

Evidence Brief: Risk of Infection in the Use of Floatation Tanks



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Issue and Research Question

Overview

Floatation tanks (also known as sensory deprivation, immersion therapy tanks, or isolation baths), are lightless, soundproof chambers in which a person floats in a shallow depth of salt water fluid.¹ The fluid is typically between 12-18 inches deep and consists of a near-saturated (25-30% by weight) mixture of potable water and epsom salt (magnesium sulfate, or $MgSO_4$). Typically the water is heated to 34-37°C, both to match the user's body temperature and allow sufficient dissolution of the high concentrations of salt.² The water does not normally contain a chemical disinfectant (e.g. chlorine or bromine), although water may be recirculated through a filtration unit between users.^{3,4} The high salt concentration allows users to float with

minimal effort by creating a saline environment 1.2-1.3 times denser than pool water. Most tanks are designed to be an enclosed, relaxing, and virtually stimulation-free environment.⁵

In recent years, the recreational use of floatation tanks has grown in popularity as a form of stress reduction.⁶ Literature in alternative medicine has identified Floatation-REST; (Restricted Environmental Stimulation Technique) as a "one hour session in a tank containing water with a high salt content (approximately 30%) and maintained at 35°C".⁷ A meta-analysis by Dierendonck and Nijenhuis concluded that floatation-REST has an impact similar to other more popular stress management techniques, such as meditation.⁸ Although floatation tanks are available for purchase by the general public, most floatation tank users visit centers that offer

the service for a fee.”⁷ Bathers lie face up, floating on the water’s surface. Generally only one individual will float at a time, however partner floatation does occur.⁹

Classification

In Ontario, public pools and spas are regulated under the Ontario Health Protection and Promotion Act (HPPA), O Reg 565, and O Reg 428.^{10,11,12} Under these Acts, public pools and spas are individually defined; however, there is currently no clear protocol in Ontario for the inspection of floatation tanks. Following HPPA definitions, a floatation tank would be exempt from the public pool requirements, as pool regulations only apply to public pools with a depth of more than 0.75 meters (29.5 inches).¹¹ Further, floatation tanks also do not fall under the definition of a public spa, as they do not utilize hydro jet circulation, air induction bubbles, current flow, or a combination of them over the majority of the pool area.¹² If a tank met the classification of a pool or spa as defined in the HPPA, operators would be required to maintain the appropriate levels of chemical disinfectant (i.e. chlorine or bromine), in addition to meeting other criteria.^{11,12} Finally, floatation tanks are not currently classified under the Ontario Recreational Water Protocol (2014), which includes other non-regulated recreational water bodies such as slide receiving water basins and wading pools.^{13,14}

Given the above considerations, floatation tanks present a unique problem to local Boards of Health. The lack of applicable legislation and differences between pool and spa classifications may create challenges when assessing associated risk. Further, there is significant variety in how individual floatation tanks are operated and maintained. This evidence brief asks: ***Is there a risk of infection associated with the use of sensory deprivation and immersion therapy (floatation) tanks?***

Methods

A research librarian in combination with two reviewers conducted a literature search between

December 2015 and January 2016. Ovid Medline and Embase databases were searched for published literature, and an additional search for grey literature was conducted using Google and Google Scholar. Included studies were English language articles published between 1974 and 2015 (December 28) with a restriction to human subjects. The search yielded 705 full text studies from Medline and 304 from Embase.

Search results were exported for a title and abstract review, conducted in duplicate for eligibility. Where discrepancies between reviewers existed, a full text review was conducted and resolved by discussion. Consultation with Public Health Ontario Laboratories (PHOL) library staff was also completed, and additional resources were added based on content expert feedback. Provincial and international guidelines were consulted in order to assess differences in recommendations and classification. Given the need to consider a wide scope of both peer reviewed and grey literature, full text versions of all potentially relevant articles were retrieved for review. Additional studies and supporting evidence were identified through hand-searching the reference lists of relevant studies, in addition to inclusion of any relevant legislation (i.e. HPPA). Hand search categories were broken down by subject area, as per the main findings. The full search strategy can be obtained from Public Health Ontario (PHO) upon request.

Main Findings

The title and abstract scan yielded 62 relevant abstracts, which were then reviewed in full text. No articles directly addressed the research question outlined above. However, ten studies provided evidence of human pathogenic salt tolerance and twelve studies discussed outbreaks related to pools and spas.

