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Original Research Article

MYTHS AND BELIEFS IN THE USE OF HOT SPRINGSIN SWAZILAND – WHAT ENVIRONMENTAL AND HEALTH RISKS?

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Abstract: An exploratory descriptive study that followed both quantitative and qualitative research approaches to data collection and analysis was carriedat the Ezulwini hot springs in Swaziland to determine the myths, believes, and human health and environmental risks posed by the use of hot springs in Swaziland. The study was prompted by the fact that, the hot springs at Ezulwini and elsewhere in Swaziland are subjected to numerous uses such as drinking, washing, bathing and enema which pose health and environmental risks to both the immediate users of the resource, those using the water downstream, and the environment at large. It purposively targeted all the hot springs at Ezulwini. The participants included people in the area and visitors using the hot springs. Persons using the springs and those employed to manage them were observed and interviewed. Convenience sampling was used hence people found at the hot springs sites on the time of data collection were interviewed using an interview schedule and informal interviews. Participatory observation methods were alsoused to observe and record data from the participants. Data saturation determined a sample size of 50 participants. The prevailing conditions at the spring's sites were observed and a checklist was used for further data collection. A diary was utilized to record anecdotes and a camera was used to take pictures. Water samples were taken and tested at the Natural Resource Laboratory in Mbabane for nitrates, sulfates, chlorides, total dissolved solids, and total coli forms. Temperature and pH were measured on site. The study found that, all the hot spring users at Ezulwini are exposed to either physical hazard due to thermal pool structure or due to activities performed at the thermal springs such as enema, bathing and induced vomiting. Waste management in Thermal Spring 1 (TS1) was wanting in that it is not cleaned regularly and also that there are no rules which may force users to manage the spring. The use of these springs also poses a major risk of cholera and other diarrheal outbreaks. The environment is also at risk by human excrement and waste directly disposed of into the water and the surrounding area these further flows into wetlands downstream and contaminate them. The study recommends that, Health education for thermal spring users be done as users tend to share apparatus which pose a health risk. In addition, people's myths and believes about hot springs need to be changed through awareness campaigns. Monitoring of vector populations, water quality, and case reporting to the Swaziland Environmental Authority (SEA) and to the Swaziland Water Services Corporation (SWSC) by the Ezulwini Town Board (ETB) needs to be done.

Keywords: Thermal springs, environment, diarrhea, waste management, Ezulwini,

Introduction

Water and life: Water is essential for health. The health aspects of hygiene, infection prevention and nutrition depend on access to water and water quality (WHO, 1998). Water has been used and contributed to positive health for millennia. The use of water for recreational is not just a luxury, but health promoting as it provides opportunities for physical exercise, rest and pleasure. Recreational use of the water environment has attracted increasing attention from the public, professionals and regulatory agencies (WHO, 2000). Globally, hot springs have been subjected to myriads of uses, abuses and perceptions. In many African nations, people believe that hot springs are God's manifestation! Others believe that it is a huge deadly snake that is manifesting its presence! While others have associated these natural resources with either good luck or bad omen.

Problem statement: Hot springs at Ezulwini and elsewhere in Swaziland are subjected to numerous uses such as drinking, washing, bathing and enema which pose health risks to both the immediate users of the resource, those using the water downstream, and the environment. The bathing and enema of individuals in hot springs as well as the consequential defecation in the water or on the land around it pollutes the water thus putting the users at a risk of contracting waterborne infections such as cholera, dysentery and typhoid. Another risk is the sharing of bathing materials and of the enema accessories. This use also raises the chances of contracting disease such as hepatitis A, skin infections, adenoviruses, and HIV/AIDS which has already overburdened the Kingdom.

Bathing and enema pollutes the water as people tend to either defecate in the water or on the adjacent land thus affecting both the aquatic and terrestrial environment. In the water, the biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are either raised or lowered by the organic material (faces), there by impacting on the availability of dissolved oxygen. Bathing and recreational areas are also prone to pose both chemical hazards from chemicals used during disinfection of the water and also naturally occurring chemicals, which the water picks up when it seeps through the soil. This and the increase in organic matter affect both aquatic plants and animals.

The neighboring environment may be polluted when individuals partaking in enema rituals defecate on the land, thus the feacal matter provides food and breeding ground for flies and or cockroaches and other insects which are diarrhoearal diseases vectors. Apart from providing food and breeding ground, feacal material is unsightly and poses the problem of odor. The flies may be a nuisance to tourists who use the resource for recreational purposes, thus impacting negatively on the tourism industry. The researchers therefore hypothesized that, the use of the hot springs at Ezulwini poses human health and environmental risks and that these may be prompted by myths and socio-cultural beliefs of the Swazi nation. Such beliefs includes the belief that, defecating in the hot water during enema strengthens the healing power of the water or solution used for enema and also the belief that, the water bubbles up from the deep confines of hell (Volcano, 1982). It is a common belief that, myths, beliefs and perceptions do influence the way people use any natural resource.

Objectives: The broad objective was to determine the human health and environmental risks posed by the use of hot springs in Swaziland taking the case of Ezulwini. The specific objectives were to identify the current uses; management practices and health risks posed by the use of hot springs, access the knowledge and socio-cultural beliefs of the Swazis towards the use of hot springs, identify possible common diseases associated with the use of the hot springs, and make recommendations for a proper, healthy and sustainable use of resource in Swaziland.

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literature review: Water plays an important part in rest and relaxation, as well as in cleanliness and the supply of basic needs. These positive aspects are taken for granted in many water rich countries (WHO, 2001). Access to safe water is an important part of general health, whether it is used for bathing or for play: children will play in water, whether it is safe or not. Research into hand washing has also demonstrated that the motivation for keeping hands clean is often based more on aesthetic reasons than a concern for health (Curtis 2002). Therefore, programmes designed to reduce diarrhea by hand washing need to take account of human behavior and motivation, which includes understanding the human desire to use water for pleasure and to look clean and smell fresh. Some water use activities are intended to maintain and improve health: for example, the postulated healing effects of spas and natural hot springs, the physical benefits of swimming and the health benefits claimed for consumption of some hot spring and mineral waters (Curtis, 2002). Long established traditions also demonstrate the symbolic importance of water for health and cleanliness in all societies and religions.

Hot springs and their origin: A hot spring is a place where, without human intervention, hot water flows from rocks or soil upon the land or into a body of surface water through a distinct channel (Blankenship at el., 1965). Hot springs may be classified according to:

- Meteoric origin; that is those that flows under the influence of gravity and,
- Those whose water is of deep origin and in part is brought up to the surface by other forces in addition to gravity.

Springs classified as hot, according to Meinzer (1927), are those having water temperature noticeably above the mean annual air temperature for their localities. They may also be classed into hot springs if their temperatures are above that of the human body, and warm springs, if the water has a temperature lower than that of the human body (Waring, 1965).

Hot springs according to Waring (1965) are commonly associated with areas of present or geologically recent volcanic activity, such as the lava of the Avergne region in France and areas of volcanic rock in central Europe, Italy, the circum-pacific belt, notably Japan, New Zealand and Chile, as well as Africa. They are also associated with areas in which the rocks have been intensely folded and faulted, such as the Alps and Pyrenees and mountains of the western United States (Waring, 1965). Springs containing in solution large amounts of mineral salts are known as mineral springs and most of these are hot springs. Some hot springs gained wide spread notice because of therapeutic value attributed to their water. Some water presents a striking appearance because of their relationship to colorful terraces formed by minerals precipitated from the water, for example at Mammoth Hot springs in Yellowstone Park, USA (Wechsberg, 1979).

