

11 Swimming water

In The Netherlands many surface waters give a perfect opportunity for recreation. For many Dutch people spare time and recreation always has something to do with open water. This is a fairly new phenomenon. Till the beginning of the twentieth century water was nearly only dealt with professionally. Nowadays the main activities involving us with surface water are swimming, surfing, sailing, rowing and canoeing. Hundreds of swimming pools are set up. A widespread surveillance has been set up for keeping an eye on the various aspects of quality and safety, because all these water activities not only can improve on health conditions, but also sometimes go along with factors that can harm them.

The positive effect on health from swimming is decreased by a sort of higher chance in illness from a number of disorders. Firstly it involves disorders of organs, which are directly exposed to water, like skin, ears, eyes and airways. Diseases of deeper lying organs are more rare (such as stomach and intestines). We as humans just are no water animals. We do not have a fat skin; on the contrary our skin softens in water. We cool down quickly at temperatures, which are quite normal for many (also warm-blooded) water animals. The blocking of our nostrils and ear canals is also not fantastic. Pathogens, as we know, profit from a decrease of resistance: a combination of a decline in skin- and mucous membranes resistance and cooling down. Not only organisms from the outside, but also already present pathogens can profit from the changed circumstances. Swimming therefore can have negative impacts on health from a bacterial point of view.

The descriptions of some diseases linked to swimming or swimming water will follow here below (like hepatitis A, illness of Weil, *Pseudomonas aeruginosa* infections, infections from *Aeromonas*, etc). After that we will examine the quality requirement of recreational water. Finally a discussion will follow about circulation baths and new acquisitions, such as whirl pools and their possibly related problems.

Weil's disease is in our country more feared than acquired. It involves several tens of cases per year, of which some deadly. The pathogen is *Leptospira ictero haemorrhagiae*, a spiral formed micro organism. Stagnant pools, where rats stay, are especially infamous. Many city canals meet however that description (people who fell in, participators in student events!). Mainly the old rats carry the leptospirae in their bladder and kidneys. Then when they urinate it gets into the water. Swimmers can pick up the organism either in the water or on the bank. Mucous membranes or little wounds in the skin are usually the portal of entry. The incubation period is 10 to 20 days. Hepatitis is one of the most important consequences. Hygiene is for more than one reason the best solution. Swimmers can for example be less friendly to rats by not littering the bank with food rests.

New Serovar Hardjo (next version)

Schistosome dermatitis (water based)

The schistosome is treated as the cause of the serious disease schistosomiasis or bilharzias. This disease fortunately does not occur in The Netherlands. We do know inflammation of the skin (dermatitis) also called swimmer's itch or water rash. Conditions: open water, birds and snails. This is easy enough for our country. In water the bather does not notice anything, but then out of the water heavy itching and redness starts after a few minutes, sometimes even fever. The pathogens are cercariae, the young form of the flatworm Schistosoma. The adult worm lives in the blood of birds, which discharge their eggs with their faeces. In water a larvae develops itself into miracidium, which enters a snail. In the snail cercariae are formed and again enter a water bird through the skin and get into the blood to become adults. Because of the lack of birds other animals are tried out as well, so also the human. They try after attaching themselves while we are leaving the water. We however take care of them quickly by forming antibodies immediately. The reaction between the antibodies and the antigens (sensitisation) of the miracidia is exactly what causes dermatitis. From this moment more and more serious reactions can occur in a period of about ten years.

Schistosomiasis (bilharzia)

This (sub) tropical disease is discussed along with the worm diseases later on

Table: Several afflictions which can be caused by swimming and swimming water.

Affliction	Causal organism	Incidence/ year NL	Details
Weil's disease	<i>Leptospira ictero-haemorrhagiae</i>	50	Source often rat urine. Quite often in people who fall into water of canals or ditches. Case fatality rate $\pm$ 10%
Schistosoma-dermatitis	Schistosoma	thousands	Lakes and pools with bird and snail populations
Pseudomonas-infections	<i>Pseudomonas aeruginosa</i>	<u>1994: 200.000</u> <u>(Search)</u>	Inflammations of exterior ear (otitis externa)
Aeromonas-enteritis	<i>Aeromonas hydrophila/ sobria/ caviae</i>	hundreds	Gastro-enteritis, often with diarrhea; higher risk for people with diminished immunity
Irritation by algae	Blue- en green-algae		Irritation of skin and eyes
Canicola fever			Dog urine
Hepatitis A	hepatitis A virus (HAV)	NL: 0 elsewhere: varies	Fecal-oral. Liver inflammation. Mostly with jaundice. Low case fatality rate
Other viral infections	entero-, adeno-, rota-viruses	thousands	fecal-oral. Infections of respiratory tract and gastro-enteritis.