Floatation Tank Use and Human Pathogen Survival

In order to assess risk, and given the paucity of evidence directly related to the research question, literature on pool/spa outbreaks as

well as pathogenic bacteria and general salt tolerance was reviewed. Given the physicochemical properties of the floatation tank saltwater environment, there was an attempt to determine the effects of concentrated magnesium sulfate solutions (Mg_2SO_4) on microorganisms typically found in a pool or spa.

Floatation tank water contains an extremely high concentration of epsom salt; between 25-35% (weight/volume or w/v).¹ This is near the saturation limit of Mg_2SO_4 , which is 30% at 20°C.¹⁵ High salt concentrations cause water to leave the cell, and it is this osmotic pressure that inhibits microbial growth and reproduction.¹⁶ Research conducted by the National Sanitation Foundation (NSF) analyzed the survival of various microorganisms in water collected from a floatation tank.¹⁷ The organisms assessed were representative of the possible pathogens found in a tank post use.^{18,19} Organisms were inoculated into the water and incubated for 24 hours at typical floatation tank temperature (35.1°C). Results are summarized in Table 1.¹⁷

Table 1: Log₁₀ reductions of select organisms when incubated in floatation tank water at 35.1°C, as reported by the NSF.¹⁷

Organism	Incubation time			
	1 hour	4 hours	8 hours	24 hours
<i>Pseudomonas aeruginosa</i>	-0.61	-0.85	-1.19	-2.58
<i>Candida albicans</i>	+0.08	-0.12	-0.37	-1.67
MS2 bacteriophage	-0.17	-0.57	-0.55	-1.39
<i>Enterococcus faecium</i>	-0.01	-0.15	-0.15	-0.76
<i>Aspergillus niger</i>	+0.13	+0.09	+0.08	+0.04

These results reinforce what would be expected. Gram-negative bacteria (such as *P. aeruginosa*) are known to have a lower tolerance for high salt concentrations than Gram-positive bacteria

(such as *E. faecium*) due to the thinner peptidoglycan layer of their cell wall.²⁰ The fungi (*C. albicans* and *A. niger*) were relatively tolerant to the magnesium sulfate solution. It is well understood that many fungi can survive in environments with low water activity (A_w).²⁰ It is difficult to know how viruses would survive based on these results. However, the MS2 bacteriophage (viral surrogate) used in this study was not significantly affected by the magnesium sulfate solution.¹⁷

An article by Crisler et al. examined the effects of saturated magnesium sulfate solutions on strains of extremely halophilic bacteria. Results demonstrated the effects on these bacteria were similar to those of saturated sodium chloride (NaCl) solutions, and that halophilic bacteria would likely survive in magnesium sulfate solutions.²¹ However, there are very few situations where sodium chloride concentrations reach 25-30% w/v. For comparison purposes, the ocean is only about 3% salt, while the concentrations in cheese brine are between 6-27%.²² Further, Surendran et al. assessed salt (NaCl) tolerance of selected cultures of *Pseudomonas* as well as strains of *Moraxella*, *Vibrio* and *Photobacterium*, among others.²³ Results showed the maximum amount of salt tolerated by *Pseudomonas*, *Vibrio* and *Micrococcus* spp. was in the range of 10 to 20%. Of the *Pseudomonas* strains tested in an extremely halophilic environment (20-32% w/v), no growth was observed.²³ These results illustrate that a concentrated salt solution (similar to that found in a floatation tank) has modest microbicidal activity. It would likely prevent the growth and replication of most pathogenic microorganisms.²⁴ However, once inoculated with pathogenic microorganisms, it appears many would survive for several hours and potentially several days, resulting in potential exposure.

Floatation Tank Use, Exposure Pathways and Infection

Exposure pathways for floatation tanks differ from those encountered in swimming pools or spas.⁹ As described, the saltwater solution is typically at a depth of 8-12 inches. Given that

most users lie on their back, the face and ventral portion of the body is above the water line.⁸ While some individuals wear bathing attire, naked bathing is commonly cited in both literature as well as a scan of online floatation tank practices.²⁵ In addition, ear plugs may be supplied to the user, and are sometimes included in a user fee.