Hot springs in Swaziland: There are 17 known hot springs in Swaziland, including the Cuddle Puddle in Ezulwini Valley and these have their temperatures ranging from 36oC to 52oC and most of them are located in the lower Highveld and Middleveld regions and have discharge rates ranging between 0.2L/s and 8L/s, (Appendix1) (Canadian International Development Agency (CIDA),1992). CIDA (1992) further points out that, these waters derive their heat from the deep confines of the earth as the water travels through the different rock strata from recharge area in the Highveld, infiltrates to depths of a few hundred meters along a network of regional fractures or fault planes, picks up geothermal heat and quickly rises to the surface as buoyant thermal water. As the thermal water travels through the strata of the soil it dissolves and carries mineral solutions from the rocks and soil, and hence it is being called the alkaline, soda carbonate thermal spring water.

Uses of hot springs: Hot spring's direct use dates back to thousands of years when people began using hot springs for bathing, cooking food, and loosening feathers and skin from game. Today, hot springs are still used as spas as well as natural thermal springs. But there are now more sophisticated ways of using this geothermal resource (Freeston, 1995).

Geothermal reservoirs of low-to moderate-temperature water (20ºC to 150ºC) provide direct heat for residential, industrial, and commercial uses. This resource is widespread globally and is used to heat homes and offices, commercial greenhouses, fish farms, food processing facilities, gold mining operations, and a variety of other applications. Geothermally heated waters according to Freeston (1995) also allow species of alligators to thrive on a farm in Colorado, where temperatures can drop below freezing.

Direct use of geothermal fluids in homes and commercial operations is much less expensive than using traditional fuels. Savings can be as much as 80% over fossil fuels (Freeston, 1995). Freeston (1995) also contends that direct use of hot springs is also very clean, producing only a small percentage of the air pollutants emitted by burning fossil fuels.

The tradition of using hot springs for pleasure and health: Waters with a reputation for health giving properties are found all over the world. The word 'spa', meaning mineral water, comes from the Belgian resort of Spa. The term now includes hot tubs, whirlpools and mineral baths drawn from natural hot springs. In addition to bathing in hot springs, modalities such as hydrotherapy, mud therapy, physical therapy, massage, steam baths, physical exercises, inhalation of water vapor, and drinking mineral water are often used as part of a complex therapy for health, preservation and treatment of disease (WHO 1999b).

Hydrotherapy pools, and other warm pools used primarily for medical purposes, draw on long established experience of the beneficial effects of water treatment. Since ancient times, drinking or bathing in mineral waters has been reputed to cure a variety of illnesses, including heart diseases, joint disorders, respiratory inflammation and kidney stones (Public Health Laboratory Service, 1994). People suffering from stress-related problems find the natural healing properties of the water particularly beneficial as it dramatically increases their feelings of well-being. The pools have also been shown to relieve skin problems, asthma, and arthritis as well as lung and heart conditions. It is also alleged to be useful in the treatment of chronic diseases of the gastro-intestinal tract, diseases of the liver and biliary passages, disorders of the genital-urinary tract and in sluggish condition of the alimentary tract (Public Health Laboratory Service, 1994).

While there have been few scientific studies of these postulated effects, there is no doubt of the benefits of warm water therapy in pain relief, joint mobility and relaxation. Naturally occurring hot springs were particularly valued in colder climates. The Baden-Baden springs in Germany, developed by the Romans as AquaeAureliae, are the hottest in Europe and like most other thermal springs, are slightly radioactive. In many of the springs in Central and Eastern Europe, the ritual of combining cold, warm and hot baths for health has survived almost unchanged. In North America, Native Americans believed in the curative effects of hot springs: one spring that became a famous spa, Saratoga, derives from the Mohawk word meaning "the place of the medicine waters of the great spirit." Religion played a part in establishing the use of spas. The thermal baths in Budapest were developed during the Ottaman rule of Hungary: the inspiration was the Islamic tradition of cleanliness (WHO 2000a).

Over the past four centuries, the science of balneology has evolved into a medical specialty in Europe and Japan, where special courses in balneotherapy are offered to both physicians and nurses by major medical schools.

Healing by balneotherapy: Anon. (2011) has cited that following eight ways in which balneotherapy has helped in healing. 1. Bathing in hot springs gradually increases the temperature of the body, thus killing harmful germs and viruses; 2. Thermal bathing increases hydrostatic pressure on the body, thus increasing blood circulation and cell oxygenation. The increase in blood flow also helps dissolve and eliminate toxins from the body; 3. Hot springs bathing increases the flow of oxygen-rich blood throughout the body, bringing improved nourishment to vital organs and tissues; 4. Bathing in thermal water increases body metabolism, including stimulating the secretions from the intestinal tract and the liver, aiding digestion; 5. Repeated hot springs bathing can help normalize the functions of the endocrine glands as well as the functioning of the body's autonomic nervous system; 6. Trace amounts of minerals such as carbon dioxide, sulfur, calcium, magnesium, and lithium are absorbed by the body and provide healing effects to various body organs and system. These healing effects can include stimulation of the immune system, leading to enhanced immunity; physical and mental relaxation; the production of endorphins; and normalized gland function; 7. Mineral springs contain high amounts of negative ions, which can help promote feelings of physical and psychological well-being; and 8. The direct application of mineralized thermal waters can have a therapeutic effect on diseases of the skin, including psoriasis, dermatitis, and fungal infections. Some mineral waters are also used to help the healing of wounds and other skin injuries.

Chronic diseases: Chronic rheumatic diseases; Functional recovery of central and peripheral neuroparalysis; Metabolic diseases, especially diabetes, obesity, and gout; Chronic gastrointestinal diseases; Chronic mild respiratory diseases; Circulatory diseases, especially moderate or mild hypertension; Peripheral circulatory diseases (affecting the hands and feet); Chronic skin diseases; Psychosomatic and stress-related diseases; Autonomic nervous system dysfunction; Vibration disorder (a middle ear disorder affecting balance); Sequela of (conditions resulting from) trauma; and Chronic gynecological diseases.

Greenhouse and aquaculture facilities: Greenhouses and aquaculture (fish farming) are the two primary uses of geothermal springs in the agribusiness industry. In the USA for example, thirty-eight greenhouses, many covering several acres, are raising vegetables, flowers, houseplants, and tree seedlings in eight western states. Twenty-eight aquaculture operations are active in ten states (Freeston, 1995). Greenhouses growing fresh vegetables and potted plants exist in the Kyungbook in Korea and fish farming in the southern parts of Korea raise shrimps, turtles, eels, snails and snakes (Han, 1995). Most greenhouse operators estimate that using geothermal resources instead of traditional energy sources saves about 80% of fuel costs – about 5% to 8% of total operating costs. The relatively rural location of most geothermal fluid resources also offers advantages, including clean air, few disease problems, clean water, a stable workforce, and, often, low taxes (Freeston,1995).

