3.0

WATER AND HEALTH

3.0

WATER AND HEALTH

We have seen in the preceding chapter that water is the sustainer of life and promoter of health. In this chapter we shall discuss how water is related to the human health. The relationship between water and health could be discussed in four aspects as under.

- Water has many beneficial effects on health, either because of its chemical constituents or its use in general sanitation.
- Water often plays an important role as a vehicle for the direct transmission of microorganisms that cause infections diseases.
- Water may have an indirect role by serving as habitat for mosquitos and other vectors that transmit disease producing organisams.
- Water also can be an important vehicle for transmitting many types of chemical toxicants.

3.1 Metabolic Fuctions

First of all we shall see how water itself function as a promoter of health. Salient functions of water in the body can be enumerated as under.

- All chemical changes which occur in the cells of the body takes place in the presence of water.
- It regulate body temperature.
- It is the vehicle for carrying carbon dioxide to the lungs and waste nitrogenous material and salts to the kidneys.
- It eliminates bowl wastes and prevent constipation.
- Water acts as a solvent for all the products of digestion, holding them in solution and permitting them to pass through the absorbing walls of the intestinal tract into the blood stream.
- 90% of water is present in the blood. This carries nutritive elements to the cells.
- It is the medium of body fluid.
- It is also an important lubricant as it prevents friction between moving body parts.
- Water helps in growth.
- It is required for life processes, for proper functioning of organs.

While water is itself the great stabilizer of bodily processes, its own balance must be regulated, not only in quantity but also in the concentration of dissolved materials. The balance of water within the body needs to be very pricise. A variation of more than one percent from the normal immediately makes it self fell as thirst or pain. When a man loses 5 percent water his skin will shrink, and 15 percent loss will prove fatal.

In one Sanskrit Subhashitam it is said that;

नास्ति क्षुधा समम् दुःखम् ।
नास्ति रोगः क्षुधा समम् ॥

(Nasti Kshudha Samam Dukham,
Nasti Roge: Kshudha Samam.)

That means, "There is no suffering like thirst, there is no disease like thirst."

The ancient Indian saints have chanted the following prayer.

"Gracious be divine waters for our protection. Be they our drink and bless us happiness. Oh water! we seek healing balm from you."

Just as water protects our planet from becoming cold, as also it protects our body from getting out heated. In hot weather and due to the work we do, our body is prone to become very hot, which may even be fatal in hot climate. But water in the body is released by skin as sweat, it evaporates, cooling our body. In other words, sweat protects our body, from getting over heated. Our normal temperature of 37^{o} C is maintained mainly because water is expelled by lungs and skin. Its rapid circulation through out the body via the blood stream enables it to carry excess heat to the surface of the body for quick release to the surrounding air.

Without, water, we will be poisoned to death by our own water products. When kidneys remove uric acid and urea, they must be dissolved in water. If there is not enough water, wastes are not removed as effectively and may build up as Kidney stones.

Water is also vital for chemical reactions in digestion and metabolism. It carries nutrients and oxygen to the cell through the blood. Water also lubricates our joints. We even need water to breathe. Our lungs must be moist to take in oxygen and excrete carbon dioxide.

Either too much or too little water can be disastrous. Too much water causes nausea and weakness and enforced drinking the water "Cure" inflicted by some savages on their enemies leads successively to mental confusion, disorientation, removes convulsions, coma and death.

Daily water balance of the normal human adult is estimated as under (3).

Item	Intake (In Kg.)	Item-	Loss (In Kg.)
Drink	1.3	Respiration	0.4
Food	0.9	Evaporation	0.5
Food oxidation	0.3	Excretion	1.6
Total	2.5	Total	2.5

Father kneipp Says :

a. Water can cure all remediable diseases.

b. It can dislodge the morbid matter in the blood.

c. It can expel from the body the dislodged morbid matter.

d. It can restore the purified blood to its proper circulation.

e. It can brace up the enfeebled organism, and can strengthen it to renewed activity.

Platen has said "Taken internally water is not only a solvent but is also bracing, cooling, smoothing, and refreshing. In its external applications it possesses these properties in a much higher degree.

Maharshi Todarananda in Ayurveda Saukhyam has described the following characteristics of water.

