

Low-Intake Dehydration in Older Adults

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Low-intake dehydration is a common and often chronic condition in older adults. Adverse health outcomes associated with low-intake dehydration in older adults include poorer cognitive performance, reduced quality of life, worsened course of illness and recovery, and a high number of unplanned hospital admissions and increased mortality. The subjective methods to assess (risk of) dehydration are not reliable, and the evidence about preventive measures are also limited. So is the knowledge about the optimal intake of beverages per day. This narrative review presents the state of the science on the role of low intake hydration in older adults. Despite its simple cause—the inadequate intake of beverages—low-intake dehydration appears to be a very complex problem to address and much more research is needed in the area. Based on the existing evidence, it seems necessary to take setting specific differences and individual problems and needs into account to tackle dehydration in older adults. Further, it is necessary to increase awareness of the prevalence and severity of low-intake dehydration among older adults and in nursing staff in care homes and hospitals as well as among caregivers of older adults living at home.

Keywords: osmolarity ; osmolality ; interventions ; drinks ; hydration

1. Introduction

Low-intake dehydration is often referred to as hypertonic, hyperosmotic, or water-loss, and describes an uncompensated, predominantly pure water deficit ^[1]. Low-intake dehydration is commonly caused by a beverage intake insufficient to compensate potential fluid losses through urine, feces, breath, and/or sweat ^[2]. This leads to a concentration of particles within body fluids, a decrease in extracellular fluid volume, and an increase in directly measured serum osmolality ^[3].

Low-intake dehydration is a common often chronic health condition in older adults ^{[1][2][3]}. When using the measurement of serum osmolality, several studies have found that the prevalence of low-intake dehydration is lowest among older adults living at home, increased in long-term care residents, and highest in older hospitalized adults ^{[1][3][4]}. The high prevalence of dehydration in long-term care residents has been confirmed in a recent systematic review ^[2]. Specifically, dysphagia, which is prevalent in about one in seven nursing home residents ^[5], is a major risk factor for poor outcomes including low-intake dehydration ^[6]. Regarding the hospital setting, studies with admission data of older patients reflect their increased risk of low-intake dehydration and show increased osmolality in almost 50% ^[1]. Unfortunately, data on low-intake dehydration developing during hospitalization are sparse ^[4]. However, it has been reported that two-thirds of patients that were dehydrated on admission, were still dehydrated after 48 h ^[1].

There are several reasons for a high prevalence of low-intake dehydration among older adults: With age, there is a weakening of physiological mechanisms after insufficient fluid intake that may increase the risk of low-intake dehydration, including a decrease in thirst sensation and primary urine concentration by the kidney ^[4]. In addition, total body water decreases with age, resulting in lower fluid stores. This aspect is exacerbated by the frequent use of diuretics and laxatives ^[4]. Besides physiological causes, low-intake dehydration in older people can be caused by a range of other risk factors, such as polypharmacy ^[7], functional and cognitive impairment ^{[3][8]}, and voluntarily reduced fluid intake: This voluntary reduction can be for a variety of reasons, ranging from the assumption that intake is sufficient for their health to fear of incontinence; social isolation; reduced physical function and access to beverages; as well as swallowing problems and dysphagia ^[4].

Adverse health outcomes associated with low-intake dehydration in older adults are multifaceted, ranging from poorer cognitive performance, reduced quality of life, delirium, falls, fractures, worsened course of illness and recovery to heart disease, heat stress, kidney failure, unplanned hospital admissions, and increased mortality ^{[8][9]}. As low-intake dehydration is associated with poorer health and thus increased medical treatments, it is not surprising that experts agree that low-intake dehydration in older adults entails high costs for the health systems ^[9]. Low-intake dehydration and the associated consequences have repeatedly been shown to be a major cause of avoidable hospital admissions in the US and Europe, and it has been estimated that this leads to an economic burden in the US of USD 5.5 billion (in 2004) ^[1].

