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CORRESPONDENCE

Chlorine exposure and the upper respiratory tract

To the Editor:

We read with great interest the report of SCHINS *et al.* [1] on their controlled human-exposure study of chlorine inhalation. The air pollutant studied, gaseous chlorine, is one of substantial relevance in terms of total industrial usage and involvement in emergency release scenarios.

The authors referred to "…a paucity of human data on the effect of chlorine on the upper respiratory tract". Their literature review, however, overlooked two recent and pertinent studies from our institution pertaining to the effects of Cl_2 on both the upper and lower respiratory tracts. D′ALESSANDRO *et al.* [2] documented a significantly greater acute bronchial (obstructive) response in asthmatic *versus* normal volunteers exposed to 1.0, but not 0.4 parts per million (ppm) Cl_2 for 15 min [2]. SHUSTERMAN *et al.* [3] demonstrated significantly higher nasal irritation ratings and nasal congestion (assessed by rhinomanometry) among seasonal allergic rhinitic volunteers (as compared to normal controls) exposed to chlorine at 0.5 ppm×15 min. A common denominator of these studies is the need to identify potentially susceptible subpopulations in order to provide the most sensitive assay for potential population-based health effects.

The inability of SCHINS *et al.* [1] to document significant subjective complaints in response to Cl_2 exposures as high as 0.5 ppm×6 h, may relate to the manner in which symptoms were recorded, which did not include baseline (pre-exposure) measures and was tempered by a physician′s subjective estimation of the likelihood of relatedness exposure. Moreover, the study did not employ objective physiological measures of nasal irritant response (*e.g.* rhinomanometry, acoustic rhinometry, nasal peak flow measurement, or rhinostereometry). Given these limitations, the negative findings of the study should be viewed with caution, especially in light of other positive studies with comparable exposure levels that were not discussed.

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From the authors:

We read with interest the comments of D. Shusterman and colleagues to our human exposure study with gaseous chlorine. Although it may seem like we have "overlooked" the two studies referred to in their letter, there are several reasons why these controlled human exposure studies were not discussed in our paper.

The major reason is that we set out to study potential adverse effects of chlorine in a healthy population, specifically excluding those with rhinitis or nonspecific bronchial hyperreactivity in our extensive screening efforts. We don′t see why our data should be "viewed with caution", when we aimed to study the nasal and pulmonary effects in healthy individuals, instead of subjects that are known to be more sensitive (at lower concentrations) showing exaggerated responses to inhaled irritants in general. In addition a nonsignificant congestive and obstructive response in normal subjects exposed to 0.4 parts per million (ppm, 60 min) or 0.5 ppm (15 min) of chlorine were reported in their own studies.

The authors, however, do have a point when they suggest objective physiological measures of nasal irritant responses. Although such measurements, which also included eye-irritation, were suggested in our initial study proposal, they were not included in the final protocol due to technical and financial reasons. However, the utmost precision was taken to score "subjective" symptoms in all four exposure conditions, where consistency, driven by an exposure-response relationship was needed to establish a symptom as an adverse effect related to chlorine exposure. In addition, a detailed medical investigation was performed at prestudy intake, and a daily short check-up was conducted before each exposure session. This information was not provided in the paper. With regard to subjective symptoms, in our study most subjects indicated they could smell the presence of chlorine already at the lowest concentration (0.1 ppm) but they were not able to discriminate between the

three different exposure levels. Considering our experience, we find it surprising that none of the subjects tested in their studies were aware of chlorine exposure, whereas half of them were hyperreactive and exposed well over the mean odour threshold of chlorine [1].

Taken together these data suggest that normal subjects do not show adverse effects <0.5 ppm chlorine up to several hours (repeated) exposure, whereas sensitive subjects (with rhinitis or hyperreactivity) show objective effects at such levels. It is up to regulatory committees to decide whether occupational exposure levels should be set to a no-effect level in highly sensitive groups.

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