पानीयम् श्रमनाशनम् , दलमहरम् मुच्छांपिपासा हरम् ।
तन्द्रा स्वप्न विनाशनम् , बलकरम् स्याज्जीवनम् तर्पणम् ॥
हृध गुप्तरस अजीर्णशमनम् , चैकान्त पथ्यम् परम् ।
शीतम् लध्वमृतापम् , रसगणनाम् कारणाम् छर्दिहत् ॥

(Paniyam Shramnashanam, Dalamharam Muchchharpipasa Haram,
Tandra Swapna Vinashnam, Balakaram Syajivanam Tarapnam.
Hadh Guptarash Hajirnashamanam, Chaikant Pathyam Param,
Shitam Ladhvamrutayam, Rasgannam Karnam Chhadirhyat.)

That means, "Water removes physical and mental fatigue, fainting (Murchha), thirst (Pipasa), drowsiness (Tandra) and Sleep (Swapna). It promotes strength. It is life giving, refreshing and cardiac tonic. It has unmanifested taste. It cures indigestion. It is wholesome and excellent. It is cooling, light and like ambrosia. It helps in the manifestation of all tastes. It cures vomiting (Chhardi)."

Proper use of water not only helps us to preserve our health but also to regain it when it lost or impaired, by eliminating all the impurities from the body. From the time immemorial people have been making use of water fro treatment of diseases. Even animals are found to make use of water whenever they get ill.

3.2 Water as Medicine

Ancient Indian saints knew that all medicines are included in water so in Vedas water is called विश्वभेषज: (meaning **universal medicine**).

In Rigveda water is prayed to provide medicines.

आपोया चामि भेषजम् , आपः प्रणित भेषजम् वरूथं ,
तन्वे ऽ मम ओक्य सूर्यदृशे ।

(Apoyachami Bheshajam, Apah,
Pranit Bheshajam Varutham,
Tanve Ru Mama Jokva Suryadashe.)

That means, "I solicit water to give me medicine. O God Water! give me efficacious medicine so that I may live long and see the sun daily."
In Ayurveda, the medicinal importance is explained by following coupletes.

औषधम् निर्मलम् वारि , वैद्यो नारायणो महान् ।
हरत : सकलान् रोगान् , अकाल निधनम् तथा ॥

(Aushadham Nirmalam Vari, Vaidhyo Narayano Mahan,
Haratah Sakalan Rogan, Akal Nidhanam Tatha.)

That means, "Pure water is the real medicine. The great sun is the real physician. they can cure all diseases and also prevent an untimely death."
The river **Ganga** is considered to be the most sacred river in India and **the Sun** is considered the source of life and energy. They are worshiped by recognising their importance in the following coupletes;

व्याधिग्रस्ते भृशंदेहे भैषज्ये निष्फले यदा ।
औषधम् जान्हवीतोयं वैद्यो नारायणो महान ॥

(Vyadhigrashte Bhrusham Dehe Bhaishajye Nishfale Yada,
Aushdham Jahanvitoyam Vaidhyo Narayano Mahan.)

That means, "When the body is much diseased and when all the best medicines are of no avail, the holy water of Ganga is the best remedy and the sun is the great physician."
The following verse is repeated by the orthodox Hindus while taking a dose of medicine during their illness.

अकालमृत्युहरणम् ,सर्वव्याधिविनाशनम् ।
औषधं जान्हवीतोयं , जठरे धारयाम्यहम् ॥

(Akalmrutyuharanam, Sarvavyadhivinashanam,
Aushadham Jhanvitoyam, Jathare Dharyamyaham.)

That means, "I take in my stomach the holy water of the Ganga which prevents untimely death and which is a destroyer of all diseases."

Water is capable of relieving pain immediately in cases of cuts, bruises, burns, sprains, concussions, febrile conditions and much more. This is because of the fact that water has the highest specific heat for vaporization, the very heat it takes away from our body, thereby relieving us from burning sensation and pain.

Water acts primarily as a pain reliever in addition to having healing effects. The principle behind the healing action of water is based on the fact that when cold water is applied to any part of the body, the initial reaction is that the temperature of that part goes down. As a result, blood tends to rush to the spot (to equalize the temperature difference) and more fresh blood tends to induce faster healing.

Ayurvedic practitioners advocate drinking of water in the following manner.

उषः कालेऽमृतं वारि जीर्णे वारि बलप्रदम् ।
विषवद् भोजनान्तेच भैषज्यं रोगपीडिते ॥

(Ushah Kaleamrutam Vari, Jirne Vari Balpradam,
Vishvad Bhojanantev, Bhaishajyam Rogpidite.)

