Evaluation of the health effects of the non compliance of emissions of diesel cars in Milan, Italy, with their specific EURO class.

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Background

It has been shown that the compliance of diesel cars with emission limits of specific EURO category would reduce the exposure to NO2 for people living in Milano, Italy, in 2017, from 44.3 ug/m3 annual mean to 37.7 ug/m3.

Methods

To estimate mortality attributable to non compliance of diesel cars with EURO directives, we used difference in annual mean of NO2. NO2 concentration is suitable for the estimation of long-term burden of chronic diseases but also for short-term effects of air pollution (Ostro, 1998).

The relationship between exposure to NO2 and "natural", i.e. general mortality excluding accidental caused was derived by the paper of Faustini (Faustini et al, 2014). Estimates of Relative Risk (RR) for a 10 ug/m3 increase in atmospheric NO2 are heterogeneous between continents, this being probably due to different in sources and to different background of other pollutants. Therefore we decided to use only European estimated, using the same weights used by Faustini in the pooled analysis.

The number of "natural" deaths among residents in Milan was extracted from the Local Health Unit web site (ATS, 2018) by subtracting from the total number of deaths, those due to accidents and trauma.

The number of cases attributable to the extra exposure was computed using the formula RA=(RR-1)/RR (Rothman, 2008)

Results

Table 1 from Faustini (Faustni et al, 2014) shows the evaluation of the RR estimates for a 10 ug/m3 increment of NO2 exposure. A weighted RR of 1,068983 is estimated.

Given an extra exposure of 6.6 ug/m3 an excess risk of RR of 0,068983 x 6.6 /10 = 0,045529 and a RR of 1,045529 are obtained. This corresponds to the attributable fraction of 0,043546 The number of "natural" deaths among the residents in Milan was 13050 in 2018 and the number of attributable deaths is 568.

Discussion

We estimated 568 extra deaths among residents in Milan due to extra exposure to NO2 from non compliance of diesel cars emissions with their specific EURO standards.

WHO (2013) proposed an RR for "natural" mortality of 1.055 based on the meta-analysis of Hoeck (2013) reporting an RR of 1.047. These meta-analyses, however, include also American and Asian Studies that report RRs considerably lower than those reported in European studies that are more applicable to our study case.

In evaluating the RR we took the reasonable assumption that the link between exposure to NO2 and the "natural" mortality is linear. The range we studied is narrow and exposure value are far from extreme values for human exposure. Moreover, as the community is concerned, a threshold value for the effects is not conceivable.

EPA (2016) classified the exposure to nitrogen oxides as "Suggestive of, but not sufficient to infer, a causal relationship". This is largely due to the negative results of the large cohort of the American Cancer Society (Pope III, 2002). That paper is focused on the effects of fine particulate matter and only an univariate result in nitrogen oxides is presented. Due to the high correlation between fine particles and nitrogen oxides, the negative results on NO2 warrant further explanation.

Conclusions

Nitrogen oxides are harmful and road traffic is an important source for these substances (HEI, 2010) Non compliance to EURO guidelines of the actual diesel cars adds a further damage to human health.

Table 1

Study	Weight	RR
Cesaroni et al	13,05	1,03
Heinrich et al	3,52	1,13
Maheswaran et al	2,0	1,28
Beelen et al.	11,31	1,03
Gehring et al	6,22	1,08
Filleul et al.	3,44	1,14
Sum of weights	39,54	
	RR weighted	1,068983

Table 1 Relative risks of natural mortality with increasing chronic exposure to NO2 by 10 ug/m3. Meta-analysis of European studies (from Faustini et al 2014).

References

ATS Milano. https://portale.ats-milano.it/salute/stato_salute/stato_salute.php?stato_salute. selected Milano on may 16,2020

Beelen R, Hoek G, van den Brandt PA, et al. Long-term effects of traffic-related air pollution on mortality in a Dutch cohort (NLCS-AIR Study). Environ Health Perspect 2008; 116: 196–202.

Cesaroni G, Badaloni C, Gariazzo C, et al. Long-term exposure to urban air pollution and mortality in a cohort of more than a million adults in Rome. Environ Health Perspect 2013; 121: 324–331.

EPA. 2016. Integrated Science Assessment for Oxides of Nitrogen –Health Criteria. EPA/600/R-15/068

Faustini A, Rapp R, Forastiere F. 2014. Nitrogen dioxide and mortality: review and meta-analysis of long-term studies Eur Respir J; 44: 744–753

Filleul L, Rondeau V, Vandentorren S, et al. Twenty five year mortality and air pollution: results from the French PAARC survey. Occup Environ Med 2005; 62: 453–460.

Gehring U, Heinrich J, Kra¨mer U, et al. Long-term exposure to ambient air pollution and cardiopulmonary mortality in females. Epidemiology 2006; 17: 545–551.

HEI 2010. HEI Panel on the Health Effects of Traffic-Related Air Pollution. Traffic-related air pollution: a critical review of the literature on emissions, exposure, and health effects. HEI Special Report 17. Boston, Health Effects Institute, 2010.

Heinrich J, Thiering E, Rzehak P, et al. 2013. Long-term exposure to NO2 and PM10 and all-cause and cause-specific mortality in a prospective cohort of females. Occup Environ Med.; 70: 179–186.

Hoek G, Krishnan RM, Beelen R, Peters A, Ostro B, Brunekreef B, Kaufman JD. 2013 Long-term air pollution exposure and cardio- respiratory mortality: a review. Environmental Health; 12:43

Maheswaran R, Pearson T, Smeeton NC, et al. Impact of outdoor air pollution on survival after stroke: population based cohort study. Stroke 2010; 41: 869–877.

Ostro B, Chestnut L. 1998. Assessing the health benefits of reducing particulate matter air pollution in United States. Environmental Research; A76: 94-106.

Pope III A, Burnet RT, Thun MJ et al. 2002. Lung cancer, Cardiopulmonary mortality and long-term exposure to fine particulate air pollution. JAMA 287:1132-1141

Rothman KJ, Greenland S, Lash TL. 2008. Modern Epidemiology. Lippincott Williams & Wilkins

WHO Regional Office for Europe 2013. Health risks of air pollution in Europe – HRAPIE project