Short asbestos fiber levels in indoor environments

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Environmental exposures to asbestos fibers could occur in buildings with altered asbestos containing materials (ACM). These materials could emit short asbestos fibers (SAF: length (L) < 5 µm) and long asbestos fibers (LAF: L ≥ 5 µm). Only LAF, as defined by the World Health Organization (WHO): L ≥ 5 µm, Diameter (D) < 3 µm, L/D > 3, are targeted by the legislation. However, recent reviews argued that the pathogenicity of SAF cannot be completely ruled out (Dodson *et al* (2003), Boulanger *et al* (2014)).

The objective of this study was to perform air sampling in buildings with ACM, mainly asbestos floor tile, to provide a first overview on indoor air SAF levels and to compare them with indoor air LAF levels.

Forty-seven buildings (schools, one university, one nursery, apartments, hospitals, offices) were monitored between December 2011 and July 2014, with air sampling performed during occupancy only, for a week, on cellulose-ester membranes at a flow rate of 7 L/min. The membranes were ashed in a low temperature asher and the ashes were transferred onto grids (indirect method) for Analytical Transmission Electron Microscopy (ATEM) analyses. All asbestos fibers, LAF and SAF, were identified and counted.

A total of 131 measurements were performed. Short asbestos fibers were detected in around 50% of all samples, long fibers in only 16%. The type of asbestos was always chrysotile. No relationship was identified between short and long fiber concentrations in indoor air.

The median concentration, mean concentration and standard deviation of SAF were respectively below the limit of detection, 17.2 fibers per liter (f/L), and 117 f/L (Table 1). The maximum concentration was 1343 f/L, and was measured in an apartment. The SAF concentrations were highly variable, with schools (median concentration: 3.6 f/L) having the highest median levels (if we except the maximum value). Since in most of the situations, the material containing asbestos was floor tiles (127 rooms out of 131), it is assumed that the indoor concentration is higher in rooms with a higher density of occupants, who amplify the floor wear.

The presence of LAF in air samples was very scarce during current activities. All the median values were below the limit of detection. The maximum value was 14.9 (in the same apartment where the maximum SAF concentration was measured). The French threshold for indoor LAF level, 5 f/L, was exceeded once (in this apartment) whereas there is no mandatory limit for SAF.

More than 90% of asbestos fibers had very short dimensions, with a length between 0.2 µm and 2 µm and a diameter less than 0.2 µm.

In summary, in buildings with asbestos floor tiles, airborne SAF are present in one out of two. It is a sign of material degradation. Toxicity of these fibers is difficult to estimate but cannot be ignored and further research is needed to identify the determinants of SAF in indoor air.

Table 1. Indoor air levels of SAF (f/L)

Type of building (numbers of buildings;data)	median level	mean level (+/-)	Max level
All types (47;131)	< LOD	17.2 (117)	1343
Apartments (12;20)	< LOD	67.9 (300)	1343
Offices (14;47)	< LOD	4.3 (14.2)	97
Nursery (1;2)	/	2.3 (/)	3.6
Schools (15;32)	3.6	22.7 (47.4)	207
Middle school (1;7)	< LOD	1.1 (1.4)	4
High school (1;8)	< LOD	2.5 (4.1)	11.5
University (1;9)	< LOD	< LOD	<LOD
Hospitals (2;6)	1.6	5.7 (8.1)	19.5

LOD: limit of detection (0.99 f/L)

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