A major problem regarding prevention and tackling of low-intake dehydration in older adults is that assessment methods widespread in clinical practice (e.g., skin turgor, urine color and volume, heart rate, feeling of a dry mouth, thirst sensation) are not reliable [8]. Some clinical signs associated with low-intake dehydration may be misleading as they can be consequences of other conditions common in this age group. Symptoms like tongue furrows, dry mucous membranes, and urine specific gravity, may indicate low-intake dehydration, but may also be influenced by medications [10]. Another problem is that the evidence on preventive measures is limited, as is knowledge about the optimal intake of beverages per day for older adults [4].

These aspects were examined in systematic literature searches for the European Society for Clinical Nutrition and Metabolism (ESPEN) guideline on nutrition and hydration in geriatrics [4]. This resulted in several evidence-based recommendations focusing on low-intake dehydration. The aim of this narrative review is to present the evidence-based recommendations on low-intake dehydration by ESPEN and based on a literature review, check if new evidence is consistent/inconsistent with the ESPEN recommendations and identify remaining gaps to research on the role of low-intake hydration in older adults.

2. Discussion on Low-Intake Dehydration in Older Adults

The ESPEN guideline on nutrition and hydration in geriatrics, published in 2019, provides evidence-based recommendations and consensus on key issues regarding low-intake dehydration. In this narrative review, we identified 16 new publications mainly in line and supporting the recommendations (see Table 1). Only one article was contrary to the ESPEN guideline. It can be concluded, that low-intake dehydration in older people is a complex problem to address and the prevalence is still high, although it seems to be a rather simple problem of not drinking enough. Low-intake dehydration is rarely identified and it remains unclear how to best intervene to prevent or treat it.

Table 1. Evidence-based recommendations regarding low-intake dehydration (adapted from [4] §).

Research Question (RQ)	Recommendation §	Grade of Recommendation *
1 How should low-intake dehydration be identified in older persons? (RQ 1.1, 1.2, 1.3)	An action threshold of directly measured serum osmolality > 300 mOsm/kg should be used to identify low-intake dehydration in older adults	B
	Where directly measured osmolality is not available then the osmolality equation (osmolality = $1.86 \times (\text{Na}^+ + \text{K}^+) + 1.15 \times \text{glucose} + \text{urea} + 14$ (all measured in mmol/L) with an action threshold of >295 mmol/L) should be used to screen for low-intake dehydration in older persons	B
	Simple signs and tests commonly used to assess low-intake dehydration such as skin turgor, mouth dryness, weight change, urine color or specific gravity, shall NOT be used to assess hydration status in older adults.	A
	Bioelectrical impedance shall NOT be used to assess hydration status in older adults as it has not been shown to be usefully diagnostic	A
2 What interventions may help to support older persons to drink well and prevent low-intake dehydration?	To prevent dehydration in older persons living in residential care, institutions should implement multicomponent strategies across their institutions for all residents	B
	These strategies should include high availability of drinks, varied choice of drinks, frequent offering of drinks, staff awareness of the need for adequate fluid intake, staff support for drinking and staff support in taking older adults to the toilet quickly and when they need it.	B
	Strategies to support adequate fluid intake should be developed including older persons themselves, staff, management, and policymakers	A
3 How much should older people drink each day?	Older women should be offered at least 1.6 L of drinks each day, while older men should be offered at least 2.0 L of drinks each day unless there is a clinical condition that requires different approach	B
4 What should older people drink each day?	A range of appropriate (i.e., hydrating) drinks should be offered to older people according to their preferences	B

* See details for grades of recommendation in ^[4]. § ESPEN guideline contain two more evidence-based recommendations regarding treatment of low-intake dehydration (recommendation 72 and 73). The recommendation is to offer subcutaneous or intravenous fluids. As this is often not feasible outside the hospital, these two recommendations are not included.

In the following, the results identified in the current review are discussed in the context of the ESPEN recommendations.

