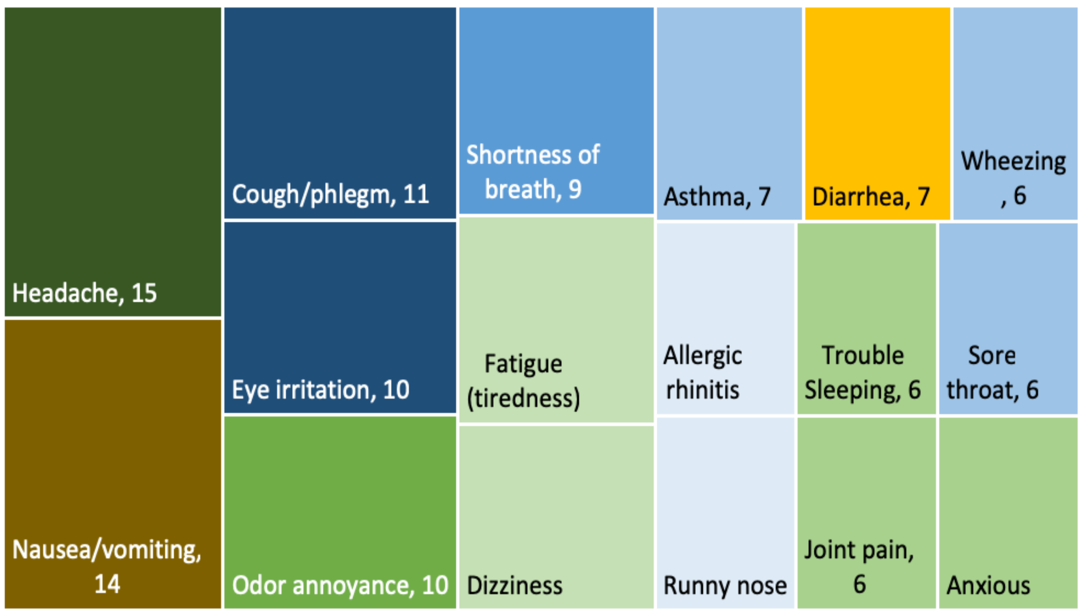
Results

We identified 7197 studies from OvidMedline and Embase *(Figure 1)*

After removing duplicates, 6151 were screened, resulting in 73 full-text articles for inclusion. We came up with a final selection of 31 relevant studies. Most study designs were cross-sectional (n=22), 7 papers used a longitudinal design and 2 ecological studies. All studies were from Europe, mainly from Germany, and from United States. The most frequently industrial source responsible for the malodor was animal feeding operations (n=14), followed by waste management (n=9) and paper industry (n=3) (table 1). We identified only 2 occupational studies, although we expected a larger variety of manuscripts of this field. This could be related with the search strategy performed.

A total of 79 outcomes were identified and extracted from the 31 studies included. *Figure 2* represents a summary list of most common reported outcomes.

Figure 2. Tree map of the most reported outcomes analysed by the authors



Discussion

This systematic review will provide a synthesis of current evidence reporting association between odor exposure and human health. The next step will be providing a description of the results both in quantitative and qualitative way. Finally, we will assess risk of bias of observational studies of the included studies and a meta-analysis will be performed according to the number and the homogeneity of the studies considered.

Final Plenary Conference - ICSHNet COST Action – Rome, 21-22 February 2019.

Use and implementation of full-chain exposure approach to develop pharmacokinetics modeling of PFAS and highlight toxicological behavior and risk for human health: the PAMPER Project

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Introduction

A huge drinking water contamination due to perfluoroalkyl substances (PFAS) is occurring in the Veneto Region (northern Italy). A chemical industry started to discharge liquid waste containing PFAS into the near river likely since the end of 1966. Even if PFAS represent an emerging environmental issue and have been claimed to pose concerns for the environment and human health, the epidemiology and toxicology of these chemicals is still limited and their toxicokinetics and underlying mechanisms poorly understood. Due to the presence of strong carbon-fluoride bonds, PFAS are generally stable to metabolic transformation and to environmental degradation. They have been suggested to bioaccumulate into the liver of living organisms and for some of them, such as PFOA, ADME seems to be supported by transporter families, which may facilitate the gastrointestinal absorption, the uptake by the tissues, and the excretion and reabsorption via the kidney. Understanding these processes, as well as identifying the main routes of exposures, would be essential to define the real risk for human population and set up scientific-based approaches to risk management.

