Toilets and health throughout history

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Abstract

Two periods in history are especially important when considering the relationship between toilets and health: antiquity (ca. 500 B.C.–500 A.D.) and the industrial age beginning from the 18th century. Most of the past there are no sources that directly illustrate the relationship between toilets and health. We must rely on indirect evidence offered by ancient texts and archaeological remains. During antiquity hygienic conditions in both public and private toilets must have been very poor, and consequently intestinal diseases have been all around. The success of the 19th century sanitation movement in Britain was manifested in the construction of piped water supply systems, water closets and sewers in towns all over the world in the late 19th century and early 20th century. The amount of different microbes and parasites, which were found to be able to be transmitted through contaminated water, escalated during the 20th century. To the bacterial diseases like typhoid fever, dysentery and cholera already known to be spread by water at the turn of the 20th century, a multitude of viral diseases like poliomyelitis were added. The intimate link connecting human defecation practices and health has remained throughout times.

Keywords: antiquity, industrial age, pathogens, toilets, water

Introduction

Ingestion is a very important way of entrance of pathogenic organisms into the human body. A host of parasites (helminths, protozoa, bacteria, viruses) are known to infect the gastrointestinal tract and are excreted in the faeces of infected humans (or other animals). Hands, soil, water and food are then contaminated by the pathogenic organisms in the faeces. Eventually they enter the mouths of previously uninfected people and the transmission cycle starts anew.

Through most of human existence it is better to speak of latrines as special places were people went to defecate. However, it is plausible to assume that it was quite natural to observe that water was a convenient vehicle to carry away the stinking stools and proper toilets appeared in the course of time. Two periods in history are especially important when considering the relationship between toilets and health: first the antiquity (ca. 500 B.C.–500 A.D.) and then the industrial age beginning from the 18th century.

Most of the past there are no sources that directly illustrate the relationship between toilets and health. We must rely on indirect evidence offered by ancient texts and archaeological remains. There are quite few modern studies trying to connect the history of toilets and health (e.g. Otaki 2007, Matsui et al. 2003). Most of the studies deal with either the history of toilets or the history of health (or history of pathogenic organisms). In treatises about history of sanitation toilets and health are usually dealt with.

The problems with written sources increase as we go further and further into the past. However, about the history of intestinal diseases we often have nothing else but the written documents. Archaeological evidence includes the remnants of toilets and human beings and their stools. Coprolites are naturally desiccated or otherwise preserved ancient faeces, which may be found, for example, in ancient mummies or latrines. Coprolites and latrine sediments offer a unique opportunity to study ancient pathogenic organisms especially intestinal parasites. Modern technologies, especially studies of ancient DNA, have opened new possibilities to study ancient intestinal infections. However, there continue to be problems with ancient DNA studies, so cautious attitude to them is still recommended (Dittmar 2009; Roberts & Ingham 2008).

Aim of this paper is to review some aspects of the history of toilets and how toilets were connected to the history of human health. Especially important has been the hygienic conditions in and around the toilets for the health of people. The identification of possible pathogenic organisms is also discussed.

Antiquity

Modern human beings (*Homo sapiens*) have existed on the earth some 100,000 years. People got there living by gathering, hunting and fishing, and lived in small bands, constantly on the move. They were occasionally troubled by pathogens transmitted by hands, soil, water or food contaminated by faeces. Humans and some intestinal parasites such pinworm (*Enterobius vermicularis*), whipworm (*Trichiuris trichiura*) and hookworms (*Ancylostoma duodenale* and *Necator americanus*) have a long shared evolutionary history (Araújo et al 2008a and 2008b). Other human intestinal parasites like fish tapeworm, *Diphyllobothrium latum*, were acquired on several occasions by changing food habits in old or new habitats (Gonçalves et al 2003; Le Bailly et al 2005).

Remains of ancient parasites offer chronologically the first hints connecting human sanitary practices and health. The remains of ancient parasites connected to hunter-gatherers are fewer compared with agriculturists but this may only reflect the population densities. The appearance of these remains is easily explained by increasing population and a more sedentary way of life. Paleoparasitological studies indicate that many of the intestinal parasites familiar for us afflicted our antecedents already thousands of years ago. Identified helminths include roundworm (*Ascaris lumbricoides*), whipworm, hookworms, pinworm and fish tapeworm (Gonçalves et al 2003; Le Bailly et al 2005). Remains of some intestinal protozoa like Giardia have also been identified (Gonçalves et al 2003; Ortega & Bonavia 2003). The available evidence also indicates that these parasites had already almost universal distribution among humans.

