# Health impact assessment of pollution from incinerator in Modugno (Bari)

Ida Galise 1
Puglia Cancer Registry 1, ida.galise@oncologico.bari.it

Maria Serinelli 2
Regional Environment Protection Agency, Puglia, Bari, Italy 2

Lucia Bisceglia 1, 2
Puglia Cancer Registry 1
Regional Environment Protection Agency, Puglia, Bari, Italy 2

Giorgio Assennato 1, 2
Puglia Cancer Registry 1
Regional Environment Protection Agency, Puglia, Bari, Italy 2

**Abstract**: The purpose of this study is to assess the potential health impact at start-up of a new incinerator on the general population living near the facility. An algorithm was applied in order to calculate the number of deaths and hospital admissions associated with a given concentration of PM10, exposed population, specific mortality/morbidity rates. For every health end-points, an estimate of RR was obtained from literature. Using PM10 as a tracer, simulations were made of incinerator emissions fallout. Residents within 2-km radius from the plant were considered. The reduction of average concentration of PM10 to 40 $\mu g/m^3$ could prevent 0.12% of natural causes of death. Proportionally, the increment in PM10 concentration of 1 $\mu g/m^3$ could be associated to 0.02% of deaths. The estimated exposure to estimated incinerator emissions should not lead to additional health risks for the neighbouring population.

**Keywords**: air pollution, incinerator, hospital admissions, mortality.

## 1. Introduction

Several studies on the possible health effects related to population residing in the proximity of incinerators have been published, and well-conducted reviews are available on this subject. While some positive studies suggest associations with reproductive outcomes and cancer, the evidence is, overall, not conclusive to establish the occurrence and magnitude of risks. Furthermore, positive studies refer mostly to old generation incineration plants.
The adoption of Best Available Technologies (BAT) in abating emissions resulted in much lower levels of exposure to pollutants and consequently less likely occurrence of measurable health effects on populations resident in the proximity of new generation incinerators (Franchini et al. 2004, WHO 2007, Italian Epidemiological Association 2008, Porta et al. 2009, Ranzi et al. 2011).

This conclusion is supported mostly by extremely low concentrations of toxic substances measured in emissions of new generation incinerators (Moniter Projects Preliminary Results, 2010). However, residents' concerns -- living in areas near incinerators -- require evaluation of potential health effects associated to estimated emissions from new plants.
The aim of the present study is to assess the health impact on people living in the proximity of a new incineration facility in Modugno, Province of Bari (Puglia, Italy) in relation to PM10 exposure, by using current health records.

## 2. Materials and Methods

Health statistics on mortality for 2005 (last available year) were retrieved from the *Regional Mortality Atlas* (Regional Epidemiological Observatory, Puglia). The *Atlas* contains cause-specific mortality data at municipal level. Hospital Admissions (HA) data for this study were gathered from regional hospital discharge archives for 2008.
Mortality and morbidity end-points were chosen from the scientific evidence available and from recent evaluations of impact assessments. In particular, mortality endpoints include overall mortality (International Classification of Diseases, 9$^{th}$ Revision (ICD-9:1-799), cardiovascular (ICD 9: 390-459) and respiratory (ICD 9: 460-519) causes of death. Selected morbidity outcomes are related to cardiac (ICD 9: 390-429) and respiratory (ICD 9: 460-519) diseases. Hourly data on PM10 were obtained for the year 2008. The PM10 daily average, measured by air quality stations located in the area, was 45.3 μg/m$^3$. A simple algorithm was used to calculate the number of attributable deaths and hospital admissions associated with a given counterfactual factor of 40 μg/m$^3$ (as suggest from European Union limits), exposed population, specific mortality/morbidity rates and relative risk (RR) estimates (Martuzzi et al. 2006).
The number of cases attributable to an air pollution concentration over a given counterfactual factor, *E*, is given by the following equation:

$$E = A^* B^* (C/10)^* P,$$

where: *P* = the population exposed; *C* = the relevant change in concentration (difference between the observed concentration and the counterfactual level), obtained from monitoring networks in each city; *A* = the proportion of effect on health attributable to air pollution, which can be calculated as follows: $A = (RR-1)/RR$.
Residents living within 2 km from incinerator, area of expected maximal deposition estimated by ISAC-CNR-Lecce through dispersion modeling, were considered as exposed (15,056 inhabitants).
Concentration-response risk coefficients were derived from epidemiological studies (Table 1) (Martuzzi et al. 2006).

| Outcomes | RR | CI 95% |
|---|---|---|
| All causes of mortality (excluding accidents) | 1.006 | 1.004-1.008 |
| Cardiovascular deaths | 1.009 | 1.005-1.013 |
| Respiratory deaths | 1.013 | 1.005-1.020 |
| Cardiac HA | 1.003 | 1.000-1.006 |
| Respiratory HA | 1.006 | 1.002-1.011 |

**Table 1:** Summary of RRs and confidence interval 95% (95% CIs)

The analyses were performed in two steps:

- at first, we estimated how many deaths could have been avoided if the observed PM10 concentration could have been reduced to the given counterfactual level (40 $\mu g/m^3$);
- on a second phase, assuming that the incinerator will operate in combination with a Combined-Cycle combustion Gas Turbine (CCGT) power generation facility (that is another plant under construction in the area of study), we referred to the additional contribution to PM10 within 2 Km radius estimated through dispersion modeling: 0.03 $\mu g/m^3$ for incinerator and 0.15 $\mu g/m^3$ for CCGT plant. As worst-case scenario, we have chosen an increase of 1 $\mu g/m^3$ of PM10 exceeding 40 $\mu g/m^3$.