Expected Results

This project has the general ambition to create a system to support the collection and processing of information for a complete and comprehensive picture of the fate of the PFAS present in the territories of the Veneto region in order to support the regional policies of public health.

The project can be considered as a prototype framework, exportable to other situations and areas, and usable in other actual or presumed contamination of substances released in environmental matrices.

The understanding of the final destiny of PFAS in humans and the timing of excretion after cessation of exposure are information that will be used to combine the measures to reduce concentrations in the environment to useful indications on time windows of possible damage in humans, due to acute and chronic exposures.

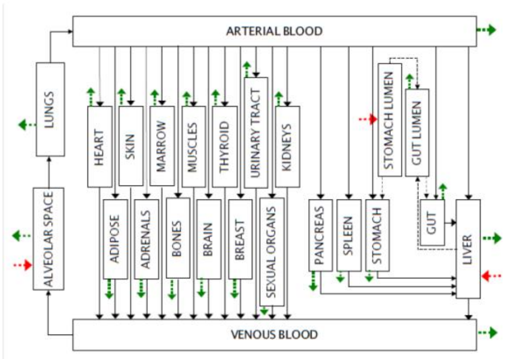

Figure 2. PBPK model scheme.
Source: Brochot C. *Documentation of the models implemented in 4FUN. The human model,* http://merlin-expo.eu

Methods

We have recently developed an integrated approach to assess the health risk posed by PFAS for Veneto population. This approach includes:

1) The exposure assessment of the population: development of geographical approach to reconstruct historical exposures; understanding of PFAS main routes of exposure through conceptual model;

2) The development of a full-chain-based model from environmental exposure via intake-uptake to PFAS dose, to contribute to a better understanding of the PFAS toxicokinetics in humans and to describe their distribution in human organs and tissues. Existing software include environmental and transfer models, tracing the contaminants from their source to human population target, and a pharmacokinetic based (PBPK) model that computes the specific tissue concentration for each compound or substance in environmental mixture, entering the organism by ingestion, inhalation or dermal contact. By integrating different existing software, we intend to implement a computational platform that will be specifically developed to model PFAS in human body. This process of implementation will be carried out by setting PBPK model parameters with the best values for PFAS and by comparing PBPK model equations from every available software to find the PFAS uttermost equation. By using these PBPK models, we will be able to determine the PFASs concentrations in all organs of human body.

3) The use of the PBPK model to develop a model-based contextualisation of in vitro toxicity data to understand the mechanisms underlying PFAS toxicity, identify their mode of action, predict the risk for the exposed populations, when tissue and organ critical concentrations are reached, and to identify thresholds of effect.