The first evidence of purposefully constructed toilets in Europe comes from Bronze Age Crete in the second millennium B.C.. Bronze Age Minoans (and Mycenaeans) built bathrooms and toilets in their houses, the most elegant ones being in the palaces, especially in the palace of Knossos (Vuorinen 2007a). The toilets were probably flushed by hand in most cases. Elaborate drainage was discovered in the palace of Knossos and rainwater was probably used to flush the

toilet near the Queen's Hall. However, severe doubts about the efficiency of the drain of the toilet have been expressed (Hodge 1992: 477 n17).

During the Roman era (circa 200 B.C. – 500 A.D.) the civilized way of life meant that people had entrance to a toilet: either public or private. Water was used to flush toilets (especially public ones). The constant flow of the water assured that in towns equipped with aqueduct(s) there was plenty of water to flush the toilets, sewers and streets (Vuorinen 2007a). A public toilet was often built in proximity to or inside a bath so that it was easily entered from both inside and outside of the bath (Brödner 1983: 116-118, 153-154; Yegül 1992: 411–413; Manderscheid 2000). This solution for the location of public toilets had two advantages: 1) the abundance of water that was conducted to the bath could also be used to flush the toilet; and 2) the distance to the sewer needed for the bath was short. Typically there were numerous seats quite near each other in the toilet.

In a "standard" public toilet water flowed in two channels (Vuorinen 2007a). One was under the seats to flush away the faeces. Another conduit of water flowed in front of the seats. Water in this conduit was used to moisten materials, which were used to rinse ones bottom. Occasionally there could have been a water basin in the toilet.

The archaeological evidence of private toilets is scant when compared with public toilets. However, at least the inhabitants of Pompeii, Herculaneum and Ostia seemed to consider a toilet to be natural to have in their house (Hermansen 1981; Jansen 1997; de Kind 1998). Generally private toilets had only one or two seats (Wilson 2000). Quite often a private toilet was located under a staircase if located in a multi-storey building.

The private toilets were either flushed with water or they had a vertical drainpipe that hardly needed flushing with water (Vuorinen 2007a). Piped water for flushing private toilets seems to have been a rarity. In many cases the private toilet was located near the kitchen, most probably because of the convenience of building a common drain for them. Also, because water was needed for many purposes in the kitchen, this water could easily be reused to flush the toilet.

The poor level of waste management, including wastewater, most probably involved a major risk for public health during antiquity (Scobie 1986; Vuorinen 2007a). For instance, toilet hygiene must have been quite poor. The Romans lacked our toilet paper. They probably commonly used sponges or moss or something similar, which was moistened in the conduit in front of the seat and then used to rinse their bottoms. In public toilets facilities were common to all; they were cramped, without any privacy, and had no decent way to wash one's hands. The private toilets seem mostly to have lacked running water and they were quite commonly located near the kitchens. All this created an excellent opportunity for the spreading of intestinal pathogens.

The accumulation of faeces in the drains made the toilets even more unhygienic and the stench from the toilet drains must have been nauseating – there were no odour traps. Because the gradient was insufficient to prevent the settling of solids, including the faecal matter, in an ancient conduit drain, periodic cleaning was necessary (Wilson 2000).

Water-borne infections must have been among the main causes of death at least in Roman towns (Grmek 1989: 16). Dysentery and different kinds of diarrhoeas must have played havoc with the populations (Lim & Wallace 2004). The ancient medical writers (e.g. in Hippocratic writings, mostly written around 400 B.C.) described different kinds of intestinal diseases. Descriptions of the intestinal diseases in the ancient texts are unfortunately so unspecific that the identification of the causative agents and the retrospective diagnoses is a very problematic venture (Stannard 1993). For instance, cholera mentioned by the ancient Greek authors cannot be identified as the cholera, which we know and which is caused by *Vibrio cholerae*. Medical historians who are familiar with history of cholera seem to be unanimous that outside Indian subcontinent cholera caused by *Vibrio cholerae* spread first time in the 19th century. Studies of ancient DNA might offer some new evidence for identification of pathogens.

Identification of DNA sequences supposed to be from *Salmonella enterica* serovar Typhi in dental pulp from probable victims of the Plague of Athens (430–426 BC) gives some support for the existence of typhoid fever during antiquity (Papagrigorakis *et al*. 2006 and 2007). Although paleomicrobiology still has many problems to be solved paleoparasitology may have more to offer. Remains of ancient parasites reveal that hookworms and whipworms were around and also Giardia and even pathogens causing amoebic dysentery might have been present (Gonçalves et al 2003).

