

'Drink clean, safe water and/or other fluids through-out the day even if you do not feel thirsty': a food-based dietary guideline for the elderly in South Africa

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This review summarises information from available literature to support the dietary guideline 'Drink Clean, Safe Water and/or Other Fluids Through-Out the Day Even if You Do Not Feel Thirsty' set for the elderly of South Africa (SA). Water is essential for life and is necessary for important functions of the body like maintenance of tissue structure, blood volume regulation, temperature regulation and excretion of metabolites through kidneys. Though water is necessary for all, the elderly are especially at risk of dehydration due to altered hormonal activity and body functions that reduce their sensitivity to thirst (water intake) and urination (water excretion). Total body water is also reduced in the elderly, so they are unable to buffer the effects of water loss in the body. Therefore, water intake should be monitored properly in the elderly so that they can lead a happy and healthy life and reduce the economic burden due to hospitalisation caused by water imbalance or dehydration, which is common in the elderly. Two litres of water per day is generally considered adequate, but there is no consensus regarding the exact requirement for water as need varies due to climate and physical activity levels. The importance of water to maintain bodily functions and the risk of dehydration substantiate the need for a dietary guideline to address the importance of clean and safe water/fluid consumption regularly throughout the day among the elderly in SA.

Keywords: elderly, fluid intake, food based dietary guidelines, South Africa, water intake

Introduction

Water is the most important nutrient required by the human body as it has multifaceted functions. Survival without water can be limited to only a few days. Water balance is maintained by the body through intake regulated by thirst and losses regulated by urinary losses, skin evaporation and respiration.¹ More than 60% of the human body consists of water but as people age, the proportion of body water is reduced to below 50%.² This reduction may have adverse effects on the body if adequate hydration levels are not maintained and regulated. Therefore, though water is essential for the survival and proper functioning of the human body at all stages of life, its importance is increased with old age.

The South African food-based dietary guidelines for people aged seven years and older include a guideline entitled 'Drink lots of clean, safe water'. Although this guideline also included the elderly population group,³ a revised guideline was developed specifically for the elderly not only to include drinking clean and safe water, but specifically to address the issues commonly experienced by the elderly and the reasons why the elderly may not consume enough fluids throughout the day. The purpose of this review paper was thus to examine and summarise the information in the literature regarding the importance of fluid intakes, including water, to provide evidence for justifying the food based dietary guideline 'Drink Clean, Safe Water and/or Other Fluids Through-Out the Day Even if You Do Not Feel Thirsty' for the elderly. During the testing of the guidelines it was accepted that the age for the elderly be set at 60 years and older. This is because the pensionable age for SA adults is set at that age.⁴ The elderly are a heterogeneous group and include people above the age of 60, which includes

healthy free-living individuals as well as institutionalised patients with acute or chronic conditions.

For the purpose of this article, daily fluid (total water) intake is defined as the amount of water consumed from foods, ordinary drinking water, and other beverages such as fruit juice, unsweetened coffee, tea, and cold drinks, soups and milk. Where consumption is described, the terminology 'fluid(s)' will be applied. 'Water', as a nutrient and component of fluids, will be used where the bodily functions are described. Institutionalised elderly refers to those elderly living in nursing homes, assisted care facilities or any other medical facility.

Fluid requirements of the elderly

According to the Institute of Medicine (IOM) Food and Nutrition Board, the adequate intake (AI) of fluids for elderly men is 3.7 litres (l) per day, compared with 2.7 l per day for elderly women.⁵ The European Food Safety Authority recommended Adequate Intakes of fluids for adults and elderly were 2 l/day for women and 2.5 l/day for men.⁶ Fluid requirements vary from individual to individual because of the complex dynamics of total body water regulation in the human body, as well as climate and physical activity levels. There is thus no widespread consensus regarding the adequate fluid requirement for different age groups and the general recommendation is 2 l per day. It has been shown that a mild neuro-endocrine defence mechanism is activated in the human body when fluid intake is below 1.8 l during a 24-hour time frame.⁷ Drinking more fluids, however, reduces the risk of kidney stones due to concentrated urine in people with normal kidney functions.⁸ In clinical practice, it is accepted to provide at least 1.5 l of water per day for all elderly through oral or tube feeding.⁹ As fluid requirements

vary with climate, level of activity and many other physical and environmental factors, there is no upper limit for drinking water, provided there is no renal failure. In the elderly with kidney problems the level of water intake has to be carefully monitored depending on the condition of the patient.¹⁰