2.1. How Should Low-Intake Dehydration Be Identified in Older Persons?

Considering the evidence from the ESPEN guideline as well as additionally identified literature within this narrative review, the use of calculated osmolality should be enhanced. Bunn and Hooper suggested using osmolality within a 2-stage screening process that includes serum osmolality, calculated from sodium, potassium, urea, and glucose levels, followed by serum osmolality measurement for those identified as high risk (calculated serum osmolality >295 mmol/L) ^[11].

Despite the described consensus of literature, there seems to be a need for further research regarding this measurement. A multidisciplinary group of experts has suggested, among others, the following research topics ^[1]:

- A prospective, interventional study that targets parameters of normal hydration (e.g., plasma osmolarities 280–300 mOsm/kg) and determines whether this translates to health and health economics co-benefits.
- The causality of the association between plasma osmolality thresholds and adverse outcomes needs to be tested through interventional studies.
- The development of a suitable device for the routine, bedside assessment of plasma osmolality.

Furthermore, it should be considered that the measurement of serum osmolality is challenging outside the hospital and may not be possible in every country ^[4]. For example, in the nursing home, some laboratory tests cannot be taken and/or analyzed and the involvement of other laboratories would be required. In addition, there may be difficulties in drawing blood samples or conducting other assessments, i.e., due to cognitive impairments and time and staff constraints. This delays the commencement of treatment resulting in deterioration of residents' health and avoidable hospital admissions ^[10].

To deal with this problem, a Delphi study was performed quite recently to reach a consensus on a relevant and feasible method (or combination of methods) to diagnose dehydration in nursing home residents ^[10]. The resulting strategy comprehends a presumption phase, where anamnestic items and physical symptoms are examined, followed by a confirmation phase with blood tests to confirm the diagnosis of low-intake dehydration ^[10].

A wide range of literature focused on identifying older adults that are already dehydrated, but less information is available regarding the identification of older adults with risk of dehydration and the prevention of low fluid intake ^[12]. To be able to intervene at an early stage, it may be useful to increase awareness of risk factors for low-intake dehydration. For example, the literature shows an overlap between the causes of malnutrition and low-intake dehydration in older people ^{[13][14][15][16]} ^[17]. In relation to this, one must be aware that an apparently simple solution to the two problems, i.e., the offering of ONS, which provides both nutrients and fluids, might not always be the correct one. For example, Marra and co-authors found that subjects with prescribed ONS had lower total fluid intake than those without ^[18]. It is therefore important to recommend the intake of thin liquids when ONS is prescribed.

Regarding the identification of older adults with low-intake dehydration, it might be easiest to consider all older persons to be at risk and to encourage all to increase fluid intake. As the literature suggests, it is difficult to identify low-intake dehydration, especially among older adults in nursing homes, where it is seldom possible to measure e.g., serum osmolality ^[10]. This approach is also recommended in the ESPEN guideline as a Good Practice Point ^[4].

2.2. What Interventions May Help to Support Older Persons to Drink Well and Prevent Low-Intake Dehydration?

The updated literature search showed that there is still limited evidence supported by randomized controlled trials on which interventions may help older people to drink well. The available evidence is based on studies in nursing homes and hospitals where research is particularly difficult (time and staff constraints, cognitive and functional impairments of participants) ^[19].

Neither the ESPEN guideline ^[4] nor the updated literature search identified any published studies of interventions performed among community-dwelling older adults. As prevalence is assumed to be lower, low-intake dehydration might be even harder to identify or treat in this setting, not the least due to the apparent significant knowledge gaps among

community-dwelling older people at risk of low intake dehydration (and malnutrition) identified by Bhanu and co-authors [20]. In addition to the prevalence of low-intake dehydration, also risk factors such as polypharmacy [7], functional and cognitive impairment [3][8], and voluntarily reduced fluid intake, appear to differ between the settings (hospital, nursing home, community-dwelling). To support older people to drink well, it might be essential to consider these different risk factors leading to low fluid intake, as customized and adjusted interventions might be favorable [12].