Industrial and commercial uses: Industrial applications include food dehydration, laundries, gold mining, milk pasteurizing, spas, and others. Dehydration, or the drying of vegetable and fruit products, is the most common industrial use of geothermal fluids. The earliest commercial use of geothermal fluids was for swimming pools and spas (Han, 1995). In Egypt for example, four thermal wells (50-75°C) in the northwestern desert, drilled primarily for oil are considered to be a target for geothermal fluid extraction. The fresh water with Total Dissolved Solids (TDS) of 464ppm discharged from these wells is fed from the Nubian aquifer system which is located in the eastern Sahara desert, North-East Africa (Boulas, 1989). The proposal is to use the waters for domestic and agricultural supply, and also for irrigating large areas of land by pumping water using electricity which would be generated from these fluids. These wells can also be used for supplying hot water to greenhouses for the production of vegetables and fruits (Freeston1995).

The hazards of recreational water use: Tourism is the world's third largest industry and tourism receipts increased by about 11% a year during the last decade (WHO, 1998). While the millions of tourists seeking sun, sand and water sports bring much needed income to developing countries, such as the resorts in the Caribbean, they expect and demand high standards of water safety. Improvement of the recreational facilities for local residents may depend on the complex relationship between risk assessment, cost-benefit and maintenance of an attractive image for tourists (WHO, 1998). There are hazards in the recreational use of water even in well-designed pools or designated bathing areas in natural hot springs. These can be grouped into four types - Physical hazards, causing drowning or accidents such as spinal injury; Microbial hazards; Exposure to chemicals; and Excessive exposure to the sun (leading to sunburn and sun stroke) and to ultraviolet radiation (leading to skin cancers) in outdoor facilities or natural sources.

Hazards vary according to the type of water and the geographical location. Swimming pools may be private (domestic), semi-public (in clubs and hotels and schools) or public (municipal or governmental). The risks also differ between outdoor and indoor pools, for example in the greater possibility of accidents around open pool areas, due to factors such as slippery surfaces around the pool, fewer structures designed to prevent injury or access; and greater access to unsupervised children. There is also a larger potential health risk of chemical exposure in indoor pools. Similarly, recreational use of natural waters includes supervised designated beaches, as well as either rural or undeveloped water areas and thermal springs, with a corresponding range of risk. Water sports with particular risks include white-water rafting and canoeing, slalom, water skiing and windsurfing. In terms of mortality the most important risks are of drowning or spinal injury, but some of the microbiological hazards are associated with serious illness, such as legionnaires' disease and some may occur frequently such as diarrhoeal disease caused by Giardia lamblia and Cryptosporidium parvum.

Health hazards of spas and natural thermal spring: Spas, natural hot springs and whirlpools may not be drained, cleaned or refilled after each use. According to (WHO, 2000a), the health hazards associated with their use include those associated with swimming pools, although the high temperatures in some types of spas exacerbate the effects of alcohol or drugs and the risk of drowning may be enhanced by the lack of transparency in colored or turbid spa waters. While deaths are rare, most have been associated with the combination of high water temperature and use of alcohol or drugs. The resulting drowsiness increases the risk of drowning.

Of 700 deaths in spas and hot tubs recorded in the USA since 1980, a third were children under five years of age, emphasizing the importance of supervision of children playing with water (WHO, 2000a). The high bather load and high turnover rate of users in many spas and whirlpools as well as in natural hot springs pose an infection risk, including microorganisms from the bathers and those present in the water. The warm, nutrient containing, aerobic water provides an ideal environment for many organisms, such as Legionella pneumophila, which is found in many types of natural and human-built water systems; the cause of legionellosis (legionnaires' disease) and Pseudomonas aerugionosa, which causes folliculitis, an infection of the hair follicles associated with an itchy rash (Bartram, 1999). Natural hot spas and springs may contain a species of amoeba that can cause meningitis (Acanthamoeba) - cases have been reported Bartram (1999) after swimming in natural spas or exposure to fountains in warm climates.

Bartram (1999) contends that, infections of the ear (otitis externa), urinary tract, respiratory tract, eye and wounds have also been linked to spas. Natural hot springs may also contain Naegleriafowleri, which is a single-celled organism that is found worldwide in soil and all natural surface waters, particularly very warm and shallow waters. Naegleriafowleri is known to cause primary amoebic meningoenchephalitis (PAM). PAM is an extremely rare disease that causes inflammation of the lining of the brain and spinal cord and can often be fatal. The disease can occur when water containing the organism gets into the nose and then moves up the nasal passages to the brain (Bartram1999). These infections are difficult to control and require frequent monitoring of the pH of the water, disinfection and filtration. Water treatment may present chemical hazards unless the chemical disinfection is well managed. There is also a risk of accidents around spas due to slips, trips and falls: bathers may also pick up fungal and other infections from the wet surfaces (WHO, 2000).

Mineral content of hot springs water and its effects: It is probable that ground water recharge in areas of the highveld infiltrates to depths of a few hundreds of meters along a network of regional fractures or fault planes, picks up geothermal heat, then rises quickly to the surface as buoyant thermal water (CIDA, 1992). Natural minerals and hot spring waters collect their constituents as they filter through rock strata, such as calcium from limestone strata or magnesium from dolomites. Iron may be present in suspension. Minor elements include fluoride and several other trace elements. The mineral content is usually higher in warmer waters. Waters from volcanic sources may contain high concentrations of sodium and bicarbonates, giving them a natural effervescence (CIDA, 1992).

The main difference between 'mineral' and 'spring' water is that no therapeutic claims are made for the latter, although water does not have to have a therapeutic claim to be described as 'mineral'. Microbiological quality control is required for both. The standards for microbiological purity and frequency of testing are usually less strict than for mains supplied water. The waters may be alkaline or acid. Mineral waters are, strictly regulated. Some mineral waters have marked effects on the gastrointestinal tract, often acting like a laxative. Bottled mineral water may be preferred for taste and supposed health benefits. This links back to the spa/mineral-water tradition, but is also determined by fashion.

Methodology

The study was carried out at Ezulwini, Swaziland and it used exploratory and descriptive research designs and followed both quantitative and qualitative approaches to data collection and analysis. The study targeted all hot springs in Swaziland and the hot springs at Ezulwini were purposively sampled for the study. The participants in the study included the people in the area and visitors using the hot springs. Convenience sampling method was used and hence people found at the hot springs sites on the time of data collection were interviewed using a questionnaire and informal interviews. The researchers used participatory observation methods to observe, interview and record data from the participants. Data saturation determined the sample size of the participants. The researchers also observed the prevailing conditions at the study site and used a checklist for the data collection. Personnel using the resource and those employed to manage the thermal springs were also observed and interviewed. A diary was utilized to record information and a camera was used to take pictures. Water samples were taken and tested at the Natural Resource Laboratory in Mbabane for nitrates, sulfates, chlorides, total dissolved solids, and total coli forms. Temperature and pH were measured on site. Other factors included in the study were physical hazards causing accidents/drowning; Age; number of individuals allowed per unit time; condition of individuals (health, state of sobriety, etc); and physical makeup of the thermal pool

The quantitative data was analyzed using a computer SPSS (Statistical Package for Social Sciences) for windows 2003 (Microsoft, 2003). The qualitative data were analyzed according to the emerging thematic areas. Permission was solicited from the participants, confidentiality and privacy were observed and no manipulations to the environment were done.