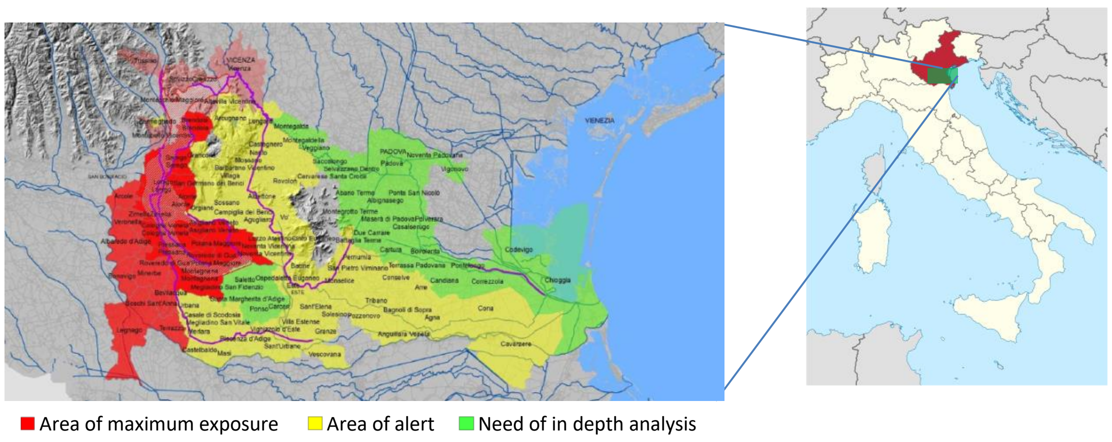

Figure 1. Exposure scenario. Source: DGRV n. 2133, 23/12/2016

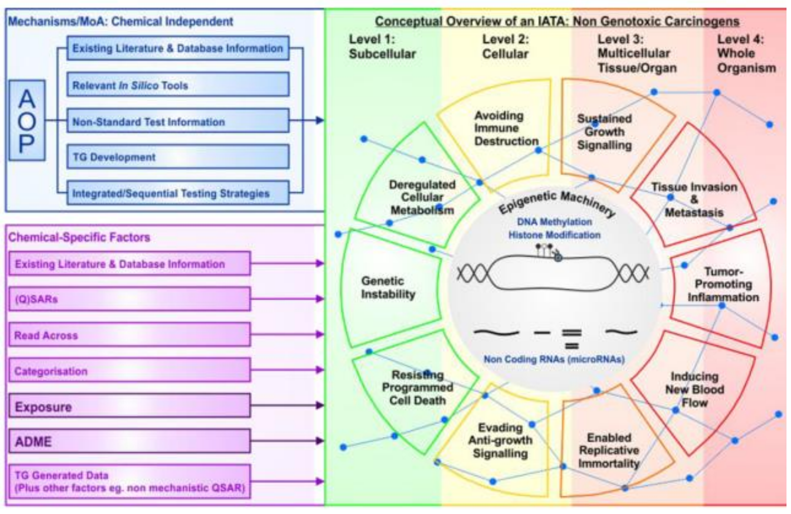

Figure 3. In silico model scheme. Source: Jacobs et al. *International regulatory needs for development of an IATA for non-genotoxic carcinogenic chemical substances*. ALTEX, vol. 33, no. 4, 2016, p. 359

Discussion

The project will increase knowledge about the mode and mechanism of action of PFAS, which is currently unknown, and the level of dose or concentration related to possible adverse effect, supporting the scientific-based process of risk assessment to human.

Indeed, the integration of the data on the PFAS toxicological profile, their effective concentrations, toxicokinetics and fate in human body will provide the essential information to the decision makers about the risk of PFAS and the scientific evidence to refine the process of risk management.

Conclusions

To obtain all the relevant data that are required to inform the decision makers about the risk of PFAS, we propose a novel approach, which integrates: 1) the exposure assessment of the population; 2) the chemical toxicokinetics based on the measured exposure and the use of a new PBPK models; 3) the chemical-agnostic toxicodynamics based on the AOP (Adverse Outcome Pathway) approach.

This integrated model will allow the quantitative prediction of in in vivo response to PFAS exposure, and the complete description of the pathway leading to adverse outcome.

The study is funded by CORIS –Veneto (call: Research Tender for the submission of innovative projects on PFAS 2017-2018)

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Risk assessment methods for combined exposure to air pollutants

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Introduction

Indoor air quality is determined by physical, chemical and biological parameters. Indoor air is a mixture of particulate matter, organic and inorganic gaseous compounds having different physical and chemical properties and, consequently, different health effects. Up to now, only a limited number or studies are available on health risk assessment of co-exposure to air pollutants due to its complexity. Children spend 6-8 h daily in school buildings, thus the air quality is an important factor of children's health, well-being and task performance.

Methods

WHO Europe is recently developing a tool for the assessment of health risk of combined exposure to multiple chemicals in indoor environment for children. Thus, online databases were searched for research studies related to the assessment of cumulative risks of multiple chemicals within indoor environments and published between 2010 and 2018. The following keywords were applied: health risk, risk assessment, cumulative risk, combined exposure and children, indoor air, air pollutants.

Results and discussions

Most pollutants are highly correlated to each other thus an additive or synergic effect cannot be excluded. Even if the indoor air concentrations of the pollutants are lower than the suggested values in the indoor air quality guidelines, when they collectively exist in an indoor environment, they can lead to a greater combined health risk [1].