Importance of water in the body related to the elderly

Water is a vital nutrient of the body as it has multifaceted functions like transportation of both nutrients and body waste, temperature regulation and maintaining tissue structures. It is the only nutrient that supports the structure and function of all the cells of the body.¹ Water is a key factor for many biochemical reactions of the body where it acts either actively or passively. Water assists with the digestion and assimilation of macronutrients (carbohydrates, proteins and fats) into the tissues and is essential for the energy-producing mechanisms of the body. Even where water does not have a direct role in the reaction, it acts as a medium for the reactions to occur in the body; for example, during the process of digestion, protein-splitting enzymes mix with complex food molecules in an aqueous environment of the gut. Water also maintains the blood volume and circulation of all nutrients from organ to organ. Therefore, all vital systems and organs depend on an adequate hydration status to function properly. Another function of water is maintaining the core body temperature by uniformly distributing the heat in the body, and through sweating (evaporation and cooling the body surface). Water is the base component for all body fluids and lubricants like saliva, mucus and fluids in the joints. Furthermore, water acts as a shock absorber and protects vital organs from damage.^{11,12}

Benefits of different fluid sources

The important sources of fluid are drinking water, food and drinks consumed, and water produced by physiological reactions in the body. In sedentary people, endogenous water – water produced from physiological reactions – can account for about 250–350 ml per day.¹³ About 20% of the fluid requirement can be met through water content in foods while the rest (80%) has to be ingested in the form of drinking water or other beverages.⁵ Although water is the best source to replenish body fluids, other sources of fluids such as 100% fruit juices, tea and coffee with no added refined sugar, vegetable juices, clear broths, milk (preferably low fat or fat free), electrolyte drinks, sugar free cold drinks and squashes, as well as soups (preferably home-made without excess salt), can also contribute to replenishing body fluids. Although many other fluids for example energy drinks, carbonated drinks and flavoured milks, are available in the marketplace, these are not recommended for the elderly due to the added sugar content.

The elderly may also be encouraged to increase the intake of fruits and vegetables that have a high water content. Examples are cucumber, peaches, lettuce, tomatoes and watermelon. Planning and adding nutritious fluid sources to the diet of the elderly plays a crucial role in their health.¹⁴ Consumption of tea was associated with better cognitive performance in the elderly – possibly due to the presence of flavonoids and antioxidants in tea.¹⁵ Low-fat milk is also an excellent fluid source for the elderly and studies have found that consumption of low-fat milk was associated with lower risk of metabolic syndrome which includes obesity, dyslipidaemia, increased blood pressure, diabetes and cardiovascular disease.¹⁶

Although it is safe to include all sources of fluids in the daily diet of all people, the elderly may have one or more diseases that may restrict their variety of fluid intake. In the presence of hypertension, fluid intake should be limited from sports drinks and drinks that contain sodium, such as instant or ready-to-eat soups. The elderly should also limit their fluid intake from carbonated and sweetened beverages, as well as coffee, because sugar and caffeine in these drinks have a diuretic effect.^{17,18} Consumption of cola-containing beverages was also found to be associated with decreased blood pH and decreased calcification of bones, leading to reduced bone mineral density.¹⁹ People with renal diseases may have fluid restrictions depending on their condition. Therefore, it is clear that although fluids are indispensable for the elderly, the amounts and sources of fluids should be individually and carefully planned.¹⁴

It should be kept in mind that although reasonable amounts of alcohol, tea, coffee and soft drinks may be consumed, these do not necessarily prevent dehydration, but may contribute to dehydration in some cases, as the kidneys may react to sugar and caffeine in these drinks.¹⁵