Results and Discusions

Physical makeup of the thermal springs and the water course: The topography of hot spring 1(HS1) is such that the area slopes down to the pool like a cone with the hot spring pool at the bottom. Obviously when it rains, the water washes the surrounding land into the spring, carrying with it all debris and waste from the surrounding upper land as well as any microorganisms. There is vegetation on all sides of the pool, and on the western side is a thicket of bamboo "umhlalangamlambo".

The water runs from the hot spring in a western direction and then veers of to the north three meters from the mouth of the pool into a wetland a hundred meters away. This spring is tributary for the Mvutjini River approximately

Two kilometers downstream. The sides of the pool in HS1 are made of concrete and are covered by algae. These concrete walls may cause accidents to bathers if they slip and fall on them. Algae is a sign that depicts the presence of life forms in hot spring water and also that spring users could be in danger of being infected by thermophilic fungus (which may cause athletes foot) which grow on such wet walls. The deep end is located at the western side near the weir and it has a sandy bottom, the shallow end at the south has concrete patches which protrude forming sharp points which could cause injury to the users.

A pipe runs from the middle of the hot spring, and this pipe extracts hot water and channels it up to the Cuddle Puddle commercial pool on the western side of the natural hot spring. At the deep end, there is a weir which serves as a barrier that helps to contain about 23750.44L of hot water and also acts as an outlet for the impounded hot water. A large pole is suspended across the pool by two logs sandwiching it and buried in the ground on either sides of the pool. This pole is used to hang the enema utensils, but now only reachable when one stands on the wall restraining the water, since the concrete bottom of the pool has been eroded; to create a much deeper pool thus the suspended log is out of reach, hence a nearby guava tree is used for hanging the enema apparatus, however, it can still be used if one has an enema apparatus which has a long pipe (approximately 3m). The water from the pool flows over the weir and veers off to the right in a northerly direction three (3) meters from the pool and wastewater from the cuddle puddle pool joins in at this very juncture.

Another three meters from this point is a line of stones placed strategically across the stream. The water path from the pool up to the point where it reaches the line of stones is void of vegetation. The pool itself is in the midst of natural vegetation; hence one cannot see it or the bathers from a distance of five meters, and this provides the only protection from prying eyes of passersby. HS2 is surrounded by eucalyptus trees and has water coming from a rock and pipes were inserted so the water comes out as if it is coming from a tap. The pool is very shallow about 14cm deep. HS2 has rocks in the shallow pool, and these are used as washing stones or for sitting on when bathing. These boulders may cause injuries to bathers as well as to those doing enema, especially at night. Water from the spring also flows into a wetland two meters away from the boulders. The wetland stretches for approximately 800 meters and then flows into the Luphohlo/Mvuntjini River.

Waste: Waste on HS1 consisted of broken bottles, plastic bottles, soft drink cans, papers, empty chips packets, bamboo poles and leaves and sticks, discarded male under wears and twigs. Most of the waste are either located on both sides of the spring mouth, near the weir, or in the stream near the mouth (figures 4.2).This presence of broken bottles in the area poses a danger to the bathers, especially those doing enema as they wade through the water to relieve themselves, they may be cut by the broken bottles in the waterway bed if they walk on the edges. Waste also has the tendency of decomposing and releasing toxic leachate in the hot spring water. This could have a large impact on the water as far as the chemical parameters of the spring water are concerned.

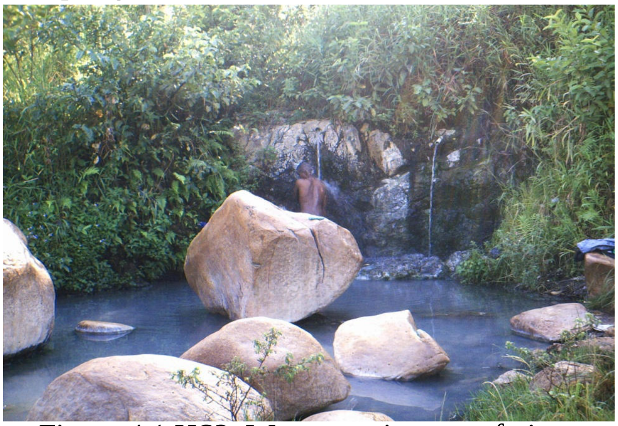


Figure 4.1 HS2. Water coming out of pipes inserted into the rock strata notes a bather and the boulders.

In HS2, waste included a few soap packets, plastics and also sawdust from saw mill 30m away of which the eucalyptus and pine trees were cut down and then processed into timber in the wetland. The wetland provides an open land without much obstruction except where there are patches of water. This together with the farming which is beginning to invade these wetlands pose a threat to the wetland, which if it goes unchecked will hinder the natural function of the wetland, thus having a large impact by interfering with the numerous natural services it provides including purification of water.

Temperature: Both HS1 and HS2 have temperature of 42^{0}c and 46^{0}c respectively at SP1, owing to the heat derived from naturally heated rocks in the earth or from direct contact with hot mud or magma. Hence they are warm and hot springs. Figure 4.3 also shows that in SP2 in both TS1 and TS2 the temperature falls to 18^{0}c and 33^{0}c respectively. This may be due to the distance the water travels (12m to SP2, TS1 and 3m to SP2, TS2) as well as the heat loss due to turbulence as the water flows downstream. In TS1, SP2 the water travels a longer distance twelve meters (12m) and at a distance of three meters (3m) from the SP1 it is joined by water released from the Cuddle puddle commercial pool. It also travels under a thicket of trees and this may contribute to the rapid heat loss as compared to TS2, SP2.

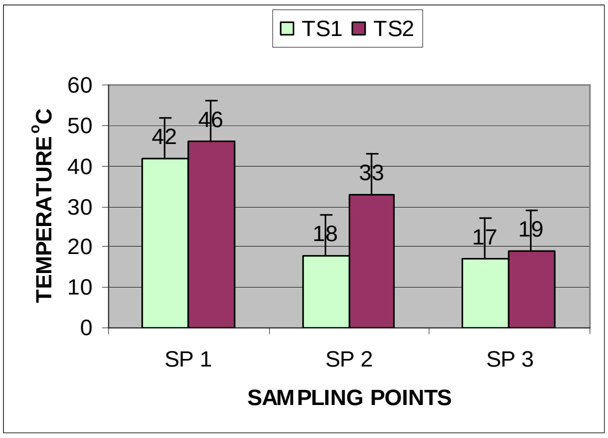


Figure 4.3.Temperature in ^{0}c for three sampling points in HS1 and HS2

In SP3 the water shows a temperature of 17^{0}c and 19^{0}c respectively. This may be attributed to the fact that the water from SP2 in both HS1 and HS2 flows into a wetland and SP3 is after the wetlands. These wetlands provide a wide range of important functions, including ecological, as well as temperature reduction as is the case above.

Nitrates: Figure 4.4 shows nitrate levels for TS1 at SP1 to be 5.6ppm and 2.41ppm for TS2 respectively. The difference in values may be due to different rock stratification as well as difference in soil make up, as the thermal water dissolves nitrates as it moves up the soil. In SP3 the levels rose at TS1 to 6.2ppm and for TS2 a much lesser increase of 2.45ppm was recorded. Again, the water from the commercial pool and also the leachate from the waste are thought to contribute to such an increase in TS1 nitrate levels. However, these levels were below the recommended maximum of 10mgN/l (Environmental Law Alliance Worldwide (ELAW), 2010).

