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The Impact of Water Quality on Human Nutrition: A Review of the Relationship between Water Intake and Nutrient Absorption

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Abstract

Water quality is intrinsically linked to human health, and ensuring access to clean and safe water is a fundamental public health goal, Water is essential to human health as it assists with nutrient delivery and digestion. The chemical, physical, and microbiological qualities of water have a substantial impact on the gastrointestinal tract's ability to absorb nutrients. Heavy metals, insecticides, and microbial infections are examples of contaminants that can hinder digestive processes, resulting in nutrient shortages and absorption. Pure, high-grade water can improve the absorption of nutrients and the effectiveness of digestion. This review examines the connection between nutrient absorption and water quality, with a particular emphasis on the effects of water pollution on human health. According to the review, nutrient absorption is greatly impacted by water quality, particularly in groups that are more sensitive. It emphasizes how crucial it is to monitor and control water quality better in order to provide the best possible nutrition and health results. This review synthesizes current research to elucidate the mechanisms through which water quality impacts nutrient absorption and overall nutritional status. It also highlights the public health implications, particularly in areas with inadequate access to clean water, and suggests interventions to improve water quality and

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support optimal health outcomes. water quality has a significant impact on human nutrition by influencing nutrient absorption, overall health, and hydration. Contaminants in water can interfere with nutrient absorption and cause a range of health issues, ultimately affecting the availability of essential nutrients in the body. Therefore, addressing water quality issues is crucial for promoting optimal nutrition and improving human health. The findings underscore the importance of ensuring access to clean drinking water as a fundamental component of nutritional health and public well-being.

Keywords*:* Water Quality, Human Nutrition, Nutrient Absorption, Heavy Metals, Microbial Pathogens, Public Health

Introduction

Water is one of the essential items needed for living beings for the survival and growth. It also maintains an ecological balance between various groups of organisms and their environment (Danmusa, A. M., & Adam, A. B. 2022). Water quality plays a crucial role in human nutrition by impacting the availability of essential nutrients and overall health. Poor water quality can lead to a range of health issues and nutrient deficiencies, ultimately impacting human nutrition. One of the key ways in which water quality impacts human nutrition is through its role in nutrient absorption. Contaminants in water, such as heavy metals, pesticides, and pathogens, can interfere with the body's ability to absorb essential nutrients. Arsenic accumulates in the heart, lungs, liver, kidneys, muscles, neural tissues, skin, nails, and hair, passing through the circulation (Abubakar M.Y et *al.,* 2024a)

Water is also present in the atmosphere in solid, liquid, and vapor states. Water is the most common liquid on our planet, vital to all life forms. It is also an important component of the tissues of most other living things. Water is one of the nature's most important gifts to mankind. It is an essential element for survival of human being nutrient deficiencies and health issues by disrupting the absorption of iron, calcium, and zinc (Abubakar M.Y et *al.,2024*b).

In addition to affecting nutrient absorption, poor water quality can also directly impact human health and nutrition. Contaminants in water can cause a range of health issues, such as gastrointestinal problems, liver and kidney damage, and neurological disorders. These health problems can in turn lead to nutrient deficiencies and malnutrition, further exacerbating the impact of poor water quality on human nutrition. Open field vegetable

production and especially greenhouse vegetable industry apply more fertilizer and water per unit of production area compared to other cropping systems (Colla et al., 2015a; Rouphael et al., 2016a). A primary challenge for extension specialists, growers and scientists associated with the vegetable industry is to ensure high yield and product quality using sustainable management with improved efficiency in the use of water and nutrients (Colla *et al.,* 2017a, b; Rouphael *et al*., 2017a).