Although written sources indicate that intestinal diseases were common during antiquity and remains of some pathogens have been identified, the main problem is: How these findings are related to the toilets? It is hard to avoid the conclusion that the unhygienic conditions prevailing in the toilets must have been a major risk for public health during antiquity. However, this conclusion is based solely on indirect evidence.

Industrial age

From Middle-Age onwards the paleoparasitological evidence is more abundant in Europe. Studies using coprolites and latrine sediments indicate that whipworms and hookworms were common but also *Giardia intestinalis* and amoebic dysentery was around (Gonçalves et al 2003; Bouchet et al 2003; de Rocha et al 2006; Le Bailly et al 2008; Mitchell et al 2008). This might be connected to the poor sanitary practices during medieval and early modern times. However always to be remembered is the fact that the more recent times the better the remains of ancient parasites are preserved.

Simultaneously with industrialization and urbanization in the Western world, enlightened people were filled with the idea of progress. Ever since the 18th century, science and reason have been considered to be able to lead humankind towards an ever happier future. The idea of progress also overwhelmed Western medicine and public health during the 19th century.

In the early 19th century British lawyer Edwin Chadwick (1800–1890) suggested a system in which a constant abundant flow of good quality water flushes away diseases, moral deficiencies like criminality and drunkenness, and other possible problems in English cities through correctly constructed sewers, and the sludge was then to be used to fertilize agricultural land (Vuorinen

2007b). The success of the sanitation movement was manifested in the construction of piped water supply systems, water closets and sewers in towns all over the world in the late 19th century and early 20th century.

The rapid spread of water closets in various European countries was a controversial blessing. On the one hand, it efficiently washed human excrements away from the immediate surroundings of people. This might have protected people who had a bathroom and water closet in their apartment, as the experience in Hamburg during the cholera epidemic in 1892 showed (Evans 1990: 425–426). On the other hand, in crowded conditions when a lot of people shared a common water closet and bathing facilities, diseases spread easily as also evidenced by Hamburg in 1892. Water closets also efficiently increased the pollution of surface waters.

Already in the middle of the 19th century British physician John Snow, who became famous for his ideas concerning the role of water in the spread of cholera, expressed doubts concerning water closets: "*It follows from what I have said above that I should recommend the discontinuance of water-closets, or at least their diminution, instead of the continued increase of their numbers. A complete and well-regulated water-closet is so great a convenience that one cannot expect it to be discontinued in the better class of houses; but the so-called water-closet used by the working classes, who form the great bulk of population, is according to the experience I have had, a worse nuisance than an open privy over a cesspool; … the greatest evil of water-closets is the inordinate demand for water they occasion, and thus prevent most large towns being supplied otherwise than from polluted rivers. If the general use of water-closets is to continue, and to increase, it will be desirable to have two supplies of water in large towns, one for the water-closets, and another, of soft, spring, or well water from a distance, to be used by meter, like the gas*." (Snow 1858)

During the 19th century the role of water (contaminated by faecal matter) in the transmission of several important intestinal diseases – cholera, dysentery, and typhoid fever – was realized (Vuorinen 2007b). The final proof came when the microbes causing these diseases were discovered in the late 19th century. 19th century was also the period when the life cycle of many helminths and protozoa began to be clarified (Cox 2002). When the transmission routes of several intestinal pathogens was cleared more specific sanitation measures could be made.

The amount of different microbes, which were found to be able to be transmitted through contaminated water, escalated during the 20th century (Vuorinen 2007c). To the diseases like typhoid fever, dysentery and cholera already known to be spread by contaminated water at the turn of the 20th century, a multitude of viral diseases like poliomyelitis were added. It is now realized that a large number of pathogens (helminths, protozoa, bacteria, viruses) are excreted in the faeces of infected humans (or other animals) and the transmission route is ingestion. The link between the practices of defecation and human health is very intimate.

Conclusion

The written and archaeological sources in connection with the history of toilets or health, especially intestinal diseases, are quite abundant when they are considered separately. However,

there are many problems when judging how toilets in fact were related to the health of people. It seems quite probably that already very early in the human biological and cultural evolution some parasites became human intestinal parasites. Most probably this was a result from the "unhygienic" sanitary practices of humans (or their ancestor species). After this early start the number of intestinal pathogens seems to have increased when humans became agriculturists. This process was closely connected to increasing population densities and the problems with sanitation, including the practices of defecation. The intimate link connecting toilets/latrines and human health has remained up to modern times.

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