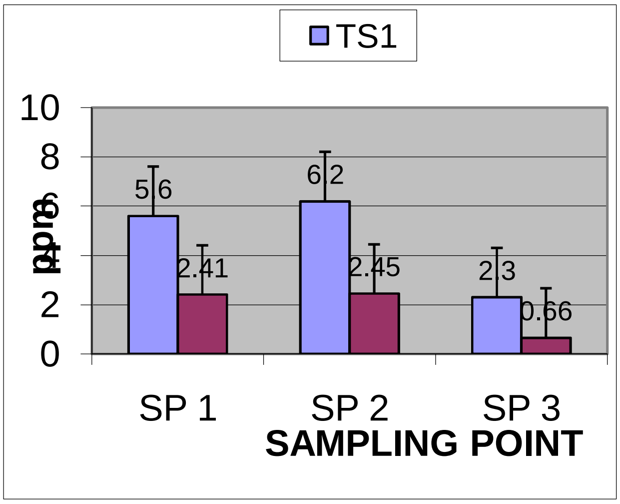


Figure4.4. Nitrate levels in TS1 and TS2 1in ppm.

Sulfates: Sulfate levels in SP1 for TS1 (figure 4.5) is 8.7ppm and for TS2 is 4.6ppm. For SP2, TS1 sulfate levels rise to about 8.9ppm and in TS2 it rises to 9.9ppm. This may be attributed to the fact that much of the people come to TS2 to wash clothes and bathing as opposed to other activities. Therefore the slight rise may be due to the soap used. The reduction in sulfate levels in bothTS1 and TS2, SP3 may be due to the natural healing properties of wetlands. The plants in the wetland may take up some levels of sulfates and also that it may be due to decomposition by bacteria.

Chlorides: The chloride levels of both springs in SP1 ranges between 9.95ppm for TS1 and 9.1ppm for TS2. This does not show much difference between the thermal springs as shown in figure 4.6. This is below the Swaziland Water Services Corporation (SWSC) guide level for drinking water. However in SP2, SP2 it rises reaching a higher level of 10.8ppm than the 9.8ppm recorded for the other spring in SP2. The high level may be due to the fact that TS1's flow is joined by water released from the Cuddle puddle commercial pool and in this pool chlorine is used to disinfect the water. In SP3 the levels fall to 6.7ppm and 7.8ppm respectively. The lower level in TS1 may be due to the size of the wetland the water travels through as compared to that of TS2. The size of the wetland may provide ample time for the chlorine in the water to breakdown naturally.

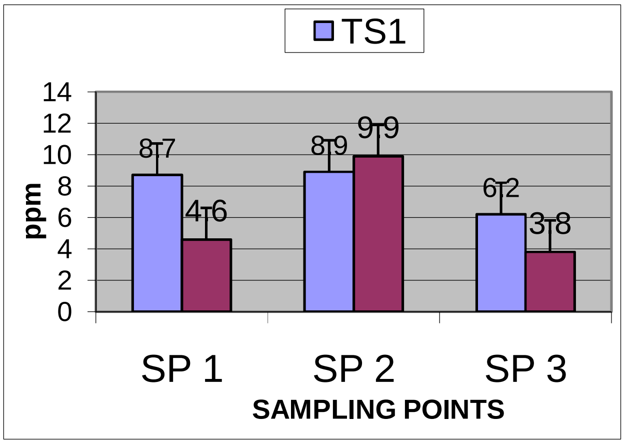


Figure4.5 Sulfate levels in TS1 and TS2 in ppm.

Saline hot springs are rich in sodium chloride. Mineral springs naturally rich in chlorides, in amounts between .5 - 3%, are considered beneficial for rheumatic conditions, arthritis, central nervous system conditions, posttraumatic and postoperative disorders, as well as orthopedic and gynecological disease.

Total dissolved solids (TDS): Figure 4.7 shows 190ppm and 176ppm of TDS which the water derives as it travels through the soil and rock strata. In SP2 for TS1 this level rises to about 272ppm, and a possible explanation for this rise is that the thermal water derives the additional TDS from the cuddle puddle commercial pool. Some TDS may also be due to chemical solutions used during enema as well as for washing. In TS2 there is also a slight rise to 178ppm in TDS value, this may be also to the same contributing factors as for TS1 but without that of the commercial pool. For SP3 of both TS1 and TS2 low levels of 102 and 85ppm are shown by figure 4.7. This may be due to the natural wastewater healing properties of wetlands. However, the TDS levels were below the effluent recommendation maximum of 500 of Swaziland (ELAW, 2010).

Total coliform count: For TS1, Sp1 the count for coliform is 57/100mL of water due to the people who bathe in the water without rinsing and also may be due to surface runoff which might have carried coliforms from surrounding land into the thermal pool. Figure 4.8 shows 0 coliforms for TS2, SP1 as the water flows from pipes two meters above the pool hence is free from feacal contamination.SP2 for both springs shows a dramatic increase to high values of 7000 and 5883 coliform counts per 100 mL of water. These counts are way above the maximum recommendation of 10 count for water quality in Swaziland (ELAW, 2010). This is supposed to be due to the people doing enema and defecating directly into the water which then flows into a wetland. In SP3 both TS1 and TS2 show a steep decrease in coliform count, a record of 200 and 96 coliforms per 100 mL respectively.

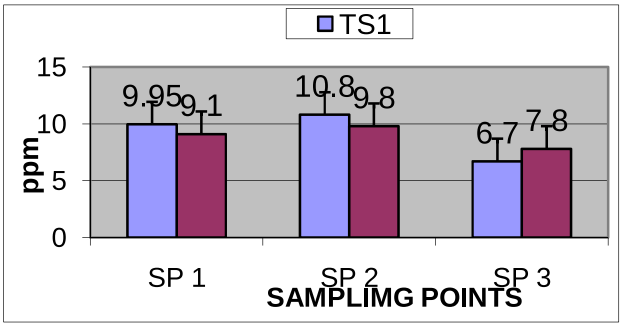


Figure4.6. Chloride levels for TS1 and TS2 in ppm.

This may be due to the fact that SP3 is after the wetland through which the water from the thermal pools flows. The water is stagnated in this wetland and during this process the coliforms may decline due factors such as interaction with chemical constituents in water and UV radiation from the sun. Others may be removed by settling silt in the wetland hence the low coliform counts at SP3 as depicted by figure4.8.

pH: TS1 had alkaline water; this may be due to the minerals the thermal water picks up in the rock strata, hence a pH of 8.7 at SP1 seen in figure 4.9. At SP2, pH slightly rises to 8.9 and this may be due to the fact that some chemical constituents come from the Cuddle Puggle pool as the pool also discharges through the same route. This however is above the SWSC guide level for drinking water. The pH at SP3 finally falls to 7.0 and this signifies the natural wastewater treatment of the wetlands through which the water passes.

Figure 4.9 also depicts pH levels of 8.3 for SP1 and a slight rise to 8.5 in SP2 which may be due to activities of users of TS2. SP3 shows a level of 7.8 this may also be due to the healing properties of the wetland the water travels through. The pH level for TS2 is within the SWSC guide lines for drinking water of a minmum of 6.5 and a maximum of 8.5 (ELAW, 2010).