Risk of dehydration in the elderly

Dehydration is very common among the elderly. Mortality rates due to dehydration and hyponatremia among older adults are more than 40% as reported by a systematic review.²⁰ The changes in the physiological and hormonal systems of the body, along with other risk factors like immobility, visual impairment, incontinence and all other age-related comorbidities, like Alzheimer's disease and osmotic disturbances due to diabetes, make the elderly prone to dehydration.^{10,21} In addition, total body water and the buffering capacity of the stored water are reduced.² Various factors affect water intake; for example, impaired mobility can reduce access to water and fluids, especially in elderly individuals living alone. Furthermore, reduced thirst and impaired kidney functions also add to lower intakes of fluids. Drinking or eating in greater amounts may also be difficult for the elderly due to swallowing problems or simply not feeling hungry or thirsty.¹³ Oropharyngeal dysphagia (OD) may also be the result of the natural ageing process (presbyphagia) and is characterised by an inability or difficulty in swallowing foods and fluids. This may also result in the elderly becoming dehydrated and malnourished due to a lack of fluid and food intake.²²

Small reductions in fluid intake or increased output can lead to severe dehydration.² A reduction of total body water (TBW) is defined as dehydration and it can be brought about mainly by two mechanisms: water loss or electrolyte or salt loss.²³ Water is also stored in the muscle mass of the body so a loss in muscle mass and increase in fat mass (which is associated with ageing) also leads to a decline in TBW.¹⁰ Chronic use of certain drugs like diuretics, corticoids and metformin as well as their route of administration have been shown to affect hydration status of the elderly in clinical studies.^{25,26} The elderly are particularly at risk of unrecognised dehydration because, in many cases, in the early stages of dehydration, no signs are present and dehydration is only detected when it is in the severe stage.²⁶ Clinical signs of dehydration include oral dryness (tongue furrows, dry mucous membranes), weight loss, skin turgor, constipation, orthostatic hypotension and urine concentration.

Research has shown that it is very difficult to assess dehydration in older people, especially because many signs and symptoms of dehydration may be caused due to the natural ageing process, for example classical signs of dehydration like dry mouth or sunken skin may be caused either due to the ageing process or due to increased intake of medications.²⁷

Hyperosmolar dehydration (HD) is defined as serum osmolality of > 300 mOsm/kg bodyweight or > 300 mOsm/l. For early detection of dehydration in the elderly, HD may be a more sensitive measurement compared with detecting the clinical signs and symptoms of dehydration that are often used.²⁴

Xerostomia, or dry mouth, is associated with ageing and has many causes including breathing through the mouth, chemical changes in saliva and certain medications. This condition can be relieved by consuming small amounts of fluids regularly throughout the day. Foods that can stimulate salivary secretion are plums, apples, lemons and olives.^{2,28}

Epidemiological studies have shown that in the elderly, the prevalence of chronic constipation is 15–20% and this rate increases as the age of the patient increases. Inadequate fluid intake is a risk factor for constipation as it causes faeces that are too hard to pass that may result in obstruction of the colon, intestinal wall ulcers and, in severe cases, colon cancer.²⁹

Although dehydration can be treated, it has many serious physical and economic implications. As early as 1991 it was calculated by Bennet that the average hospitalisation cost of the elderly due to dehydration was \$1.2 billion for one year in the USA.³⁰ In 2011 it was reported that 100 000 elderly were hospitalised with dehydration as their primary diagnosis.⁹ A systematic review concluded that dehydration in the elderly was an independent factor associated with higher health costs and an increase in hospital mortality, utilisation of intensive care and other hospital resources and readmission rates.²⁰