It is normally assumed that the contribution of food tototal water intake is 20–30%, whereas 70–80% is provided by beverages. This relationship is not fixed and depends on the type of beverages and on the choice of foods (EFSA, 2008). For an individual at rest under temperate conditions, the volume that might be drunk in a day is on an average 1.5 l. This has to be adapted according to age, gender, climate and physical activity. The water content of food can vary within a wide range, and consequently the amount of water contributed by foods can vary between 500 ml and 1 l a day. Endogenous or metabolic water represents about 250–350 ml a day in sedentary people. The adequate total water intakes for sedentary adults are on an average between 2 and 2.5 l per day (women and men, respectively) (EFSA, 2008). In conclusion, the total water inputs for sedentary adults are on an average between 2 and 3 l.

Role of Nutrition in Health

Nutrition refers to the intake of food and its impact on the body's health and function. A balanced diet provides essential nutrients, including macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals), which are necessary for Energy Production (Whitney & Rolfes, 2018). Growth and Development (Sizer & Whitney, 2016), Immune Function (Gombart et al., 2020). Cognitive Function (Benton, 2010). Disease Prevention: (Hu, 2002).

Importance of Water Intake

Water is essential for life, accounting for about 60% of body weight in adults. It is involved in nearly every bodily function, and maintaining adequate hydration is critical for: **Cellular Functions**: Water is vital for cellular metabolism, nutrient transport, and waste elimination (Jéquier & Constant, 2010). **Temperature Regulation**: Through processes like sweating

and respiration, water helps regulate body temperature, preventing overheating and dehydration (Sawka et al., 2007). **Digestive Health**: Adequate water intake supports digestion by aiding in the breakdown and absorption of nutrients and preventing constipation (Popkin et al., 2010). **Joint Lubrication**: Water acts as a lubricant for joints, reducing friction and preventing injuries and joint disorders (Grandjean & Campbell, 2004). **Kidney Function**: Water is essential for kidney function, helping to filter and eliminate waste products from the body through urine (Institute of Medicine, 2004).

Water Quality and Nutrient Absorption

Water is essential for human health, and access to safe and clean drinking water is a fundamental human right (WHO, 2019). However, the quality of water can vary significantly depending on the source, treatment, and distribution (CDC, 2020). Water pollution has become a major global concern, with millions of people worldwide lacking access to safe drinking water (UNICEF, 2020). Water quality has a direct impact on human health, with waterborne diseases causing millions of deaths worldwide each year (WHO, 2018). In addition to microbiological contaminants, water can also contain chemical contaminants such as heavy metals, pesticides, and industrial pollutants (EPA, 2020). Exposure to these contaminants has been linked to various health effects, including cancer, reproductive problems, and neurological damage (ATSDR, 2020).

Adsorption of nutrients using agricultural waste (AWBs)

The use of agricultural waste and by-products (AWBs) in the adsorption process has been thoroughly studied. Whether these materials are used as raw materials for the production of activated carbon (AC) or for the Adsorption of Nutrients Using Low-cost Adsorbents from Agricultural Waste and By-products, their affordability, accessibility locally, and effectiveness in eliminating a variety of unwanted toxics and pollutants—primarily heavy metals and dyes—make them an important consideration. Hence, they could be used in place of more costly but typical adsorbent materials, especially in underdeveloped nations where many enterprises lack suitable individual sewage treatment technologies. For the elimination of, AWBs were made from inexpensive and easily accessible materials such agave bagasse (Valix et al., 2004), almond and apricot shells (Aygun, 2003), and coir pith (Namasivayam et al., 2001) were employed to eliminate a variety of contaminants, primarily

heavy metals and dyes, from aqueous solutions. AWBs can be utilized in their original or altered state. When the product is in its natural state, it is utilized in adsorption testing after being cleaned, ground, and sieved to the appropriate particle size. However, in order to improve the adsorption capacity for some pollutants by raising the number of active sites, pre-treatment using modification techniques is required.