Frequency population by age: The population ranged from as low age as 8 years to the oldest observed being over 38 years of age, with the majority being those of the age group of 27-37 signaling a high number at 18 inTS1 and 20 in TS2 respectively, These are followed by 16-26 age group with 16in TS1 and 7 in TS2. Users in TS1 are only males, and in TS2 users are mixed, that is it is utilized by both male and females (Table 4.1.)

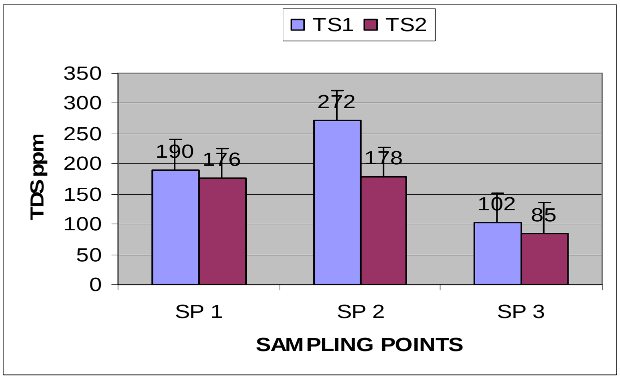
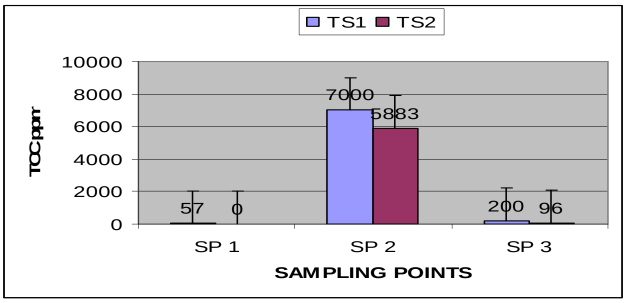


Figure4.7. Total Dissolved Solids in TS1 and TS2 in ppm

Activities: These include bathing, induced vomiting, enema as well as washing. Other people come to the thermal spring as it has become a meeting place, where usually men meet to discuss any issue ranging from religion, witch craft, matters of national concern, death, as well as sport games, especially football. One individual was seen as if he was performing some sort of prayer in the middle of the thermal pool, whilst the other people went on with their businesses without giving this individual a second glance. This was thought to be caused by the fact that the other people were used to this kind of behavior.

Bathing: Bathers sit around the pool edge but crowd around the mouth of the pool, where the water is deeper. They scrub each other's backs using stones (*tincopho*) as bathing tools scrubbing or empty onion/ orange sack (*lisaka*) and these are shared if one does not have one. Bathers use the spring mainly for keeping themselves clean, and mostly use the facility at late hours, that is; when they are from work. Figure 4.10 shows the percentages of bathers by age and most of these are the Middle Ages, with ranges of 32 - 36 % in TS1 and 40 % in TS 2, in the age group of 27-37.These bathers are at risk of injury by over scrubbing as the skin is more limber from the hot water, also the sharing of these tools may transmit diseases such as hepatitis A and HIV/ AIDS, as there may be fluid transfer when the supple skin of the bather breaks during scrubbing, and then lending the next bather who also performs the same task and maybe injure himself. Young bathers were noticed to be higher in TS2 (about 16 %). These and the elder bathers (38+ years) about 30% in TS 2+ and 24% in TS1 are also at risk due to their low immune system, either due to being young and/old thus poor development or receding immune system, due to old age.



Figur 4.8. Total Coliform Count per mL of water for TS1 and TS2

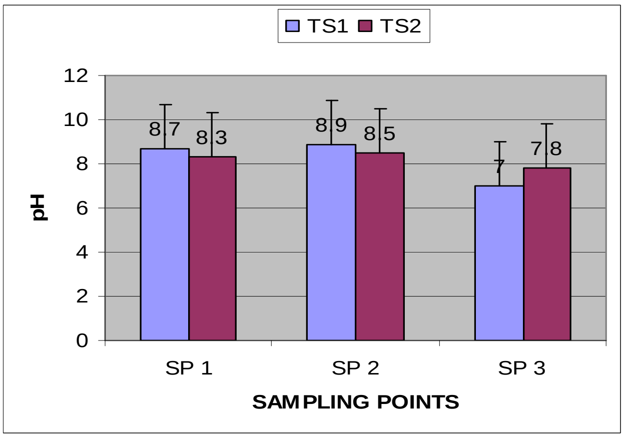


Figure 4.9. pH levels for TS1 and TS2.

Shaving: Razor blades as seen in figure 4.11and 4.12 below, are used for shaving off beards, these are also shared as a person wishing to shave borrows the shaver from the owner and it is lent to him without a fuss. This sharing of razors poses the hazard of transmitting HIV and AIDS and other body fluid related infections. Shaving was notice to occur more in TS1.

Table 4.1 Frequency of visitors to TS1 and TS2 by age group N = 50. Where N = Total number of people

AGE GROUP	FRQUENCY IN TS1	FREQUENCY IN TS2
5-15	4	8
16-26	16	7
27-37	18	20
38+	12	15
Total	**50**	**50**

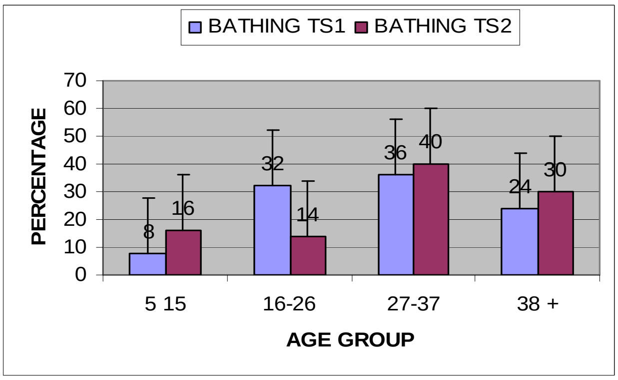


Figure 4.10. Bathers by age in TS1 and TS2.

Washing: Clothes are washed nearer the mouth of the pool but the areas along the walls and the pool wall are used as a washing stones in TS1. The clothes washed include clothes with tough to remove stains, overalls, underwear etc. whilst in TS2 clothes are mainly washed by women during the day when males are at work. Washing basins are used and natural stones in the 14 cm deep water are used as washing stones. TS2 was observed to have the highest number of people washing in the age groups of 16-26 and all of these were women. This could be attributed to the fact that at these ages most women are married or if not they do washings for the whole family including their siblings. This shows that TS2 is prone to have higher detergent levels than TS1.

Enema: Enema is practiced as a ritual. People do it weekly and are done using the thermal water from the pool on an empty stomach. Other men use herbs for enema but before they use them they start by using the thermal water from the pool laced with soup for several times. Figure 4.13 shows that 65% of enema participants in hot springs perform enema using the thermal water and soap solution and 35 % use thermal water, soap solution, and herbs respectively.

Figure 4.11 Discarded shaving razor number 1 in TS1.

Enema is a way of cleaning the colon/ bowel thus the herbs will function properly. Most of the enema performers either complained of having being infected by jaundices or not performing well as far as their husbandry duties is concerned. Enema is performed as much as 13 times per single visit to the thermal pool, with the lowest number of times being three. The high number of repetitions may have health implications in that excessive washing of the colon may disturb the balance of normal fauna in the colon. It may also interference with electrolyte balance in the body which may result in shock and or coma. The enema apparatus are made of 5 liter plastic bottles (figure 4.14) which have their bottom ends cut and ropes/ strings are tied and used to hang the bottles.