Some former substantial works addressed the complexities of multi-pollutant health effects and related methods [2]. Three types of actions of mixtures can be described: additive actions, independent actions and interactive actions.

A WHO/IPCS framework for the risk assessment of combined exposure to multiple chemicals has been developed [3]. Cumulative risk assessment (CRA) addresses exposure to multiple compounds, based on defined criteria such as chemical structure, mechanism of action, target organ or toxic effect.

An overview of the main methodologies available to estimate the human health risk of environmental chemical mixtures is reviewed [4]:

Hazard Index

$$HI = \sum_{i=1}^{n} \frac{exp_i}{ref_i}$$

Point of Departure Index

$$PODI = \sum_{i=1}^{n} \frac{exp_i}{POD_i}$$

Margin of Exposure of a Mixture

$$MOE_{mix} = \left(\frac{1}{MOE_1} + \frac{1}{MOE_2} + \ldots + \frac{1}{MOE_n} \right)^{-1}$$

Cumulative Risk Index

$$CRI = 1 / \sum_{i=1}^{n} \frac{exp_i}{ref_i}$$

Total Equivalent Quantity

$$TEQ = \sum_{i=1}^{n} \left(c_i * TEF_i \right)$$

Since the previously suggested CRA methodologies generally considered only one chemical family, Fournier et al. (2014) proposed a methodology for grouping substances with similar effects (e.g. neurotoxicity) or mechanisms of action which do not all belong to the same chemical family. This can form the basis for exposure-based CRA. The limitation of this method was the lack of available and comparable data in the scientific literature [5].

De Brouwere et al. (2014) demonstrated the application of the maximum cumulative ratio (MCR) approach for indoor air, based on raw data of four European surveys, only one of them containing data from school indoors [5]. MCR was defined as the risk caused by combined adverse health effects due to exposure to multiple stressors via all relevant routes. The MCR of the individual's exposure to the mixture is the ratio of the HI of the mixture to the maximum of the hazard quotients of the individual components (max HQi).

$$MCR = \frac{HI}{maxHQ_i}$$

Mishra et al. (2015) applied the MCR method for estimating the risk of exposure of children to several indoor air pollutants (VOCs and carbonyls) in classroom [6]. They aimed to identify the number and type of substances in indoor air in classrooms, and to classify the mixtures into groups for different risk assessment by quantifying the HI and MCR value for each substance in the mixture.

In a recent work of Colman Lerner (2018), the VOC levels in indoor air of homes and schools in residential, urban, and industrial areas were analyzed by using passive samplers [7]. Lifetime cancer risks (LCR) were calculated for benzene, styrene, trichloroethylene and tetrachloroethylene and using RPFs the cumulative cancer risk was calculated by summation the LCRs for the chemicals in each indoor environment. They calculated the total risk of children for these chemicals by adding the values of CR obtained by expositions in homes, schools, and in outdoor areas proportionally to the time in which each child is exposed in each environment during the 24 h of the day.

Pelletier et al. (2018), to assess the public health risk posed by 32 SVOCs, such as phthalates, PBDEs and PCBs), performed both a chemical-by-chemical risk assessment, using a HQ or excess risk method, and a cumulative risk assessment for the 32 indoor SVOCs measured in French dwellings [8].

The risk assessment methods reviewed in this work could be applied to children living in industrially contaminated areas.

Conclusions

The works on health risk estimates of co-exposure to multiple chemicals in children's indoor environments are reviewed. A dose addition is generally used as default option in combined risk assessments. However, there is a need to move from dose addition to more detailed analysis of the possible interactions among the components in a chemical mixture.
Development of multipollutant risk assessment and management requires a continuously broadening scientific base with integration of findings from observational, experimental, and exposure studies with simultaneously monitored multiple pollutants in the air, identification of the most relevant mixtures, standardization of toxicological data, investigation the different modes of action, as well as enhancement of statistical analysis methods, that can characterize the associations between multiple pollutants and health outcomes. Beyond there is a need for incorporating data from molecular studies and new technologies into children's health risk assessment.
It is clear from the literature review that there is limited information on the risk for multiple chemicals in indoor settings on children.