Water balance or osmotic pressure is maintained within the body between extra-cellular fluid (ECF) and intra-cellular fluid (ICF) but true equilibrium is never reached. This process can also compensate for small periods of time when fluids are required but are not ingested. In the elderly, due to cellular water loss, the compensation of fluids to compensate for dehydration is also hampered due to loss of body cells. Some other risk factors for the elderly are hypovolemia (extra-cellular water loss), which causes hypotonic and isotonic dehydration due to vomiting and diarrhoea. Hypotonic dehydration causes reduced blood volume and may cause dizziness, fainting and ultimately hypovolemic shock, which may result in death. The other important characteristic of this kind of dehydration is that there is no sensation of thirst associated and thus, if unrecognised by other clinical signs, this can lead to fatal consequences in the elderly. The best way to detect dehydration in the elderly is therefore by laboratory findings of serum osmolality.¹⁰

As it is difficult to assess dehydration in the elderly, especially in the community at the early stages, and due to the fact that it is mostly only determined at a more severe stage, it is better to prevent this situation from happening by promoting regular intake of fluids throughout the day, even when not feeling thirsty.¹¹

Importance of fluoridated water for oral health among the elderly

Dental caries is one of the most prevalent chronic diseases and oral health is thus essential for general health.³¹ Very little information is known about oral health of the elderly in SA. A dental survey conducted in 1989 showed that 95% of the elderly had periodontal conditions such as tooth decay and missing teeth.³² A recent study undertaken in Johannesburg indicated that, despite free oral health services being available for all age groups, utilisation of these services was low (only 28% of the elderly) due to perceived high cost of dental services, lack of transportation and fear of dentists.³³ Tooth loss is an important indicator of oral health status of the elderly and is often caused by a diet containing refined sugars³⁴ and by not consuming adequate fluoride, of which fluoridated drinking water is the main source in the diet.³⁵

The protective effect of fluoride in drinking water against dental caries is well known. Fluoride has three important functions in tooth health, namely it reduces and inhibits demineralisation, it remineralises teeth enamel where porous lesions appear and it prevents plaque formation by inhibiting bacterial metabolism of sugar.³⁵ Tap water in SA is fluoridated and the ideal concentration of fluoride was established to be 0.7 mg/l (upper limit of 1.5 mg/l) as legislated by the Department of Health in 2003 (South African National Standard 241).³⁶ Although topical fluoride application sources such as toothpaste, gels and fluoride-rich mouth rinses, as well as consumption of fluoride-rich teas and agricultural products can contribute to oral health, consumption of fluoridated drinking water is considered one of the most viable options for the prevention and reduction of dental caries prevalence.³

South African situation

The SA constitution identifies water as a human right, but water insecurity is a major problem in the country.³⁷ SA is a dry country with an average rainfall of 450 mm per annum. Climate change, water pollution, low rainfall, high evaporation rates, an expanding economy and the growing population all contribute to less water being available to the people of SA.³⁸ In 2017, 80% of the South African population had access to safely managed water services, with 6% and 9% with basic and limited, and 3% with no safely managed water services. In rural areas, however, 19% and 7% had either limited or no safely managed water services compared with 3% and 0% in the urban areas respectively.³⁹ With a total of 58.8 million people in SA,⁴⁰ this means that 1.77 million people still do not have access to an improved drinking water source that is located on their household premises, available when needed, and free of faecal and chemical contamination.³⁹ However, a cross-sectional survey done to determine water insecurity in SA during 2017 showed that 56% of all households still used un-purified surface water as their primary water source. Most people accepted that the municipal or piped water was cleaner and safer and tried using that for drinking or cooking purposes. Other domestic use water mainly came from surface water like rivers and streams.³⁷

Research done on the public perception of drinking water safety in SA showed that taste, odour and clarity of water and not microbial content were factors considered when water is consumed by the general population of SA and this perception has been consistent over the years. Even a large cholera outbreak in KwaZulu-Natal in 2000–2001 was not able to affect this perception of water safety and cleanliness.⁴¹ Although

water safety is an issue in SA, due to the presence of microbes in higher than acceptable amounts (when compared with the maximum limits laid out by the Department of Water and Sanitation), this situation is similar to that in other developing countries.^{42,43} Water quality from piped water distributed by the municipality in the urban areas poses many fewer health risks compared with water used mostly by the non-urban populations.⁴⁴