Intestine diseases

A number of disorders of the stomach and intestines by micro organisms, which occur in untreated drinking water, can also be obtained through swimming; diseases such as (para)typhoid and shigellosis. This can happen in theory, it is however not that bad in the end. Mainly because by swimming only a small amount is taken in and on the contrary with contaminated drinking water it involves an intake from decilitres up to litres. However people still should watch out, which is proven by the hepatitis A epidemic near Oporto in 1975.

The most dramatic incident of proven serious enteritis by swimming water was an epidemic of stomach typhoid in The English marine pool in Walmer in 1909. Seawater was extracted 100 m away from a sewer discharge without treating it with filtration or chlorination. A sensible swimmer should have been warned: the turbid water had a 'clear' sight of 1 cm (!) and the ground was covered in a smelling sludge layer. 28 of the 330 swimmers got stomach typhoid (morbidity?).

Primair amoeba meningo-encefalitis

This is treated in another chapter: amoebiasis.

Pseudomonas aeruginosa

Most people know the smell of this water bacterium: flower water smells the same, when it is not refreshed in time. Nowadays we know that *Pseudomonas* is an unwelcome guest in swimming pools, when the water is insufficiently chlorinated, especially in whirlpools, circulation pools and bubble baths. This is the other side of the paradise pool conditions that we normally long for.

In the summer of 1994 the bacterium caused a wave of inflammation of the ear canals (otitis externa). A number of several hundred thousands of people got infected by the bacterium in water. The source was the surface water of pools and lakes, of which the water temperature had increased with sometimes more than 25 C after a heat wave in July and August. This was favourable for *pseudomonas*. Several swimming places were closed. After some time the doctors were prepared for this disorder and its cause (your author however was after a warm swim in the IJsselmeer gone to Japan, and only after several doctors and hospital visits it became clear what the actual problem was). The warming up of the earth will possibly also have a negative influence on the flora of swimming water.

Aeromonas

Aeromonas was already known for a while as a water bacterium, but only the last ten years it is recognized to be often a cause of intestine complaints (usually with diarrhoea) by people who, especially in summer, are in contact with surface water. These people are for example swimmers, surfers and fishermen. Routine bacterial research of faeces in hospitals found the bacterium in about half percent of the cases, which normally was checked for others than *Aeromonas* in cases of intestine complaints (such as diarrhoea). People, who were predisposed to either serious diseases or heavy (immunity suppressing) therapy, or both, ran a lot more risk of *Aeromonas* enteritis. Import cases also happen from abroad.

Quality requirements

These involve the location as well as the physical, chemical and (micro) biological factors. The whole situation should be taken into account: crystal clear water can be serious contaminated by radiation or by chemicals; turbid water (peat parts) does not have to be dangerous at all. One single sample of one place is often too little for a good evaluation, as it applies for ground contamination in the same way. The sampling should be done with good background knowledge of the local situation, such as:

Stream patterns

Waste water discharges

Emergency exits of sewers

Landfills

Polder pumps

Shipping

Rats, cattle and water birds

Of course a good knowledge of the country is as important. Local investigations of the pseudomonas epidemic of summer 1994 were quickly known, for example by the Medical Inspection in The Hague, with positive results for prevention, diagnostics and treatment.

The most important variables at evaluating recreational water are:

1. The water management system, especially the possible presence of contaminated sources
2. The possible presence of sensory visual contamination, such as floating substances
3. The possible presence of components harmful for swimmers or components indicating this
4. The self cleaning capacity of water

There are three water qualities of swimming water to distinguish:

Quality 1: the desirable quality; unnecessary to improve

Quality 2: an acceptability quality; desirable to improve

Quality 3: an undesirable quality; urgent need to improve

In the following table the three quality groups are worked out for physical, chemical and microbiological factors. The quality is assumed not to be influenced by people, who use the water as recreation (through food, urine, faeces, etc.).

Three criteria exist, that are not yet divided into the three groups:

- Chemical contamination with possible toxic compounds, such as pesticides, heavy metals. Generally these have low concentrations in seawater and surface water used for recreation. One must be prepared must be for sudden discharges; acute fish death is a possible sign.
- Soil condition. Preferable sandy soil instead of soft muddy soil. Of course the absence of sharp objects and obstacles.
- Water depth. Signs in case of the possibility of great temperature differences must notify a water dept of more than 5 meters.

Table: Physical, chemical and microbiological criteria for surface water with recreational functions.

