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EVALUATION OF THE EFFECT OF ENVIRONMENTAL TOBACCO SMOKE ON
AIRLINER CABIN AIR QUALITY

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In a recent article, Oldaker and Conrad(1) performed measurements of nicotine in passenger cabins of three types of commercial aircraft in order to assess the effectiveness of smoker segregation on nonsmokers' exposures to environmental tobacco smoke (ETS) in aircraft. They concluded that exposures are insignificant when compared to smoking a cigarette.

Nevertheless, from their reported data it appears that nonsmokers' exposures are significant when compared to exposures encountered in ground-based public microenvironments. Oldaker and Conrad(1) report nicotine concentrations ranging from nondetectable to 40 ug/m^3 in nonsmoking sections. Based on the geometric mean (5.5 ug/m^3) of this data interpreted in the form of cigarette equivalents of nicotine inhaled, they assert that nonsmokers exposures are "orders of magnitude lower than the exposures represented by smoking a single cigarette" and that the current system of smoker segregation "significantly reduces the exposure of persons seated in no-smoking sections to ETS" compared to the concentrations encountered in smoking sections. However, the Surgeon General has stated that extrapolation from atmospheric measures of ETS to cigarette equivalent units is a

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meaningless process(2). Moreover, the use of the geometric mean rather than the arithmetic mean minimizes the health risk(3) as well as the extremes of the observational data. Further, the ratio of the arithmetic mean of nicotine in the smoking section (22.4 ug/m^3) to that in the nonsmoking section (9.3 ug/m^3) about 2.4 to 1, is comparable to that seen in ground-based public facilities(4) despite the "once through" aircraft heating, ventilation, and air conditioning (HVAC) systems, implying that aircraft systems, as designed and operated, are no more effective than ventilation systems in buildings.

Oldaker and Conrad(1) assert that the mean nicotine levels in the aircraft investigated are substantially lower than mean levels observed in environments where the density of smokers is similar, citing data reported by Muramatsu et al.(5). However, the comparison of the data of Oldaker and Conrad(1) with that of Muramatsu(5) is flawed because neither provide any information on smoker density. Further, they inappropriately compare their geometric means to Murumatsu's arithmetic means.

Analysis of the work of Muramatsu et al.(5), however, does provide useful information for evaluating the levels of nicotine measured by Oldaker and Conrad(1). Muramatsu et al.(5) report simultaneous measurements of nicotine and RSP. It appears that the ratio of RSP (less a 30 ug/m^3 background) to nicotine measured in an office environment is about 7:1; other authors have reported values twice as high(6). With the assumption

of this low RSP-to-nicotine ratio, the nicotine data of Oldaker and Conrad can be conservatively compared to RSP values measured in public facilities on the ground. The arithmetic means of nicotine measured in the nonsmoking and smoking sections of the aircraft then translate into estimated RSP values of about 95 ug/m^3 and 187 ug/m^3 respectively, with a 30 ug/m^3 estimated non-ETS RSP background(7) added in. These mean levels are higher than the levels measured in the nonsmoking and smoking sections of large restaurants(4). Moreover, fully 25% of the data which Oldaker and Conrad(1) report for nonsmoking sections in aircraft (estimated RSP concentrations from 100 to 310 ug/m^3 -- including background) have levels which are as high or higher than the levels encountered(4) in the smoking sections of these restaurants (100 to 160 ug/m^3). Thus, simple separation of smokers and nonsmokers aboard aircraft appears inadequate to protect nonsmokers from high levels of toxic and carcinogenic air contaminants from ETS, particularly flight attendants and passengers with cardiovascular or respiratory disease. This conclusion is in accord with the Surgeon General's conclusion that separation of smokers and nonsmokers will reduce but not eliminate exposure to ETS(2), and with the National Research Council's conclusion that smoking on aircraft should be banned(8).

*The views presented in this letter do not necessarily represent the official policies of the authors' respective agencies.

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