That means, "Water serves as nector, early in the morning and as a tonic when the food is digested. It works as a poison in the end of meal while it serves as a medicine to the patients during illness."

3.3 Hydrotherapy

The treatment of diseases with water is one of the oldest methods adopted by the primitive races. **Hydrotherapy** is a term applied to a system of treatment of diseases by means of water. (Hudor = Greek Word for Water.) **Hippocrates** (460-377 B.C.) and many others have clearly stated that in the remotest ages, cold water and baths of all kinds were instrumental in curing diseases. Vincent Priessnifz (1826) is known to be the founder of Hydro-therapy. Hydrotherapy is the hand-maid of nature and the minister of health.

We can make use of water (Hydrotherapy) :

- To improve our digestion
- To keep our bowels regularly active
- To regulate our urinary flow
- To cleanse the skin and keep the pores open for free perspiration
- To reduce perspiration when there is an excess of it
- To induce a natural and healthy sleep
- To reduce the temperature fever

- To prevent the rush to blood to any part of the body
- To quicken the circulation of blood
- To raise the temperature when it is subnormal and in chills
- To remove inflammation and congestion in any part of the body
- To prevent suppuration in any inflamed parts
- To allay thirst during any illness
- To heal all injuries such as wounds, cuts, falls, fractures, burns, scalds etc.
- To assuage pain in a natural way
- To aid nature in eliminating impurities toxins etc from the body
- To cure liver troubles, gall-stone, abdominal pains, constipation, obesity etc.
- To heal all blood and sin diseases such as scabies, pimples, eruptions boils, absesses, cysts etc.
- To cure reumatism, sexual weaknesses, impotence, female troubles
- To sustain, renovate and brace-up exhausted and weakened persons
- To clean up eye surfaces and lubricate them to ease movement of the eyelid

Hydropathic treatment of human ailments is very simple and neutral, not difficult, provides no side effects, non-poisons, cheapest and available everywhere. It improves digestion and removes constipation which are otherwise sources of many diseases. It is painless yet removes pain speedily.

Further to this, how water is used as a domestic medicinal tool is illustrated in the **Annexure - 3.1.**

Use of cold or hot water bath has become a part of every one's life. Bath with water not only removes external impurities of the body but also provides internal benefits which are described by many hydrotherapists. Effects of water at different temperatures are known as under.

- Water cooler than the body is rousing, cooling and stimulating.
- Water warmer than the body is bracing, invigorating and strengthening.
- Water which is hot smoothes, calms and removes all pains but it causes exhaustion.
- Water slightly lower than the temperature of the body is always beneficial and suitable for general use.

Ice applied over the body lowers the temperature. It also cures headaque and neuralgic pains. A cold water bath is to be preferred over a warm water bath. the main reason being that when cold water comes in contact with the skin, it drives away the blood from the periphery to the inside. As an equal and opposite reaction, the blood rushes back with increased vigour to warm up the skin. It is due to this that one feels warm and refreshed after a cold water bath. In contrast to this, a warm water bath has the advantage of opening up the pores of our skin, thereby facilitating the process of sweating. It also extricate dirt with greater ease.

Hot water fomentations relieve the inflammations of the eyes. It relieves the pain in the abdomen, spasms, cramps etc. in any part of the body. It also relieve the pain of the injuries. Hot water enema gives tone to the bowels and cures constipation.

3.4 Health Effects of Chemicals in Water

Although water does not contain any calory, it contains many minerals necessary for the body. A number of inorganics are essential to human nutrition at low doses, yet demonstrate adverse health effects at higher doses. Toxic effects of chemicals can be explained as under.

Mutagenic :- They produce changes in the base sequence in DNA. So incorrect genetic information is transmitted. The outcome is that wrong proteins and enzymes are produced leading to a change in the organism. It causes heritable alteration of the genetic material within living cell.

Teratogenic :- Triggering birth defects by interfering with the DNA. It causes non hereditary congenial malformations in off springs.

Carcinogenic :- They stimulate the uncontrolled cell growth called Cancer. Cause aberrant cells into malignant tumors. Polycyclic aromatic hydrocarbons from Petroleum wastes (e.g. Benzo - Pyrene) are found to be carcinogenic. DDT and BHC are also carcinogenic and are associated with nerve and Brouh damage or kidney and liver damages.