## 3. Results

The results of step 1 are reported in Tables 2 and 3. In detail, 0.12% of overall deaths, 0.19% of cardiovascular and 0.27% of respiratory mortality are attributable to levels of PM10 exceeding 40 $\mu g/m^3$ (Table 2). For morbidity: 0.06% of HA for cardiac and 0.12% of HA for respiratory diseases (Table 3).
The results of step 2 are reported in table 4.

| Causes of death | Cases | Rates *(100,000 inhabitants)* | Attributable cases | CI 95% | | % Attributable cases | CI 95% | |
|---|---|---|---|---|---|---|---|---|
| Overall mortality | 208 | 562 | 0.26 | 0.17 | 0.34 | 0.12 | 0.08 | 0.17 |
| Cardiovascular | 78 | 211 | 0.15 | 0.08 | 0.21 | 0.19 | 0.11 | 0.28 |
| Respiratory | 18 | 49 | 0.05 | 0.02 | 0.08 | 0.27 | 0.11 | 0.42 |

**Table 2:** Cause-specific deaths attributable to mean levels of PM10 exceeding 40 $\mu g/m^3$. Modugno, 2008

| Hospital admissions | Cases | Rates *(100,000 inhabitants)* | Attributable cases | CI 95% | | % Attributable cases | CI 95% | |
|---|---|---|---|---|---|---|---|---|
| Cardiovascular | 1,189 | 3.110 | 0.74 | 0.00 | 1.48 | 0.06 | 0.00 | 0.12 |
| Respiratory | 586 | 1.533 | 0.73 | 0.24 | 1.33 | 0.12 | 0.04 | 0.23 |

**Table 3:** Cause-specific hospital admissions attributable to mean levels of PM10 exceeding 40 $\mu g/m^3$. Modugno, 2008

| Outcomes | Attributable cases | CI 95% | | % Attributable cases | CI 95% | |
|---|---|---|---|---|---|---|
| Overall mortality | 0.05 | 0.03 | 0.06 | 0.02 | 0.02 | 0.03 |
| Cardiovascular mortality | 0.03 | 0.02 | 0.04 | 0.04 | 0.02 | 0.05 |
| Respiratory mortality | 0.01 | 0.00 | 0.01 | 0.05 | 0.02 | 0.08 |
| Cardiovascular HA | 0.14 | 0.00 | 0.28 | 0.01 | 0.00 | 0.02 |
| Respiratory HA | 0.14 | 0.05 | 0.25 | 0.02 | 0.01 | 0.04 |

**Table 4:** Cases attributable to increase of 1 μg/m$^3$ of PM10 exceeding 40 μg/m$^3$. Modugno, 2008

## 4. Concluding remarks

Estimated PM10 levels associated to new incinerator emissions should not lead to additional health risks for the neighbouring population.
This evaluation is to be considered limited, given the following parameters: the small amount of residing population; the chemical and toxicological data of specific compounds; the characterization of individual exposure. Nevertheless, we confirm the need to activate an environmental and epidemiological surveillance in the examined area.

## References


Franchini M., Rial M., Buiatti E., Bianchi F. (2004) Health effects of exposure to waste incinerator emissions: a review of epidemiological studies, *Ann. Ist. Super. Sanità*, 40:101-15.

WHO (2007) Population health and waste management: scientific data and policy options. Report of a WHO workshop, Rome, Italy. [http://www.euro.who.int/__data/assets/pdf_file/0012/91101/E91021.pdf].

Porta D., Milani S., Lazzarino A.I., Perucci C.A., Forastiere F. (2009) Systematic review of epidemiological studies on health effects associated with management of solid waste, *Environmental Health*, 8:60.

Ranzi A., Fano V., Erspamer L., Lauriola P., Perucci C.A., Forastiere F. (2011) Mortality and morbidity among people living close to incinerators: a cohort study based on dispersion modeling for exposure assessment, *Environmental Health*, 10:22.

AIE (2008) Waste processing and health. A position document of the Italian Association of Epidemiology (AIE), *Ann. Ist. Super. Sanità*, 44(3):301-306.

http://www.arpa.emr.it/cms3/documenti/moniter/risultati/20100914/02%20scheda_report_emissioni.pdf

Martuzzi M., Mitis F., Iavarone I., Serinelli M. (2006) Health impact assessment of PM10 and Ozone in 13 Italian cities. *World Health Organization - European Centre for Environment and Health.*