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Termites and asthma: is there a connection?

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To the Editor,

Termites (order *Isoptera*; phylum *Arthropoda*) are highly social insects with a worldwide distribution. They are detritus feeders, and commonly consume dead wood in plants and trees. They can digest lignocellulose with the help of a combination of digestive enzymes produced by their intestinal epithelia and symbiotic gut microbiota.

A relationship between exposure to household arthropods and the development of asthma has been described (1), but little literature has focused on links between termites and asthma. The aim of this correspondence is to outline the potential link between these insects and this inflammatory condition.

Different genera of anaerobic and methanogenic flagellates (*Trichonympha*, *Pseudotrichonympha*, *Spirotrichonympha* and *Oxymonads*) have been observed in the hindgut of termite's species such as *Reticulitermes*, *Coptotermes*, and *Cryptotermes*. These organisms play an essential role in lignocellulose digestion (2). The acquisition of flagellate symbionts by the first nymphal instar of these insects arises from feeding on the anal droppings of infested adults, a phenomenon called "proctodeal trophallaxis". These protozoal flagellates appear to remain dormant in termite droppings for long periods by developing cystic forms in response to adverse environmental conditions and then reactivating if consumed by other termites or in other favourable circumstances.

In buildings that have termite nests, dust particles from termite droppings are present in the air, particularly where they are disseminated by air conditioning and heating systems. Dust particles containing protozoal cysts may consequently be inhaled and deposited into the respiratory tract where they may contribute to inflammatory processes.

Figure 1 shows images taken from the sputa of two asthmatic patients (clinical data are shown in Table 1).

Both panel A and B includes two multiflagellated protozoa most likely belonging to the order *Hypermastigida*, based on morphological features such as ovoid-pyriform in shape, presence of numerous irregular flagella around 2/3 of the cytoplasmatic surface, and phagocytic vacuoles into the cytoplasm. The observation of some leukocytes (± 12 μm in diameter) in the smears helps to calculate the size of both protozoa. These morphological features differ significantly from the characteristics of degenerate ciliated bronchial cells (the cilia are observed only in one of the ends of the cellular body and display a terminal bar). As supplementary data (Video 1), the attached video-sequence of one of these multi-flagellated protozoa highlights the irregular movement of the flagella in fresh sputum.

Two aspects of the respiratory tract may provide favourable conditions for anaerobic, or partially anaerobic, flagellates. Exhaled nitric oxide levels are increased in patients with asthma and oxygen levels may be reduced in pockets by the presence of excess mucus, and we have the example of *Pseudomonas aeruginosa, which* can multiply in hypoxic zones found in thickened mucus in cystic fibrosis (3).

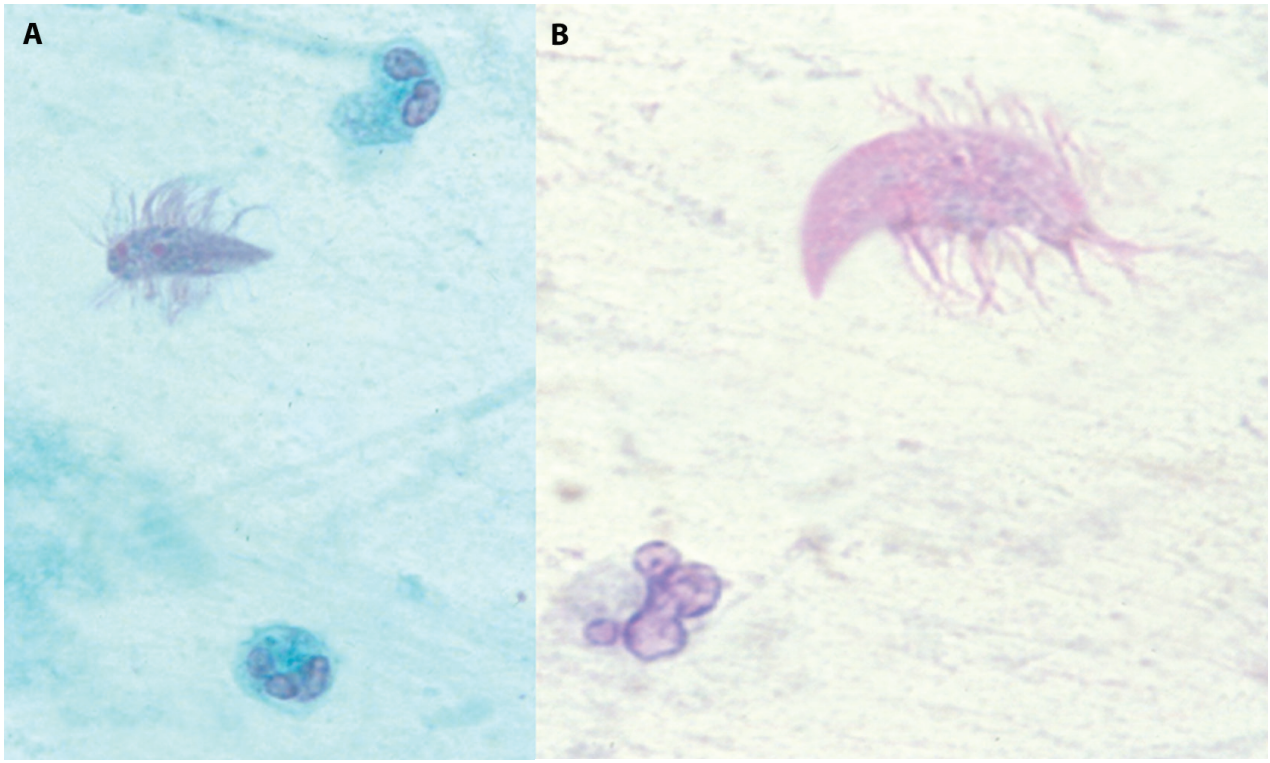

Figure 1. Figure 1: Sputum smears. A: Multiflagellated protozoon between two leukocytes, with characteristic ovoid elongated cytoplasmic shape and irregular flagella arranged along its borders (Weathley´s trichromic, x 1000). B: Similar multiflagellated protozoon (Papanicolaou stain, x 1200).

Table 1. Clinical summary of the asthmatic patients

	Patient A	**Patient B**
Gender	Female	Female
Age range	15-20 yrs	25-30 yrs
Specific IgE	30 u/mL	19.5 u/mL
Eosinophils blood count	1,900/μL	1,600/ μL
Main symptoms	Chronic cough and acute onset of breathlessness	Chronic cough and acute onset of breathlessness

Inhaled excysted protozoa may secrete enzymes that disrupt the epithelial barrier. Two mechanisms may be relevant in asthma. Firstly, the respiratory tract contains protease-activated receptors (PAR) that are activated by cleavage of part of their extracellular domain. PARs are present on respiratory cells including alveoli, ciliated cells and goblet cells (4), and it is therefore plausible that proteases produced by flagellated protozoa, originally derived from termite hindgut, may contribute to the inflammatory response that occurs in asthma and other atopic conditions.

Secondly, flagellated protozoa may act as disruptors to the airway epithelium by means of its interaction with the tight-junctions, as anaerobic flagellated protozoa have been reported in sputum smears from asthmatic patients (5,6). This is supported by the fact that high desquamation and denudation of the respiratory epithelium is a recognised characteristic in cytological and biopsy samples from asthmatic patients.

Thus, in the absence of specific culture media or molecular markers, observation under light microscopy

remains the only feasible method for identifying these protozoa in respiratory samples.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement, etc.) that might pose a conflict of interest in connection with the submitted article.

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