Toxic :- Causing deleterious response in a biologic system, seriously injuring function or producing death. these effects may result from acute conditions (short high dose exposure) chronic (longterm - low dose) exposure or subchronic (intermediate term and dose) exposure.

Enzyme inhibition:- Some elements can block the active sites of enzymes or replace an essential element like Zn.

The sight, smell, taste and even the feel of water is affected by chemicals contained within it. The chemistry of water can lead to a disease either if there is an absence of a necessary constituent or more commonly, if there is an excess of a harmful chemical. These diseases are clearly not infectious and are prevented simply by adding the chemical which is deficient or removing the chemical which is harmful.

Water chemistry and disease may be considered under three headings,

- The absence of necessary chemicals
- The excess of harmful inorganics
- The excess of harmful organics

3.4.1 The absence of necessary chemicals

Human needs metals for growth, health and survival. Metal such as calcium, sodium, potassium and magnesium are essential to maintain physiological milieu

essential for life. Micro quantities of othe trace metals such as manganese, copper, iron, vanadium, cobalt, zinc and nickel affect their influence on enzymes and help to maintain the structural integrity of genetic materials.

The absence of essential substances is not generally a problem because there are alternative sources of these substances in food.

Iodine is an essential element for synthesis of Thyroid hormone. Its deficiency causes goitre which can best be controlled by the introduction of iodised salts.

A deficiency of fluoride in water can cause poor growth of bones and teeth in the young. Low fluoride intake may result into a higher incidence of dental caries. This could be prevented by adding fluoride to public water supplies. Some relation has been found between water hardness and heart disease. In general, people using hard water have a lower incidence of cardiovascular disease.

Other relationships have been noticed between certain trace elements in water and resistance to disease. Such incidences are rare and the evidence is often inconclusive.

The absence of necessary chemical constituents in water is not a widespread problem as the remedy is as likely to be in the diet as the water.

3.4.2 Harmful inorganics

It is evident that while a certain amount of trace meters are necessary for the proper functioning and survival of the organism, the same trace metals can assault the organism in toxic levels.

A number of metallic ions are known to cause metabolic distrubances in human body by upsetting the production and function of certain enzymes or to cause a variety of toxic effects. Arsenic, cadmium, chromium, cyanide, fluoride, lead, mercury, nitrate and selenium are all known for adverse physiological effects.

High concentration of salts in ground water mainly **chloride** and **sulfate** makes the water **unpalatable** and causes **laxative** effects. High intake of **sodium** usually as **sodiumchloride** causes high **blood pressure.**

Although a deficiency of **fluoride** is implicated in **tooth decay,** higher concentrations are associated with mottling of tooth enamel, stiffness and pain in joints and skeletal deformities. **High nitrate** concentration in drinking water is potentially hazardous to health. The nitrates are reduced in the body to nitrites and can cause a serious blood condition in infants known as **methaemoglobinaemia** (infantile cyanosis) particularly if their diet is not rich in **vitamin -C.** Very high concentration of nitrates may be implicated in the causation of gastric cancer.

3.4.3 Harmful organics

Some of the organic compounds of groups of compounds are known to be either toxic or carcinogenic (cancer producing) or producing odour or tastes. Chlorine used for disinfection reacts with some organic compounds to produce odour or tastes.

Most of the toxic substances are **pesticides**. Pesticides present in water are also likely to accumulate in the food chain particularly in fish, presenting a greater hazard to the people who eat them.

Some other organic chemicals are known to cause cancer when consumed in drinking water. Poly aromatic hydrocarbons(PAH_S) and Trihalo methane (THM_S) are compound causing concern. THM_S are mainly formed during water treatment by the reaction of chlorine with organic compounds in water.

Ideally, for essential elements, the concentration should be at the minimum risk levels. For toxic substances it should be below the no-effect level, or zero for substances which are believed to have no thresold limits.

The beneficial and deleterious effects of some of the major elements found in water are summarised in **Table - 3.1**

Some of the elements and ions come to water from natural resources like minerals. Fluoride and Nitrates fall into this category, which cause adverse health effects, when in excessive amount. The adverse health effects of both these are discussed elaborately in separate chapters.

However, heavy metals and toxic materials mostly come from domestic and Industrial wastes which cause serious health implications. Due to heavily increasing industrialization and urbanization, the threat of toxic effects in drinking water from industrial effluents are increasing posing a serious threat to the existence of life on this planet.

