Eur Respir J 2012; 40: 1065–1066
DOI: 10.1183/09031936.00056412
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EDITORIAL

Alveolar macrophages carbon load: a marker of exposure?

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In December 2011, the Council of Europe adopted recommendations to prevent the most common chronic conditions in childhood, especially respiratory diseases in children, and ''invited the member states to tackle the problems that constitute the biggest risk factors that could trigger a chronic respiratory disease: tobacco smoke, poor indoor air quality, and outdoor air pollution'' [1].

Another major health problem for the European population is increasing in body weight due to lack of sufficient physical activity. The World Health Organization (WHO) stresses the importance of physical activity for all age groups including the elderly [2].

Nowadays, as most pollution in cities stems from motor vehicle traffic, the widespread and sensible recommendation to walk or to cycle to work is thus performing two good outcomes at once, *i.e.* reducing emissions and increasing personal physical activity. However, cycling to work in cities with heavy traffic might also contribute to the development of respiratory disease.

A recent review ''quantitatively compared the health benefits from physical activity with the risks related to air pollution and traffic accidents between cycling and car driving for short trips, distinguishing the individuals who shift modes of travel from society as a whole. Estimated inhaled air pollution doses were higher in cyclists.'' [3]. The review concluded that ''On average, the estimated health benefits of cycling were substantially larger than the risks of cycling relative to car driving. For the society as a whole, this can be even larger because there will be a reduction in air pollution emissions and eventually fewer traffic accidents. Policies stimulating cycling are likely to have net beneficial effects on public health, especially if accompanied by suitable transport planning and safety measures.'' [3].

However, some older studies found that persons commuting by public transport or car inhaled more particles [4] and more volatile organic carbons [5, 6] than those cycling to work. But higher exposure to ultrafine particles was found, by VINZENTS *et al.* [7], for cyclists. Thus the discussion about inhalation of pollutants and its respective health consequences remains open.

In the early 1990s the COST (European Cooperation in Science and Technology) project ''Air pollution epidemiology'' was instrumental in initiating European collaborative projects on this topic. Its first publication was on exposure assessment and its measurements [8]. One of the main focuses of the report was whether and how health effects are dependent on the duration of exposure and whether short peaks are more damaging to human health than continuous long-term exposure. This discussion has direct policy implications; regulators following WHO recommendations [9] based on such publications/findings and most countries set standards for short-term levels of pollutants. Averaging time for recommended guideline values or for standards set by different authorities vary for different pollutants. Thus, for particulate matter (PM) $<2.5\ \mu\text{m}$ in aerodynamic diameter ($PM_{2.5}$) an annual mean of $10\ \mu\text{g}\cdot\text{m}^{-3}$ is recommended, whereas the short-term value is given as a 24-h mean ($25\ \mu\text{g}\cdot\text{m}^{-3}$). The same averaging times are applied for PM $<10\ \mu\text{m}$ in aerodynamic diameter (PM_{10}), *i.e.* annual mean of $20\ \mu\text{g}\cdot\text{m}^{-3}$ and a 24-h mean of $50\ \mu\text{g}\cdot\text{m}^{-3}$. For ozone ($O_3$) an averaging time of 8 h is used, *i.e.* 8 h mean of $100\ \mu\text{g}\cdot\text{m}^{-3}$. And for nitrogen dioxide (annual mean of $40\ \mu\text{g}\cdot\text{m}^{-3}$) the short-term value is given as a 1-h mean, *i.e.* $200\ \mu\text{g}\cdot\text{m}^{-3}$ mean. Yet studies that relate short-term exposures to health effects are rare (except for O_3), as personal exposure measurements with high time-resolution are not easily available for large studies, which is also true for most studies on health effects of long-term exposure to air pollutants. The most recent analysis of the Harvard Six Cities Study still relies on exposure terms, which are just the annual means of $PM_{2.5}$, and still finds the strong association between exposure and mortality [10].

The majority of studies on the effect of short-term exposure use routinely collected data on pollution levels and the respective short-term effects in populations, be it mortality, hospital admissions or even medication intake [11]. These studies usually do not have exact measures of each participant's exposure.

The development of personal samplers or smaller personal monitors with high time-resolution in combination with time-activity diaries allows better estimates of individual exposure. The use of geographical data with high resolution and source-specific factors describing, for example, the share of the fine fraction on the total PM_{10}, taking into account the different emission times, and combining it with personal behaviour pattern have resulted in detailed personal exposure estimates [12]. Based on such models the effect of small changes in exposure on reduction of age-related decline of lung function [13] and incidence of respiratory symptoms [14] could be shown in a large population study. These personal estimates are usually describing long-term exposure and thus are used in cohort studies. Yet the question on the relevant time-windows for health-relevant exposures remains a subject that needs more attention.

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The paper by NWOKORO *et al*. [15] in this issue of the *European Respiratory Journal* explores the hypothesis that short peaks of exposure would lead to a higher carbon-load of airway macrophages than usual continuous exposure. For this purpose the authors compare persons who usually cycle to work in London, UK with others who walk or use public transport. With personal monitoring of black carbon (BC) exposure during 1 day for each participant they can show that while the average exposure of the two groups is the same, cyclists clearly experience higher exposure peaks during cycling. This would not be surprising; however, they also found a higher BC load in cyclists' macrophages taken from the sputum when compared with those who commute by public transport or by foot. Thus, they concluded that ''cycling to work in London is associated with increased long-term inhaled dose of BC. Whether increased V'_E [minute ventilation] associated with cycling is an independent risk factor for increased inhaled BC remains unclear.'' [15]. The study compared 14 subjects in each group and they were different (although this difference was not statistically significant due to the small number of subjects studied) in sex, age, height, weight, leisure-time activity, and distance to next major road (where cyclist lived in a mean distance of 100 m, non-cyclists in 209 m). Thus, the results would need confirmation from larger studies with more, and more similar subjects.

Why do the authors say that the findings reflect effects of long-term exposure? They argue that the macrophages remain for 3 months in the airways and, thus, accumulate the continuous doses of inhaled BC. And, in spite of the longer distance to the next major road, non-cyclists had higher background PM_{10} and higher levels of measured home BC exposure. What do we learn from this? Perhaps very short, high peaks of exposure contribute more to total load of inhaled pollutants and, thus, we ought to control not only the mean pollutant levels but avoid higher peaks. And if you cycle, which is still advisable for general health reasons, you should avoid major roads.

STATEMENT OF INTEREST

None declared.

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