The lid of the plastic bottle is pierced and a small (thin) water pipe is inserted through this hole. This water pipe of maximum diameter 100mm and length varying between 2 meters and 5 meters, has its end cut and either has a smaller and or finer tapering tube inserted to compensate its insertion in the anal opening or left roughly cut. This apparatus is either brought from home or rented for about E7.00 (seven Emalangeni) from the cuddle puddle at TS1, and these are shared amongst enema participants, who just wait for another to finish and then joins in to do the same. The enema tool brought from home is either taken along or left behind with fellow enema participants if they are known to owner(s) and if it is rented it is returned to the guard at the cuddle puddle gate. At TS2 the enema tools are brought from home and are shared amongst enema participants. This sharing of enema equipment poses a health risk in that if an apparatus having diameter of 100mm and is roughly cut is used, the soft tissue of the rectal muscle may be damaged. This may lead to diseases such as hepatitis A and HIV/ AIDS transmission during apparatus sharing as fluid is likely to be exchanged between those sharing whilst one of them suffers a damaged muscle.

The enema procedure entails, the participant getting into (either standing under the down pouring water in TS2 or in the pool in TS1) the water for five (5) minutes to get the body warm, the participant then puts the pool water in the enema apparatus and hangs it bottom up on a nearby tree (at least two meters above the participant) or on the horizontal pole running across the pool. He then jumps into the pool and performs the enema submerged (with only the head and shoulders showing) in the pool and after draining the plastic container he then scuttles out of the pool and rounds the bend along the stream towards some nearby stones. Upon reaching the stones, they turn around facing the oncoming flow of water, perches snugly on the line of rocks and hunker down to defecate in the running water. After finishing this he then returns to the pool and either rinses him before getting into the pool or just jumps into the pool without rinsing. In TS2 enema participants hang their apparatus on nearby trees and stand facing the boulders, often leaning on them for support. The next step is to rush and defecate 3 meters away in the running water whilst patched on makeshift planks(figure.4.15) which also serve as a foot bridge as well as demarcates the clean area(bathing area) and the dirty area(defecation area).

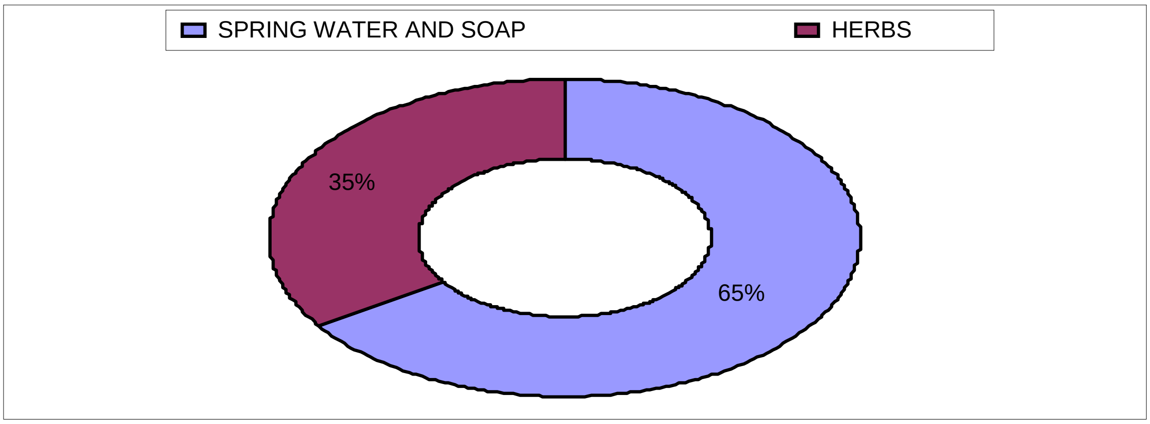


Figure 4.13. People using thermal spring water and soap for enema and those using herbs

Figure4.14. Enema apparatus made of 5L plastic bottles and metal hanged on a guava tree in TS1 with tubes of length ranging from 2m to 5m and diameters of 6mm to 12mm.

Figure4.15. Make shift planks used to squat on when defecating in TS2

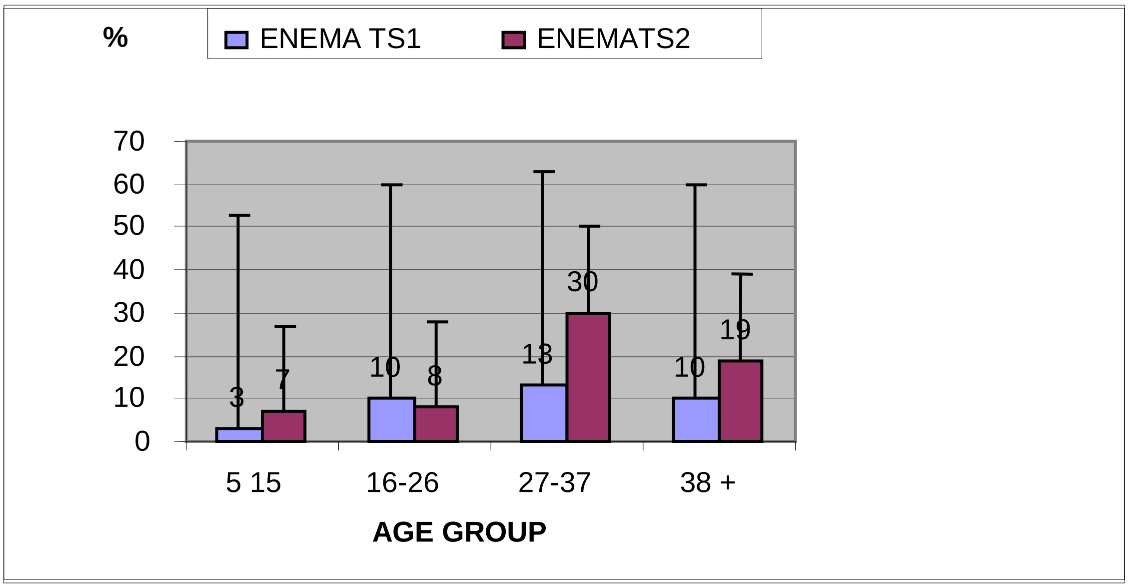


Figure 4.16. Enema by age in TS1 and TS2.

Those having age above 38 years show a decrease in TS2 at 19% and 10 percent for TS1. The number of those with younger age groups (5-15) is also higher for TS2 at 7% and TS1 trails behind at 3%, the higher numbers in TS2 may be due to the fact that TS2 is located nearer to homesteads, whilst TS1 is near the road but away from homesteads but closer to the hotels at Ezulwini Sun. The behavior of enema participants as displayed in figure 4.17 indicates that about 34% of enema participants in the 27-37 age group do not rinse before getting into TS1 pool and only 16% and 14% in the 38+ and 16-26 age categories respectively do not rinse before getting into the pool. The 5-15 age group shows the highest number of enema participants, 70%, who do not rinse before getting into the pool.