3.5 Incidence of Minamata

The incidence of **Minamata** disease has drawn worldwide attention. It was a case of Mercury pollution of sea water at Minamata island in southern Japan during 1953-61. A factory (Chisso) manufacturing Acetaldehyde and Vinyl chloride used Mercury as a Catalyst. The effluent discharge from this factory into the near by sea contained mercuric chloride (catalyst), which was converted to Methyl mercury during the catalytic reactions. Initially fish and local sea birds were affected. upon eating the fish, the effect was carried to human beings. the symptoms were tragic. they included muscular weakness, blindness, inco-ordination, paralysis and in some cases coma and death. by 1973 sixty five people had died from **Minamata** disease and many more have been crippled, blinded or otherwise affected. This dreadful disease is a grim warming for

all industrialised countries of what can be the cost of the community of an advanced technology when no consideration is given to possible consequences of disposal of wastes containing toxic elements. there are some other metallic contaminants like Cd, Ni, Cr, Sb, Hg, Cu, Zn, the accumulation of which in body tissue could produce illness.

3.6 Hazards of Biological Agents

The hazards from biological agents are those that may affect man following - ingestion of water or other forms of water contact or through insect vectors. The principal biological agents transmitted in this way can be grouped into the following categories.

- Pathogenic bacteria,
- Viruses,
- parasites
- other organisms.

Some sort of relationship between water and health was recognised from the time of Hippocrates (460 - 377 BC) if not earlier. The relationship between diseases and polluted water was discovered by Robert Burton in 1621. Dr. John Snow (1813-1858) was the first to show a precise relationship of a disease to water in his well known studies of cholera. He invented the outbreak of cholera in the Golden square area of London in which over 500 deaths occurred in a small area within a span of 10 days, due to drinking water polluted by sewage infiltration. He was closely followed by Budd who demonstrated the spread of typhoid through water supplies. Mansoon (1877) showed the relation of water with filariasis and Ross for Malaria, Both infections were shown to be transmitted by mosquitoes, whose (arvae live in and are dependent on surface water. Before that Guinea warm and Schistosomiasis (Bilharziasis)were shown to depend on fresh water invertebrates for their spread.

The contamination of water by pathogenic bacteria, viruses and parasites can be attributed either to the pollution of the water sources itself or to the pollution of water during its conveyance from sources to consumer. The pollutants may include the excretions, faecal and animals, sewage and sewage effluents and washing from the soil. Infections are spread both by patients and by carriers who shed the pathogens in faeces and urine. the most widespread contamination of water is from diseases bearing human wastes usually detected by measuring faecal coliform levels. Human wastes pose great health risks for the many people who are compelled to drink and wash in untreated waters from rivers and ponds.

3.7 Water Borne Diseases

Bacterial diseases capable of being transmitted through contaminated water or food prepared with such water as under.

Disease	Causative organism
Cholera	Vibrio cholera
Bacillary dysentery	Shigella SPP
Typhoid fever	Salmonella typhi
Para typhoid fever	Salmonella Para typhi
Gastroenteritis	Shigella, Proteins SPP etc.
Infantile Diarrhoea	Escherichia coli
Leptosperosis	Leptospira SPP
Tularaenia	Tularensis

The virus most commonly present in polluted waters and sewage are the enteroviruses (Polio viruses, Coxachieveviruses and echo viruses) adeno viruses reaviruses and the viruses of infectious hepatitis. the parasite that may be ingested is Entamoeba histolytica (Amoebic dysentery and Amoebic live abcess). It is widespread through out the warm countries of the world and where ever sanitary conditions are poor. The classification of infective diseases in relation to water can be made as shown in **Table - 3.2**

Those infections which are spread by an insect, shail or other cold blooded organisms or which undergo a development in soil need a fairly warm temperature, if they are to complete, the stages of their life spent outside man. They are easily available to tropical countries and hence the problems are more. Vector borne diseases like malaria, schistosomiasis Guinea-worm and yellow fever are terrible scourge and threat to many tropical population. Many diseases in water-borne, Water washed, and water based categories depend on access of human wastes to water or peoples month. They could be controlled by safe waste disposal or improved water supply.

The statistics indicate that in India such diseases claim about five million lives every year majority of which are children. About fifty million people suffer from these diseases resulting into loss of millions of working manhours of people in productive age group. The socio-economic implications of this state of affairs is vicious circle of poverty, ill-health causing sufferings, diminishing productivity and huge sums of money spent on medicines.