Although there were no data available for how much water the elderly of SA consumed, a review of several other studies showed that the institutionalised elderly (those in elderly care centres or hospitals) usually consume less water compared with the elderly at home. In the USA the average water intake for institutionalised elderly people was 1.5 l/day while in the UK it was 1.16 l/day.² A study conducted in Cape Town in 1989⁴⁵ showed an average of 1.77 l per capita fluid consumption of adults. Of the total fluid consumption per day, the majority (1.1 l) was from domestic tap water. A similar study undertaken in 2001 in Cape Town showed 2.19, 1.26 and 1.4 l of tap water consumption among the white, the coloured and the black population groups respectively.⁴⁶

Apart from water, there has been a steady increase in the consumption of other fluids in SA. Flavoured milk consumption has increased by 16% compared with cow's milk consumption, which has increased by 7% since the 1990s. Coffee and tea consumption have also increased over the years. Fruit intake has increased by about 6% since the 1990s. Carbonated drink consumption has risen in SA, particularly in the urban areas, but due to better education and awareness among consumers a shift towards selecting low-calorie and non-cola carbonated drinks has been observed. An increased consumption of 100% juice was also seen in SA, making it more popular than fruit drinks and nectar.⁴⁷

However, no national consumption data specifically for the elderly are available. Two smaller studies showed that fluids mainly consumed by the elderly in Sharpeville⁴⁸ and Umlazi⁴⁹ were tea, full cream milk, mageu, fruit juice (orange and punch respectively), and coffee. Carbonated cold drinks, fruit (apples, oranges), soup and vegetables (cabbage and spinach) also appeared in the top 20 most commonly consumed foods in Sharpeville;⁴⁸ however, the daily per capita intake of these foods showed small portion sizes. Similarly, in Umlazi, vegetables (cabbage, spinach, tomatoes and onions) also appeared in the top 20 most commonly consumed foods, but also in small daily per capita intakes. These results point to an inadequate intake of fluids among the elderly in these two communities.⁴⁹

Barriers to implementing the FBDG

Reduced food intakes

Fluid intakes in the elderly may be reduced for various reasons. The first may be a reduction in food intake. Elderly people may reduce food intake intentionally or unintentionally due to a number of factors such as difficulty in swallowing, loss of taste and appetite.⁵⁰ Another reason for low fruit and vegetable intakes may be food insecurity, which may result in cheaper energy-dense food procurement and mainly carbohydrate-based diets as observed among the elderly in Sharpeville⁴⁸ and Umlazi.⁴⁹ The second reason for low fluid intakes is incontinence, which may be defined as lack of voluntary control over urination. The elderly may sometimes consciously refrain from consuming fluids due to the embarrassment of incontinence.

Simply finding and visiting the toilet frequently may be a challenge due to limited mobility.⁵¹ Limited mobility may also result in inadequate fluid intakes due to difficulty in accessing fluids.¹³ Elderly people with dementia may forget to consume fluids and foods and this may also result in low intakes.³

Impairment of thirst mechanisms in the elderly

Water balance is maintained in the human body through input primarily regulated by the thirst mechanism and output primarily regulated by the renin mechanism in the kidneys. There is evidence in the literature to suggest that both these mechanisms are impaired in the elderly, leading to impaired fluid balance. Those elderly individuals who consumed an electrolyte-infused drink to reduce the osmolality of blood and induce thirst sensation showed that they expressed less thirst on a visual analogue scale as compared with a group of younger individuals given the same solution. This proves that thirst sensations in the elderly are reduced.¹¹ In other studies it was found that, although the thirst sensation was the same in both young and older people, the daily amount of fluids consumed by the elderly group was much less. This shows that once a small amount of water is consumed by the elderly, the oropharyngeal cues and gastric distention makes the sensation of thirst diminish quickly.¹⁰ It is thus advisable to encourage and remind the elderly to drink more fluids during the day, even though they are not thirsty, to prevent dehydration.^{10,13}