The hazards encountered in recreational water environments vary by site and activity. It has been recommended that bathers shower before entering a floatation tank, which may help limit the quantity of microorganisms and other organic material that is introduced into the floatation tank.⁴ Generally, floatation tank water does not come into contact with the eyes, nose, or mouth.⁴ Bathers may succumb to infection when an organism colonises a suitable growth site in the body.²⁶ These portals of entry may include the mucous membranes of the genitals, anus, or small openings in the skin.^{27,28} In investigating outbreaks of whirlpool associated skin infections such as dermatitis and folliculitis, *Pseudomonas aeruginosa* has been most commonly reported.^{24,29} In addition, illness caused by *Staphylococcus aureus*, *Mycobacterium* spp., *Streptococci* spp. and *Acanthamoeba* spp. have been reported, but less frequently.³⁰ Furthermore, the interaction of the saturated magnesium sulfate solution with open wounds will produce significant discomfort, possibly deterring participation. Ultimately, the degree of infectivity and pathogenicity depends on conditions of the exposure as well as host, immune status and susceptibility.³¹

Floatation Tank Filtration and Disinfection

Most floatation tanks contain recirculation systems which are typically in operation when the floatation tank is unoccupied (i.e. between clients, or at the end of the day). These recirculation systems contain filtration units designed to remove particulates from the water. This could reduce the burden of pathogenic microorganisms in the water by removing skin particles and other organic material that could prolong their survival.³²

Many floatation tanks also incorporate a UV disinfection unit that disinfects the water as it is recirculated. In these cases, the risk of infection is typically low, as UV systems are highly effective at destroying microorganisms in solution.⁹ In this case, microorganisms likely to survive are those that are adhered to the sides of the chamber, thus avoiding the disinfection system.

Finally, routine cleaning and disinfection will serve to minimize microorganisms on the surfaces of the chamber. To perform this type of disinfection, the chamber will have to be drained of all water, manually cleaned with a detergent, and disinfected with a suitable disinfectant.³³ The frequency of cleaning and disinfection type will ultimately determine the level of outstanding contamination adhered to the chamber walls.

Discussion and Conclusions

The solution used in floatation tanks is inhospitable to all but the most highly salt-tolerant microorganisms. Despite this, pathogenic microorganisms commonly associated with pool or spa use can survive in a near-saturated magnesium sulfate solution for hours to days after their introduction. Outbreaks in recreational and therapeutic whirlpools appear to be directly related to inadequate operational and maintenance procedures, making routine cleaning an important element of infection control for recreational water activities like floatation tank operation.

Several factors reduce the ability of these microorganisms to infect users which include but are not limited to: Portals of entry (i.e. not exposing eyes, ears, nose and mouth), filtration of the water to remove organic material, disinfection with UV systems and routine cleaning/disinfection of the floatation tank chamber walls.^{2,17} Proper maintenance is essential to the prevention and control of waterborne infection.^{24,34}

Limitations of this Evidence Brief

This evidence brief presents key findings from the scientific literature. Its purpose is to investigate a research question in a timely manner to help inform decision making. This report is not a comprehensive review of the literature, but rather a rapid assessment of the available evidence. There may be relevant pieces of research not included and these may alter the conclusions drawn from the document. Further, there is a lack of peer reviewed literature directly related to the research question. Differences in provincial guidelines and classification vary; and this may also create challenges in estimating the risks for infection, based on differences in operator practice and routine use. Given floatation tanks are a growing recreational activity; more research in this area may better inform both public health policy and health unit recommendations.

Appendix

Definitions

Floatation tank: (a.k.a. Float Tank, Floatation tank, Float Room/Pod, Isolation Tank, or Sensory Deprivation Tank): A tank that contains a saturated solution of magnesium sulfate having a specific gravity of 1.23 to 1.3, provides a light and sound free environment, and is maintained at a temperature of approximately 93.5°F (34.1°C).¹

Public Pool: “public pool” means a structure, basin, chamber or tank containing or intended to contain an artificial body of water for swimming, water sport, water recreation or entertainment, but does not include,

- (a) one that is located on a private residential property under the control of the owner or occupant and that is limited to use for swimming or bathing by the owner or occupant, members of their family and their visitors, or
- (b) one that is used solely for commercial display and demonstration purposes; (“piscine publique”).^{10,11}

Public Spa: “public spa” means a hydro-massage pool containing an artificial body of water that is intended primarily for therapeutic or recreational use, that is not drained, cleaned or refilled before use by each individual and that utilizes hydrojet circulation, air induction bubbles, current flow or a combination of them over the majority of the pool area.^{10,12}

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