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Home-based and informal work exposes the families to high levels of potentially toxic elements

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Introduction

The city of Limeira presents a relevant productive chain of jewellery and fashion jewellery, including a scenario of outsourcing informal home practices. It is highly complex to understand the potentially toxic elements (PTE: Cr, Mn, Ni, Cu, Zn, As, Cd, Sn, Sb, Hg, and Pb) exposures of the workers because this productive chain encompasses households. This study aimed to investigate the associations between blood PTE levels and informal work in the home environment.

Methods

Fifty-two families divided into Exposed group (n = 112) and Control group (n = 53) were included. Families' blood (n =165) and welder's breathing zone air samples (n = 9) were collected and PTEs concentrations were determined by ICP-MS. Questionnaires were applied to collect sociodemographic information and workplace details. Principal component analysis, Mann-Whitney test, cluster and a logistic regression analysis based on environment-wide association studies (EWAS) were carried out. Ni, Cu, Zn, Cd and Pb concentrations in the air samples were higher than occupational guidelines.

Results

Eighty percent of the workers were female, and 43.5% of those females then worked as welder. A significant difference was found for Pb concentration between the exposed and control group ($p < 0.0001$) and between sexes ($p = 0.0046$). For Cu ($p < 0.0001$) and Sb ($p=0.0434$), differences were found between the sexes. The receiver operating characteristic of the EWAS was 0.80, providing evidence of a potential model to associate exposure levels and occupational factors. PTEs concentrations in the air samples raised concerns, particularly for children, who were in the same exposure scenario. Inadequate work conditions were observed in the houses, revealing the need of public actions to protect these families.

Table. 2 Geometric means (GM) and their 95% confidence interval (CI 95%), and 95th percentiles (95th) for the potentially toxic elements levels (PTE) determined in the blood of study participants (µg. L-1), by exposure group and sex.

PTE	Exposed group						Control group					
	Male (n = 51)		Female (n = 61)		Overall		Male (n = 15)		Female (n = 38)		Overall	
	95th	GM (CI 95%)	95th	GM (CI 95%)	95th	GM (CI 95%)	95th	GM (CI 95%)	95th	GM (CI 95%)	95th	GM (CI 95%)
Mn	17.56	9.33 (8.51–10.23)	16.81	10.05 (9.24–10.93)	17.34	9.71 (9.13–10.33)	11.33	8.62 (7.74–9.59)	14.65	9.70 (8.81–10.68)	13.87	9.38 (8.70–10.11)
Ni	9.18	5.62 (5.16–6.12)	11.38	5.73 (5.12–6.42)	11.27	5.68 (5.29–6.10)	7.41	5.28 (4.71–5.93)	9.64	5.55 (4.84–6.37)	8.79	5.47 (4.95–6.06)
Cu	1,45	939 (884–998)	1,75	1,15 (1,08–1,23)	1,73	1,05 (1,00–1,10)	1,22	887 (788–998)	1,42	1,03 (970–1,09)	1,33	986 (934–1,04)
Zn	4,98	3,21 (2,99–3,45)	4,93	3,31 (3,10–3,54)	4,98	3,27 (3,11–3,43)	4,59	3,45 (3,16–3,75)	4,29	3,20 (3,01–3,41)	4,47	3,27 (3,11–3,44)
Cd	a	a	3.48	a	3.05	a	a	a	a	a	a	a
Sn	3.00	0.99 (0.82–1.19)	3.69	1.32 (1.10–1.59)	3.54	1.88 (1.72–2.05)	a	a	a	a	a	a
Sb	3.44	1.57 (1.36–1.84)	3.40	1.75 (1.53–2.00)	3.44	1.90 (1.75–2.05)	4.74	1.36 (0.96–1.95)	3.04	1.70 (1.51–1.93)	3.04	1.76 (1.60–1.94)
Pb	39.17	15.01 (12.73–17.71)	36.62	13.25 (11.40–15.40)	38.59	14.02 (12.56–15.66)	29.40	11.85 (8.68–16.19)	15.90	8.04 (6.93–9.33)	22.50	8.97 (7.79–10.33)

[a] Not calculated: proportion of results below limit of quantification was too high to provide a valid result.