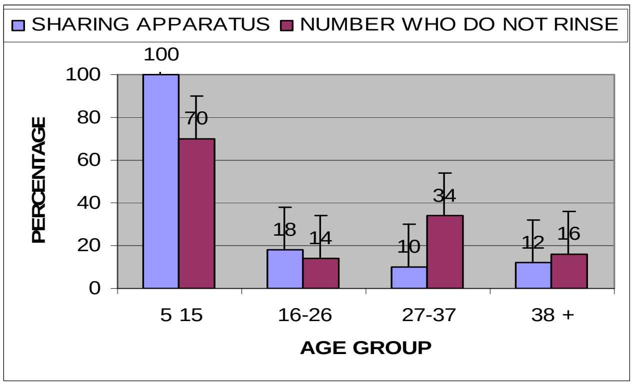


Figure4.17. Behavior of enema participants by age.

Enema participants are also prone to sharing their apparatus with fellow enema participants who are either known or not known. Figure 4.17 also points out that 18% in the 16-26 age groups share their enema apparatus, compared to 12% and 10 % in the 38+ and 27-37 age groups respectively. The 5-15 age group show 100% sharing rate, this may be due to the fact that participants in this age group do not own any enema apparatus and also that some youngsters come to do enema whilst in the company of adults who then share their apparatus with them. On the other hand sharing may be due to knowing the next person or also from the tendency of people to be kind towards others. This puts most (more than70%) of enema participants at risk of being infected with HIV/AIDS, and hepatitis A or B.

Induced vomiting: This is done using the thermal spring water from the same pool which is used for bathing in TS1. The person to drink the water just uses a roughly cut plastic bottle picked from the rubbish lying around the thermal pool site. Alternatively a jar brought from home is used to scoop water from the pool whilst everybody is still in the pool, perches neatly on the pool wall or stands in water and drinks it to fill his empty stomach. The water in TS1 has total coliform counts above those recommended by the SWSC guide for drinking water quality and these pathogenic microorganisms may cause diarrheal diseases. He then advances to the weir and performs the laborious task of inducing vomiting by pushing his finger against the soft palate. After finishing he rinses himself in the running water and moves away from the pool mouth and either performs the ritual for a number of times until satisfied that he has done it properly or concludes the ordeal with that one session. Figure 4.18 shows that most of the people who are in the risk of inflicting injuries on the soft palate as they push their fingers against the soft palate in trying to irritate it to induce vomiting are those with ages between 27- 37 in TS2 with 36% and those in the age group of 38+ in the same spring 25%. The 5-15 age groups virtually have no induced vomiting participants. In TS1, the induced vomiting participants are highest at the age group of 38+ years with 18% and the number recedes with age group. This absence of induced vomiting participants in the 5-15 age categories in both springs may be due to being too young or due to the fact that induced vomiting involves such a laborious procedure.

In TS2 the thermal water is collected as it falls from pipes to the pool and is thus virtually free of secondary contaminants, when compared to that which is gathered at the pool in TS1. TS1 poses most health risks as its thermal water is contained for about 6.6 hours and during this time people performing different rituals in the same pool. Those at highest risk are the induced vomit partakers who without hesitating just scoop thermal water from the same pool and drinking it. This action may lead to ingestion of microorganism from feacal material and also from the waste which comes off bodies during bathing.

Cleaning and management: The pool of TS1 is cleaned using a bamboo pole which is used to skim the surface of the pool to remove scum, plant leaves, floating algae which have been dislodged from the bottom and sides of the pool and also any debris which have found their way into the pool. Cleaning is done by any individual using the pool at any instant.

It was noted that nobody is employed to manage the natural TS1 but individuals clean out of their own will. There are no dustbins or any waste collection systems in place despite the fact that TS1 is adjacent to one of the most popular hospitality industries in Swaziland, the Ezulwini Royal Swazi Sun Hotels. Cleaning in TS1 is limited to the pool itself, thus the land which marks the margins of the pool is neglected. This is illustrated by figure 4.19 which is a condition on the western side of the weir in TS1.

In TS2 cleaning and managing the spring is practiced by males on seasonal basis, evident as there are very few plastics (waste) lying around. This is organized through community meetings held in the area by the area's elders. Anyone using TS2 makes sure that he does not litter upon finishing using it. It is suspected that the cleaning is done whole heartedly as the people are aware that their effort is rewarded by enjoying using a clean spring.

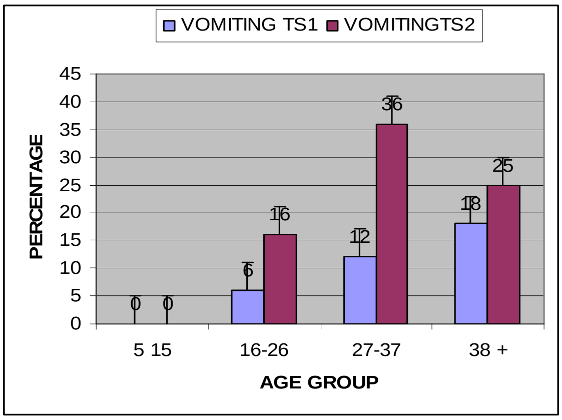


Figure 4.18. Induced vomiting by age group

Odor and vectors: The unpleasant smell of the human excrement is persistent through out the day and was strongest near the stones which mark the defecating area in TS1, as people partake in rituals of enema randomly. Flies were the only vectors noticed, probably attracted by the smell of human excrement on sunny – hot weather and these were located near the defecating areas, that is near the line of stones in TS1 and near the makeshift planks in TS2. Although flies were the only noticed disease vectors in both springs, it is suspected that other vectors such as cockroaches as well as rodents come to salvage any edible waste including human excrement. This has the danger of posing disease outbreaks such as cholera and other vector transmitted diseases.

The odor inTS1 may deter visitors from coming to the hospitality industry, the Ezulwini Sun hotels, thus reducing finances as a source of income. It may also deny other thermal pool users the pleasure of using an odorless thermal pool, as an aesthetic perspective.

Figure4.19. Bamboo poles used for cleaning TS1 pool and some personal possessions of TS1 users

Conclusion: From the findings of the study it is evident that all the thermal spring users at Ezulwini are exposed to either physical hazards due to thermal pool structure or due to activities performed at the thermal springs (enema, bathing and vomiting). Waste management in TS1 was wanting in that it is not cleaned regularly and also that there are no binding rules which may force users to manage the thermal pool. The use of these natural resources by visitors, especially visitors from abroad also poses a major threat in that cholera outbreaks may reoccur. Importation of cases into the Ezulwini thermal pool area may occur hence the thermal spring serve as a ticking biological time bomb. The environment was found to be threatened in that human excrement was directly disposed into the water and this further flowed into wetlands thus also contaminating them. The air near these areas was also found to be polluted by the feacal odor and waste due to improper management practices.

Recommendations: Health education for thermal spring users is needs to be done as users tend to share apparatus which pose a health risk. Monitoring of vector populations, water quality, as well as case reporting to the Swaziland Environmental Authority (SEA) and to the SWSC by the Ezulwini town board need to be done. The town board also needs to place dustbins and provide for waste management and also for the general management of thermal springs at Ezulwini. The SEA should provide for the protection of wetlands from being destroyed by the indiscriminate excrement disposal. And, establish laws and regulations for the protection of thermal springs in Swaziland.

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