The direct impact of water borne diseases in huge, especially for children and the poor, (who are at most risk). Unsafe water is implicated in many cases of diarrheal diseases, which, as a group kill more than 3 million people, mostly children and cause about 900 million episodes of illness each year. At any onetime more than 900 million people are afflicated with roundworm injection and 200 million with schistosomiasis. Water borne diseases are the main cause of 14.6 million deaths annually in developing countries of

children under the age of five. Out of these about 4 million are diarrhoea related. The adult population too suffers heavily in mortality an morbidity from the same disease.

A number of infections, are affected by hookworms which penetrate the skin from damp contaminated soil and contain flukes encyst in food items. The hookworms live in the small intestine and cause major blood loss, acting as a cause of **Anaemia.** The common roundworms (Ascaris) lay very numerous eggs which escape in the faeces and mature in the ground before becoming infective to the man if ingested. Various flukes whose eggs escape in faeces and gain access to man such as **Paragonimus** and clonorchis, the lung fluke or liver fluke. These parasites can cause extensive damage to liver.

3.8 Safe water, a basic need to control diseases.

Water carries a wide range of various infective agents that can be deadly pathogens either directly or acting as vectors. As per WHO records out of all diseases prevailing in the world today, 80 percent are due to water borne diseases only. 25 percent of the hospital beds are occupied by the patients suffering from water borne diseases only. In such circumstances by the mid 1970s, it was universally recognised that access to safe water was a basic need. Development studies have showed that provision of domestic piped water supplies, either in the dwelling or close by could save many lives and have a great positive impact on the populations quality of life. Safe water is no longer merely considered as a "normal" element of comfort, but as an essential component to ensure the minimum level of well being and health of people. While emphasazing the need for water it is said .that, **"Water is called life".** But saying more precisely we can say that **"Safe water is healthy life".**

3.9 References

1. The wonderful liquid by V.K. Joseph in Science Reporter, May 1993
2. **Reader's Digest** Bombay (India) August 1990.
3. **Handbook of Water Purification** by W. Lorch, McGraw Hill Publication U.K.
4. **Drugless Prevention and cure of diseases with water (Hydrotherapy)** by Dr. V.M. Kulkarni, Chrest Publishing House, New Delhi (1993)
5. **World Development Report - 1992** - Published by the World Bank - New York, USA
6. **Environmental pollution and Health Problems** by Rais Akhtar (1990) Ashish Publishing House - New Delhi.
7. **Environmental Health Engineering in the tropics** (Second edition) - By Sandy Cairncorss and Richard Feachem. - John Wiley and Sons, New York.
8. **Water Quality and Its Control** by James C Lamb- John Wiley and Sons, New York.
9. **Handbook of Drinking Water Quality Standards and Controls** By John De Zuane - Van Nostrand Reinhold- New York.

Annexure 3·1

WATER AS A DOMESTIC MEDICINAL TOOL

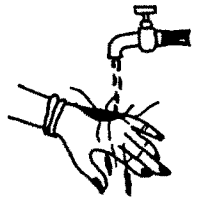
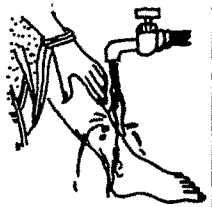
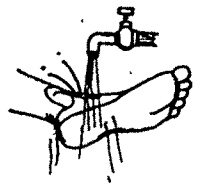
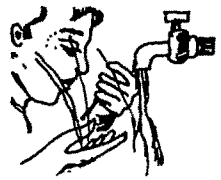
In case of	What to do ?	How water is useful	Beware
Burning 	Immediately dip the affected portion in cold water or continue pouring water 	Burning results in heating the ligaments in the body. water dioninishes this heat as in the case of application of potato or egg.	Never apply grease or oil on the affected portion
Dog or other animal bite. 	Immediately wash the affected portion with soap & water. 	The wash washes away the germs present in animals saliva.	Never apply any lotion, it can ripen the wound.
Sprain 	Keep the sprained portion dipped in water for half an hour. 	Sprain damages the Ligaments resulting in haemorrage, cold water controls this blood flow.	Never apply any kind of massage nor keep any weight on the sprained portion
Any foreign matter entering an eye. 	Apply water wash or open - close eye dipped in water 	Because of water the matter does not damage the eye; often it comes out easily	Never rub the eye for taking out matter