Further research on interventions to increase fluid intake could focus on several aspects, including beverage offer (frequency, timing, variety, and consistency), drinking vessels, staff awareness, technological possibilities, and the social aspects of drinking:

Based on the studies identified during the literature search, it appears that a more frequent and systematic offering of beverages may improve fluid intake [21][22]. Furthermore, there might be a need to focus on beverage consistency, as total fluid intake is higher in those consuming thin vs. thickened liquids [18]. Recently, it has been questioned whether thickened liquids have a place in the dysphagia tool kit at all [23]. Additionally, supporting and extending residents' fluid choices (e.g., with the Drinks Menu) might positively influence the acceptance of offered drinks [22]. All these findings support the ESPEN recommendations.

One study identified in the literature search focused on drinking vessels, an aspect not mentioned in the ESPEN guideline. An obvious cause of limited intake of beverages is that the drinking vessels may be difficult to handle, e.g., too heavy for frail older people. Replacing these vessels with ones that are easier to handle appears to increase intake of beverages [24].

To improve fluid intake, it might be an opportunity to include nursing staff and care providers. Increasing staff awareness and especially knowledge regarding the detection of low-intake dehydration, interventions, as well as the adequate amount of fluid intake per day, seems essential [25][26]. Maybe not only by educating, but by actively increasing awareness and facilitation [27]. In relation to this, Paulis and co-authors [2] highlight the importance of differentiating between acute and chronic dehydration. The latter develops slowly after a longer period of inadequate fluid intake, whereas acute dehydration is a consequence of an illness. Subsequently, acute dehydration is more visible and predictable and could therefore be detected more easily [2]. However, this requires that nurses are aware of these different types of dehydration.

Further research is needed regarding adequate intervention strategies, for example with technological possibilities to monitor the intake of beverages: In the Cochrane review by Hooper and co-workers [8], drinks intake showed some potential on being useful to discover low-intake dehydration.

Unfortunately, the assessment of fluid intake in older adults is often highly inaccurate because drinks are omitted from staff assessments and because recordings refer to the amounts of beverages provided rather than the consumed amount [4].

Different innovative strategies have been tested, including, for example, bed weights, electronic charts and more, so far without definite results [28]. Hence, a reliable and feasible solution, especially for those frail older people where staff is not available around the clock, is needed. In the UK, a recently developed hydration monitoring app appears promising, but further development is needed mainly due to technical issues [29].

Furthermore, drinking (and eating) has a social aspect and as many older adults have reduced social contacts, it might be an opportunity to develop supporting interventions. According to caregivers' perception, interventions focusing on the social aspect of food and fluid intake might be useful [25][26].

It might also be possible to focus on a combined intervention with technological possibilities and social involvement. Social involvement might be increased by virtual reality settings, technological gadgets and (serious) games [30][31]. Especially for older adults with cognitive impairment who might forget to drink [32], regular feedback regarding the amount of fluid intake might help to improve intake.

2.3. How Much Should Older People Drink Each Day?

The current narrative review did not identify any new findings regarding the amount of fluid that should be consumed. Therefore, until there is further research, the ESPEN/EFSA recommendations regarding the amount of fluid needed to prevent dehydration should be used. Communicating this amount to older adults, nursing staff, and other care providers (homecare, family, friends) is important to prevent low-intake dehydration.

2.4. What Should Older People Drink Each Day?

Considering the evidence from the ESPEN guideline as well as additionally identified literature within this narrative review, it seems to be more important that older people drink, not what they drink. However, consuming other beverages besides water, such as smoothies, and milk products, can increase the intake of nutrients in addition to hydration.

Regarding the intake of alcohol as part of fluid intake, it is necessary to distinguish between frequent, heavy alcohol consumption and light to moderate alcohol consumption, which appears to be safe in terms of hydration, at least in older men [33].

2.5. Limitations

Although a systematic approach was used to identify the literature and the search was focused, the included publications may not represent all available studies and reviews on the effects of low-intake dehydration and specific domains. It should be noted, that only one database was used, non-English publications and articles with missing full text were excluded, and the selection of articles was not performed in duplicate. In addition, although the search was based on the ESPEN guideline, there is a possibility that the search terms did not reflect all relevant aspects.

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