Hormonal imbalances in the elderly regulating water balance

The most important hormones in the maintenance of body fluid levels are part of the renin-angiotensin system. In response to extracellular fluid loss, renin is secreted and it increases water uptake and retention by the kidneys. Renin also stimulates the secretion of angiotensin, which induces thirst sensations through the hypothalamus of the brain. With the progression of age, the rennin function is lowered and the kidneys lose the ability to concentrate urine. Angiotensin stimulation of thirst may also be impaired as studies on rats reported that adding angiotensin stimulants in drinks does not increase thirst in the elderly as it would normally do in younger animals.^{13,27} The second important set of hormones regulating water balance are part of the arginine vasopressin system. Vasopressin is called the antidiuretic hormone because of its potent ability to increase fluid retention in the kidneys. Aldosterone is a mineralocorticoid that primarily regulates sodium balance in the kidneys by stimulating sodium reabsorption and potassium excretion. Both secretion and sensitivity of the hormone is reduced due to ageing.^{13,27,52}

Strategies to increase fluid intake in the elderly

It is easier to monitor fluid intake in the elderly at medical care centres or care homes, but free-living elderly individuals are at most risk when it comes to dehydration. Recognising the factors that may lead the elderly not to drink enough fluids is the first step towards better care. Providing education on the requirements of fluid to the elderly, particularly because they may not be willing or able to drink enough, maintaining a log of fluid intake to remind the elderly of missed drinks, having a variety of fluids available in the house and having special aids like special cups or containers from which it is easier for the elderly to drink, are some strategies that can be applied at home. Drinking water when taking medication should also be encouraged as it is a common practice for elderly people to be taking some medication routinely and this may form a routine of water consumption.⁵³

In addition, the elderly could be encouraged to carry bottled water for easy access, choose water instead of sugar-sweetened or carbonated beverages at home as well as when eating out, and prepare and consume infused water by adding a wedge of lemon or other fruits like watermelon or oranges to water to improve taste or make water more fun to drink.⁵⁴

Several interventions to minimise dehydration in the institutionalised elderly have been tested. Although there is no consensus, multi-component interventions were the most successful in reducing dehydration. Some of the intervention strategies that could be used in the care homes are: staff training to promote fluid/water consumption, having the preferred fluids available, providing assistance while drinking and allowing families to encourage fluid intakes during visiting hours.⁵⁵

The elderly should be encouraged to boil water and let it cool before it is used as drinking water or for food preparation. This will ensure microbial safety⁵⁶ in areas where access to piped water is limited and where the elderly have to rely on dam and river water for consumption, as is the case in many areas in SA.⁵⁷

Conclusions and recommendations

The literature provided sufficient evidence that water is very important to the elderly and that dehydration is a real problem for them for many reasons. Not regulating fluid intake in the elderly can lead to detrimental effects with physical, mental and economic consequences. Unlike younger people, the elderly are unable to maintain the water balance in the body through the body's own mechanisms and this has to be monitored. As many of the elderly also face problems of mobility, both drinking water and urination can be a problem. The literature thus supports the food-based dietary guideline for the elderly not only to focus on water consumption, but also that clean, safe water/fluids should be consumed throughout the day even if the elderly do not feel thirsty. We recognise, however, that there are limited water consumption data available specifically related to the elderly and more research is needed to address this.

It is recommended that nutrition education programmes for the elderly should include the importance of water consumption.³ Additionally, caregivers play a very important role to remind and assist the elderly to consume water frequently during the day and this message should be included in regular nutrition education and training programmes. Access to safe and clean water is still a problem in large areas of the country and should be addressed as a priority by policy-makers due to water being essential to health, not only for drinking, but also for all other domestic, sanitary and hygienic purposes.

Author contributions

All authors assiduously contributed to the preparation of this manuscript and gave their respective approvals.

Disclosure statement – No potential conflict of interest was reported by the authors.

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Received: 20-02-2020 Accepted: 20-06-2021