Aspect	Class 1	Class 2	Class 3	Motivation
Clearness	at least 1 m (or till the bottom)	0,5 - 1 m	0,5 m	indirect health danger by less control; troubled water is also unaesthetic.
colour, smell, taste	not really perceptible	only by natural circumstances	by water pollution	If unpleasant: visitors stay away; For the rest: recreational water can be allowed own characteristics.
floating material	none	some	yes: e.g. dead fish, oil, foam	Health danger is small; class 3 is aesthetically unacceptable
O ₂ % resp. BOC #	75-125 % 5 mg/ l	50-75 % of 125-150 % 5-10 mg/l	50 % of 100 % 10 mg/l	No direct influence on swimmer and his health. But both parameters for the degree of water pollution
PH	4-9	4-9	4 of 9	
bacteriological quality	Virtually no fecal pollution	Light fecal pollution	Obvious fecal pollution	Urges a large number of investigations during a continuous period
MPN ##	1	1-10	10	Idem

Percentage oxygen saturation, resp. Biochemical Oxygen Consumption after five days at 20°C

Microbial Pollution Number. Number of fecal E.coli's per ml according to Eijkman's test. Has to be repeated often during a continuous period in order to obtain a reliable result.

Circulation baths and medical problems

People are far more anxious for medical damage after the usage of swimming pools than after recreational waters. The institutions are after all municipal or private and are checked for their quality, also because legal liability is a consequence of health deprivation.

Epidemiological research teaches us that circulation baths sometimes are more dangerous than natural swimming water. The risk lies mainly in injuries by accidents. Problems with hygiene can also occur. It must be bared in mind that the intensity is often a number of ten till hundred times bigger; many people in a small place. The water is besides this usually considerably warmer than surface water. Several problems of swimming pools are:

- Rough walls or floors and sharp corners and edges hinder good cleaning and increase the risk of injuries.
- Insufficient maintenance, especially the cleaning of hallways, dressing rooms, toilets etc. gives a chance to various diseases.
- Open surfaces of materials as some wood parts, coconut matting, and porous tiles, make it possible for fungi to hold on and develop themselves.
- Micro organisms as well as chemicals can provide problems in water (also chlorine).

Skin infections and little wounds can be risky for fellow humans as well as for the swimmer himself. People should be disciplined with regard to these hygiene problems and stay away from water. Unfortunately the inspection has not improved in the last few years. Luckily enough more and more users of swimming pools have a shower before entering the water. Towels should not be shared; for foot fungi can be transmitted by these. Wooden planking is also a suitable fomite for fungi. However one should realize that the own flora often causes infections, especially when the body undergoes a decrease in resistance through water and cooling. We then speak of commensally infections. Since more and more people have a decreased resistance, e.g. by cancer, cytostatics, corticosteroids, radiation or HIV infection, well known infections as well as the so-called opportunistic infections become more numerous. Several diseases are discussed below which can be obtained in swimming pools.

Skin infections

Through for example staphylococcus and streptococcus, which are sometimes from the swimmer himself (commensal). The already mentioned *Pseudomonas aeruginosa* can cause skin rash as well as otitis externa.

Foot fungi

Fungi of the genus Trichophyton and Epidermo phyton find themselves preferably in folds of the skin. They can be transmitted not only in swimming pools and their various rooms, but also in dressing rooms and washing rooms. The following things could work as prevention:

- Building materials with closed surfaces (like good connecting tiles)
- Good cleaning, especially spaces where people go on bare feet
- Keeping the mentioned pales as dry as possible
- Keeping out users with fungi (financial suicide by infecting often a large percentage)
- Good foot care (here it is up to the users)

Foot warts

Comparable to foot fungi, including the prevention measures. A virus is the cause. Transmission also comparable to foot fungi, but including often dry environments such as gymnastic rooms and sport halls.

Swimming pool granuloma

Mainly in older baths grating along rough surfaces can damage the skin. On these places of the skin a little bump can occur that can develop itself into an abscess. This is innocent, but very stubborn. The cause is the *Mycobacterium marinum* related to the tubercle bacterium, which causes tuberculosis-like kind of abscesses.

Otitis externa

Has already been discussed at the *Pseudomonas aeruginosa* infections.

Eye disorders

Irritation can be the consequence of chemicals with which water is treated. Swimmers benefit from chlorination of swimming pools, however chlorination can also cause irritation of eyes and mucosa at (too) high as well as (too) low concentrations. Di- and tri-chloride amines can occur by economical use of chlorine. The safe concentration, also from a microbial point of view, is 7 micro mol/l or 0.5 mg/l. A dangerous aspect is the formation of chloride nitrogen compounds, which can be harmful.

Conjunctivitis, or infection of the conjunctivae is usually caused by *Chlamydia trachomatis* (virus kind of micro organism) in too lightly chlorinated water. Sometimes the cornea is also affected (we discuss chlamydia at the STD's).

Pharyngo-conjunctivitis (infection of throat as well as conjunctives) occurs also in too economical chlorinated water. The pathogen is the adenovirus 3. Fever and diarrhoea can occur.

Disorders of the airways

Very rarely lung oedema can occur by chlorinated water, because sometimes one is over sensitive for chlorine, even by the usual concentrations.

Disorders of the internal organs

Primary amoeba meningo-encephalitis is already discussed in another chapter.

Intestine diseases

(See another chapter).