

Colonization of Infants and Hospitalized Patients with *Clostridium difficile* and Lactobacilli. PAUL NAABER, KARIN KLAUS, EPP SEPP, BENGT BJÖRKSTEN, AND MARIKA MIKELSAAR. *From the Institute of Microbiology, University of Tartu, Tartu, Estonia; and the Department of Paediatrics, University Hospital, Linköping, Sweden*

Clostridium difficile is the most frequent agent of nosocomial diarrhea in industrialized countries. Approximately 10%–25% of hospitalized patients become colonized by *C. difficile* [1]. Among nonhospitalized adults, the rate of carriage of *C. difficile* in the intestinal tract varies in different countries, ranging from 2% in Sweden to 15% in Japan [2]. Asymptomatic carriage of *C. difficile* is more common among infants and young children, ranging from 15% to 63% [2].

It is generally agreed that the disruption of the indigenous intestinal microflora is an essential prerequisite for colonization by *C. difficile*. The presence of lactobacilli as a component of the indigenous intestinal microflora has traditionally been associated with resistance to colonization with intestinal pathogens [3, 4]. However, it is not clear if the counts of lactobacilli differ significantly between persons who are colonized by *C. difficile* and those who are not. The aim of our study was to compare the prevalence and counts of *C. difficile* and intestinal lactobacilli in Estonian and Swedish children and to compare the counts of lactobacilli in hospitalized Estonian patients in relation to the presence of *C. difficile*.

We investigated the fecal microflora of 27 healthy Estonian infants and 29 healthy Swedish infants (all 1 year of age) and 34 consecutive patients (66 fecal samples) in the neurological intensive care unit of Tartu University Hospital (Tartu, Estonia). The patients had been hospitalized because of neurological surgery or brain trauma for periods ranging from 2 days to 5 months (median duration, 11 days) before sampling. These patients had been treated with up to nine different antimicrobial agents (median number, four; some had not received any agents).

The study was done during two 2-month periods separated by a 10-month interval. To detect *C. difficile* in these hospitalized patients, the fecal samples were seeded after alcohol shock into cefoxitin-cycloserine-fructose agar and incubated anaerobically for 4 days. In addition, the counts of *C. difficile* and lactobacilli in all samples from the infants and in 20 randomized samples from the hospitalized patients that were collected in the second period were determined as described previously [5].

Ten (35%) of 29 Swedish infants and only one (4%) of 27 Estonian infants were colonized with *C. difficile* ($P < .05$; figure 1A). Furthermore, counts of *C. difficile* in feces were significantly higher in Swedish infants than in Estonian infants ($P < .05$; figure 1B). However, both the prevalence and counts of lactobacilli were significantly higher among the Estonian infants than among the Swedish infants ($P < .005$).

None of the 21 hospitalized patients was colonized by *C. difficile* during the first 2-month observation period, whereas seven of 13 patients were found to be colonized during the second period. The counts of *C. difficile* varied from 4.3 log cfu/g to 8.1 log cfu/g (median count, 7.0 log cfu/g). The counts of lactobacilli were

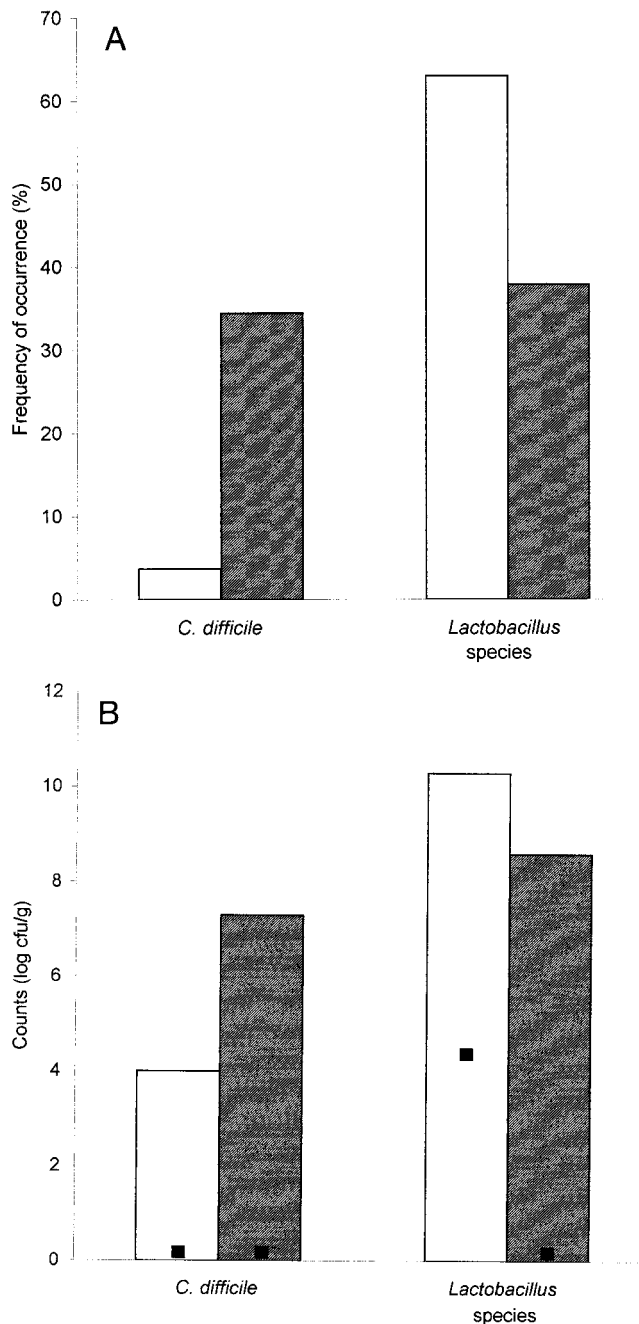


Figure 1. A, Frequency of the occurrence of *Clostridium difficile* and lactobacilli in Estonian (□) and Swedish (■) infants. B, Ranges and medians (■) of counts of *C. difficile* and lactobacilli in Estonian (□) and Swedish (■) infants.

significantly higher ($P < .05$) in *C. difficile*-negative samples (0–8.8 log cfu/g; median count, 5.3 log cfu/g) than in *C. difficile*-positive samples (0–7.1 log cfu/g; median count, 0 log cfu/g).

Thus, we found that the intestinal carriage rate for *C. difficile* was relatively low among Estonian infants as compared with that

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among Swedish infants. At the same time, Estonian infants were more often colonized with lactobacilli, and the counts were higher. It is known that some lactobacilli are antagonistic to *C. difficile* in vitro and in vivo [3, 4]. Therefore, we speculate that high counts of lactobacilli in the intestines of Estonian infants are protective against colonization by *C. difficile*. The differences in the prevalence of lactobacilli and some other intestinal microbes among Estonian and Swedish infants could be due to different diets and/or other conditions under which the sources for normal intestinal microflora are established (authors' unpublished data). The maternal vaginal and intestinal microflora and the hospital environment are the most likely determinants of acquisition of *C. difficile* by neonates. Thus, the low carriage rate for *C. difficile* among Estonian pregnant women (authors' unpublished data) could also explain the low prevalence of *C. difficile*.

The counts of lactobacilli were significantly lower in the *C. difficile*-positive hospitalized patients. Furthermore, the patients in whom the lactobacilli remained relatively intact after antimicrobial

treatment were less likely to be colonized by *C. difficile*. Whether lactobacilli play a significant role in the maintenance of resistance to *C. difficile* colonization in various populations and hospitalized patients needs further study.

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