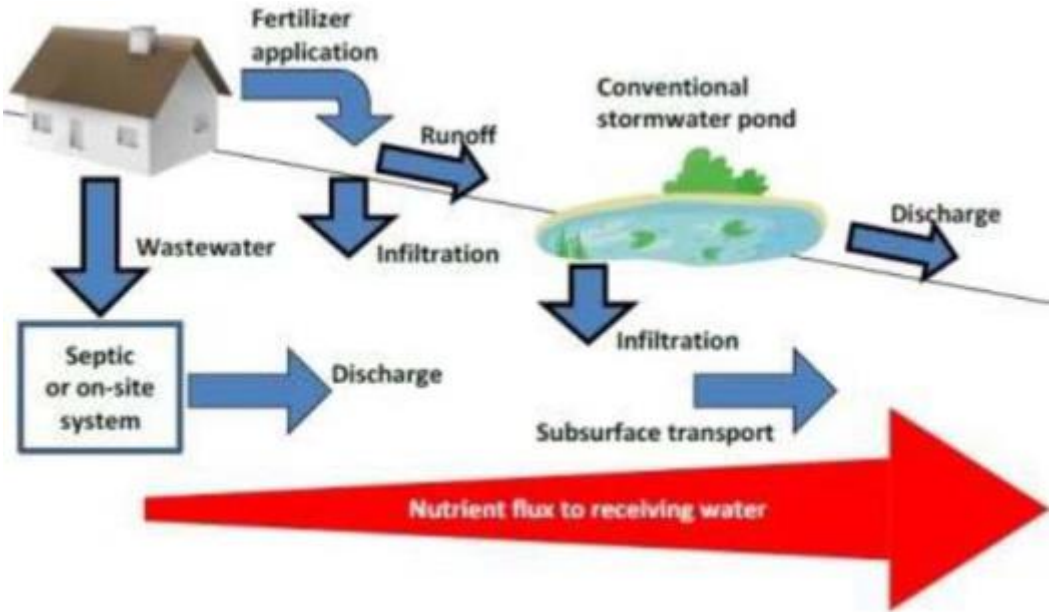

Figure1 : Nutrient contamination sources (http://usf-reclaim.org/)

Some important of nutrition are shown below ;

* provides energy and supports growth and development
* Helps maintain healthy weight and body composition
* Supports immune function and reduces risk of diseases
* Promotes healthy skin, hair, and nails
* Supports eye health and vision
*Helps maintain healthy bones and muscles
* Supports cognitive function and mental health
*Reduces risk of chronic diseases like heart disease, diabetes, and certain cancers

Nutrition

A healthy diet is crucial for maintaining optimal health. Adequate nutrition provides the body with the necessary nutrients, vitamins, and minerals to function properly. A diet that is deficient in essential nutrients can lead to a range of health problems, including malnutrition, fatigue, and weakened immune function (WHO, 2018). A well-balanced diet should include a variety of foods from all food groups, including fruits, vegetables, whole grains, lean proteins, and healthy fats (USDA, 2020).

Water Intake

Adequate water intake is essential for maintaining proper bodily functions. Water helps to regulate body temperature, transport nutrients and oxygen to cells, and remove waste products (NAS, 2004). Inadequate water intake can lead to dehydration, which can cause symptoms such as headaches, fatigue, and dizziness (Mayo clinic, 2020). Additionally, water intake has been linked to a reduced risk of certain diseases, including kidney stones, urinary tract infections, and some types of cancer (NIEHS, 2020).

Conclusion

This review highlights the crucial link between water quality and human nutrition, specifically nutrient absorption. Contaminated water, containing heavy metals, insecticides, and microbial pathogens, can significantly hinder the digestive process, leading to nutrient deficiencies and impaired absorption. Conversely, access to clean, high-quality water promotes optimal nutrient uptake and overall digestive health. This is particularly critical for vulnerable populations who are more susceptible to the negative impacts of poor water quality. Therefore, prioritizing water quality monitoring, implementing effective control measures, and ensuring access to safe drinking water are essential for enhancing nutrient absorption, improving overall health outcomes, and safeguarding public well-being.

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