

VIRUSES IN BEACH SAND

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Introduction

Beach sand is a broad habitat inhabited by many organisms. The organisms inhabiting supratidal and intertidal sands and the ones found above the margin of an aquifer are termed psammon. The most commonly known is possibly the macropsammon comprised of molluscs, crustaceans, and annelids. The meiopsammon, less familiar, are near-microscopic organisms such as nematodes, copepods, and flatworms often predators, collectors and grazers. Even less studied are the sand microbes also termed micropsammon. Remarkably, little is known about the micropsammon especially in comparison to soil, water, and bottom/submerged sediment. Sand microbes include autochthonous species and allochthonous organisms, including faecal indicator bacteria (FIB) and other waterborne pathogens such as viruses and protozoa, which are deposited by way of waves, runoff, air, and animals. The destiny of these microorganisms spans from death, to temporary persistence and/or possible replication, to naturalization of thriving populations and integration in the indigenous community. Undoubtedly, fungi and bacteria are able to proliferate in sand. The detection of culturable fungi and direct microscopic bacterial counts from sand has been previously reported, with numbers up to $1.5 - 7.6 \times 10^6$ CFU/g and greater than 10^7 /g sand, respectively. Transport of the micropsammon occurs vertically, from ground water to sand surface and horizontally across the beach. Additionally, transport through interstitial flow, particle-associated microbes, and terrestrial runoff and wave movement are also possible. A multiplicity of pathogens has been studied from beach sand with recent epidemiological reports showing some correlation between sand exposure and associated health risks. Only a few studies have been conducted on the occurrence of enteric viruses in beach sand. These studies focused mainly on the detection of cultivable enteric viruses, i.e. enteroviruses and reoviruses. No studies have focused on the presence of noroviruses and hepatitis A viruses, the main aetiological agents of water and foodborne gastroenteritis and hepatitis. The same happens for the presence of hepatitis E viruses.

The present study aimed to detect different pathogenic viruses: noroviruses GI (NoVGI), noroviruses GII (NoVGII), hepatitis A (HAV) and hepatitis E (HEV), Adenovirus (HAdV) and JC polyomavirus in beach sand.

HAV were detected in 6.25% (3 out of 48) and HadV were detected in 8.33% (4 out of 48) samples using qPCR. These results corroborate the reporting of sand as an independent source of GI illness.

The present study emphasizes the need to include sand in regulation and analytical standards for microbiological quality of bathing beaches. The assessment of water quality by itself is not adequate for protecting public health of recreational users, as previously demonstrated and now confirmed by our results. Moreover, the persistence and presence of viruses associated with human disease does not correlated with the current FIB.