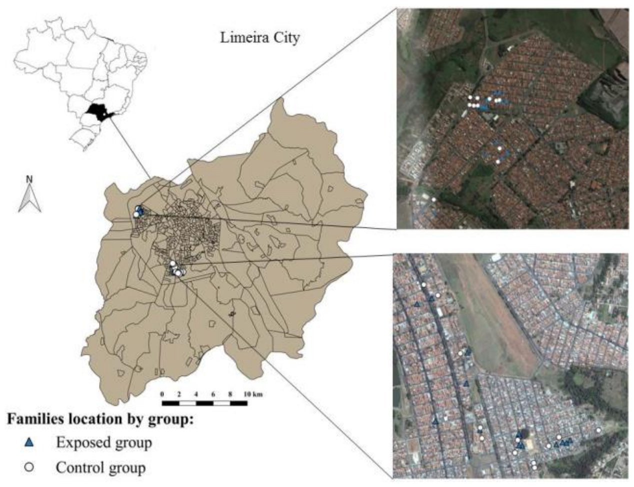

Figure. 1 Map of the city of Limeira and the distribution of the families by group (exposed or control)

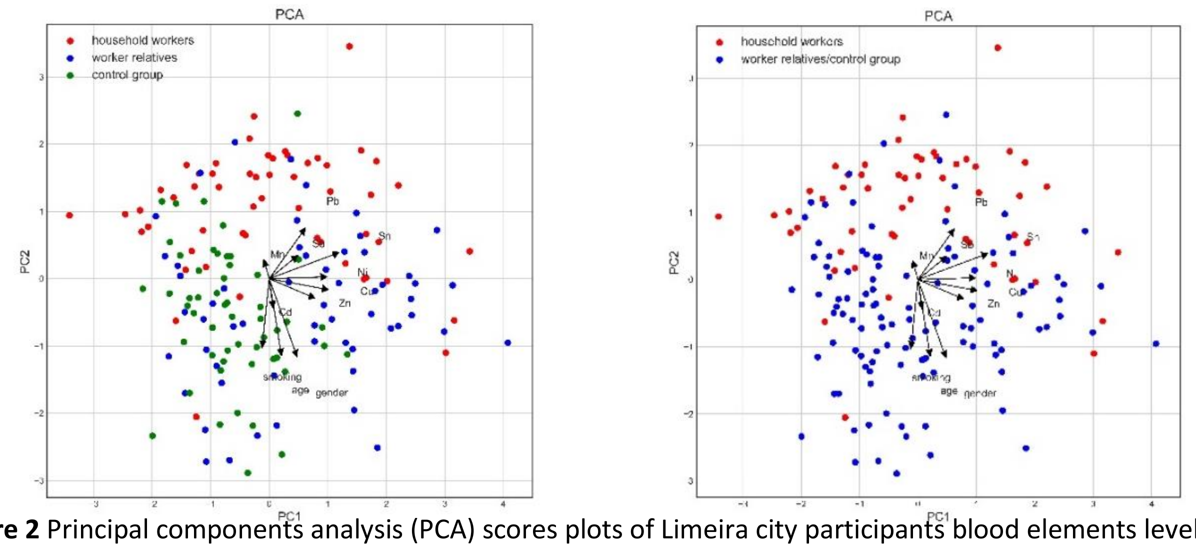

Figure 2 Principal components analysis (PCA) scores plots of Limeira city participants blood elements levels evaluating variation among different exposure groups. In the left, PCA illustrates the scores plots (PC1 and PC2) for workers (red), relatives (blue) and control group (green). In the right, workers (red) as well as relatives and control group (blue) after merging them in one group in the right.

Conclusions

The PTE concentrations found in the air analyzed in the present study raise concerns once the families, especially children, are in the same exposure scenario. The air elements levels were found to be higher than environmental limits for manganese, nickel, zinc, cadmium, and lead. Cadmium, zinc, and copper air levels surpassed even occupational limits. The elements concentration found in blood samples showed that the relatives of the workers have a higher exposure comparing to the Control group indicating an influence of exposure level by the shared workplace inside the workers' house. Inadequate work conditions were observed in the houses, revealing the urgent need to implement public actions to protect those workers and their families.

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