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Oil Refinery Release of Pollutants in Human and Animal Health: The Case of Priolo (Eastern Sicily) Oil Refinery

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Short Communication

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ABSTRACT

Oil refineries have been investigated in several studies focused on soil and water pollution in proximity of refinery plants, as we reported recently for the Augusta-Priolo area (Eastern Sicily). The present study is aimed at evaluating the effects on human and animal health related to residence nearby refinery plants.

Material and Methods: A literature search was effected in PubMed, and in our previous archives combining "oil refinery", "health" and "disease", building an overall database.

Results: Multiple evidence was found related to residence nearby oil refineries, or occupational exposure and affecting human health, including genetic defects and cancer. Further literature was found relating the exposure to oil refinery pollution *vs*. multiple adverse effects in several biota, including animals along with other exposed biota.

Key Words: Oil refinery; Soil/water pollution; Health effects; Animal toxicity; Multiple biota

INTRODUCTION

Several forms of environmental pollution have been associated to oil refineries and proximate topsoil in a number of locations in Europe, Asia and America [1-8]. We have previously investigated the soil pollution endpoints in Augusta-Priolo (South East Sicily) oil refinery area, along to a previous recent report focused on marine sediment [7-9]. Inorganic analysis of topsoil was both carried for 23 metals and 16 Rare Earth Elements (REEs), which are recognized additives in oil refining additives [6,8]. Organic analyses were focused on polycyclic aromatic hydrocarbons [8,9] and total aliphatic

hydrocarbons. Topsoil samples were tested for toxicity in several bioassay models, and samples collected at sites closest to petrochemical facilities suggested their contributions to topsoil environmental toxicity.

Beyond experimental toxicity testing, the present mini-review is aimed at evaluating the literature database focused on the association of oil refinery plants with human health (Figure 1), and the literature associating oil refineries with adverse effects on animal health and on a number of other biota as plants and microorganisms.

Figure 1. Augusta-Priolo oil refinery plant.

Oil refineries and human health effects

The residential or occupational exposures to the environmental pollution associated to oil refineries have been investigated in a number of epidemiological studies as summarized in Table 1.

Table 1. Reports on associations of oil refining plants with human health.

Location	Observed health anomalies	Exposure types
Gela (sicily)	Excess congenital malformations	Resident children [10]
Sicily region	Mortality, hospitalization, and cancer incidence	Resident children [11]
Al-Hashimeya *vs* Bal'ma (Jordan)	Respiratory health problems and history of abortions in the family	Resident children [12]
Multiple (review)	As preterm deliveries and low birth weight	Residence[6]
Oil and gas industry	Occupational health and safety, primary care,	Occupational exposure [13]
Workers (review)	Mental health and well-being	In oil and gas industry
Asalouyeh (Southern Iran)	Metal(loid)s urinary level among workers of gas refinery and petrochemical companies	Occupational exposure [14]
Multiple (review)	Risk of leukemia	Occupational exposure [15]
Rural Colorado	Childhood hematologic cancer	Resident children [16]
Abadan and Khorramshahr	Excess oxidative potential of street dust	Residence [17]

Multiple (review)	Cancer incidence and mortality	Occupational exposure[18]
Pančevo (serbia)	Increased carcinogenic risk	Occupational and residential exposure [19]
Multiple (review) Texas, Colorado, and Pennsylvania	Respiratory and prenatal damage	Residence [20]
Taiwan	Childhood leukemia	Residence [21]
Taiwan	Cancer incidence	Residence [22]

The data were obtained from childhood severe health effects such as congenital malformations, following children or maternal residence close to a number of oil refineries across a number of locations including Sicily, Saudi Arabia, Jordan, Iran, rural Colorado, Serbia, China and Taiwan [1,2,4-6,9-11,16,17,19,22,23]. Altogether, this database testifies a general association of residential exposures to oil refineries with severe health outcomes in children and newborns. Another body of evidence may be assessed on occupational exposure in oil refineries and gas processing plants, as reported in set of extensive reviews and the occurrence of cancer and leukemias [3,14,24]. Altogether, several exposures to oil refineries can be assessed as etiologic sources of severe effects to human health.

Associations of oil refineries with adverse effects in several biota

A more limited database is available focused on the adverse effects associated with oil refineries in a number of biota, namely animals, plants and microbial models, as summarized in Table 2.

Table 2. Database on associations of oil refineries in several biota (animal, plant and microbial models).

Test models	Observed effects	Exposure types
Dogs in oil and gas industry	Environmental dust and levels in blood and hair samples	Living in oil and gas plants [25]
Female C57Bl/6 mice	Adverse reproductive and developmental health outcomes	Prenatal exposure [26]
Male Sprague Dawley rats	Adverse pulmonary and systemic effects of inhaled diesel emissions with cerium oxide fuel additive	Inhalation [27]
Seafood and terrestrial food (review)	Levels of inorganic and organic pollutants	Feeding habits [13]
Amphibian tadpoles	Water contaminants associated with unconventional oil and gas extraction	Proximity to oil refinery [28]
Priestia megaterium	Toxicity and oxidative stress	Sediment exposure [29]
Plant Health Index	170 process variables	Evaluation of health index based on design ranges of parameters [30]

Tested animals included watchdogs dwelling in oil refineries, and rodent models either submitted to pregnancy exposure or to inhalation of diesel emissions [25-27]. The results showed increased hydrocarbon bioaccumulation in blood and hair samples, adverse reproductive and developmental health outcomes, and adverse pulmonary and systemic effects of inhaled diesel emissions with cerium oxide fuel additive. Further data were reported in a tadpole model exposed to oil refinery and gas extraction [27]. Among other biota models, other adverse effects were reported in a microbial model, and in a review of Plant Health Index [29,30].

Open questions and need of further investigations

The established body of evidence associating residential or occupational in oil refinery facilities to adverse human health effects (Table 1), along with the circumstantial data relating analogous effects in dogs and rats [25,27] altogether raise the rationale for undertaking from this investigation focused on animal adverse health effects. In the frame of our study of the Augusta-Priolo oil refineries, an image of a sheep yard approached the Priolo refinery (Figure 2) should provide a well-based ground towards veterinary investigations [8,31].

Figure 2. Sheep living nearby priolo oil refinery.

CONCLUSION

We consider this technique described to be a sufficient and safe novel surgical option when conservative therapy proves insufficient. This validated and established procedure in humans has now been successfully adapted for equine medicine allowing sustainable treatment of cervical radiculopathy caused by foraminal stenosis.

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