Table - 3.1

Beneficial and deleterious effects of major elements/ions found in Water

Sr. No.	Element/Ion	Beneficial Effect	Deleterious effect
1	Arsenic	• Essential in human nutrition • Enhances growth	• Irrigation to Mucous membranes and eyes • Low acute toxicity • Vomiting & poisoning • Creates weakness and bone pain • Skin cancer • Dermetological manifestation • Liver and kidney damage
2	Barium	----	• Chronic exposure hypertensive • Cardiotoxicity
3	Cadmium	----	• Nausea and vomiting • Severe toxic but nonfetal • Renal disfunction
4	Chromium	• Trivalent form is nutritionally essential • Deficiency causes growth retardation • It is useful in enzymatic reactions	• Hexavalent form is toxic and carcinogenic • Skin effect • Respiratory complications • Kidney and gastrointestinal damage
5 A	Chloride	• Improves taste	• Interferes with palatability
B	Chlorine	----	• Chlorine reacts with organic materials to produce Trihalomethanes (THM) which are believed to be carcinogenic
6	Copper	• Nutritionally essential • Helpful in metabolism • Senthesis of Hemoglobin	• Liver damage • Impart taste to water (Astringent taste) • Gastroenteritis with nausea • Renal damage
7	Cyanide	----	• It is highly poisonous

Table 3·1 contd.....

8	Fluoride	• Essential to prevent dental carries	• Dental fluorosis • Skeletal fluorosis • Osteosclerosis • Crippling fluorosis
9	Hardness (Sum of polyvalent cations)	• Inversely related with cardiovascular diseases • Moderate increase in calcium lowers cholesterol • Inhibits blood clotting and protect against cardiovascular diseases	----
10	Iron	• Useful in oxygen transport mechanism	• Causes Vomiting at higher concentration
11	Iodine	• Essential for Thyroid hormone • Deficiency cause goiter	• Excessively high dose is fatal
12	Lead	• No desirable nutritional value	• Cumulative poisoning • Toxic • Damages brain • Gastrointestinal disturbances
13	Magnesium	----	• Laxative and diuretic effect • Non toxic to humans
14	Manganese	• Helpful in Reproductive capabilities • Deficiency causes deformity	• No harmful effects known
15	Mercury	• Biologically nonessential	• Chronic poisoning • Kidney damage • Renal disturbances • Minamata disease
16	Molybdenum	• Essential diatery element	• Over exposure damages liver and kidney • Weight loss • Bone abnormality • Male infertility
17	Nickel	• Nutritionally essential	• Over exposure causes blood and enzyme changes

Table 3·1 contd....

18	Nitrates	----	• Impairs oxygen transport particularly in infants. (Methemoglobinimea) • Cardiovascular effect at high doses
19	Salinity (TDS)	• Essential to produce taste	• excessive amount causes unpalatable taste • Laxative effect
20	Selenium	• Essential in metabolic reactions • Prevents Endemic disease	• Toxic at high levels • Effects similar to Arsenic
21	Sodium	----	• High blood pressure and heart diseases • Cirrhosis and renal diseases • Gastrointestinal irritation
22	Sulfate	----	• Causes diarrhea and dehydration • Gastro intestinal irritation
23	Zinc	• Beneficial in human metabolism • Deficiency causes growth retardation in children	• Toxic at higher levels • Produces taste problem at higher level • Muscular pain and naucea

Table - 3.2

Classification of infective diseases in relation to water supplies

Category	Type	Example	Preventive Strategy
Infection spread through water Supplies	Water borne diseases	• Classical Typhoid/Cholera • Non classical Infective hepatitis	• Improve water qualit • Prevent casual use of other unimproved sourcesy
Diseases due to lack of water for personal hygiene	Water washed diseases	• Skin and eyes, scabies, trachoma • Diarrhoeal diseases, Bacillary dysentery	• Improve water quantity • Improve water accessibility • Improve hygiene
Infections transmitted through an aquatic invertebrate animal	Water based diseases	• penetrating skin Schistosomiasis • Ingested guinea worm	• Decrease need for water contact • Control snail population • Improve quality
Infections spread by insects that depend of water	Water related diseases	• Biting near water spleeping sickness • Breeding in water yellow fever	• Improve surface water management • Destroy breeding sites of insects • Decrease need to visit breeding sites
Infection primarily due to defective sanitation	----	• Hook worm	• Improve Sanitation