

**Generation of thirst: a critical review of dehydration amongst older adults living in residential care**

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# 1 Generation of thirst: a critical review of 2 dehydration amongst older adults living in 3 residential care.

## 4 **Abstract**

5 Dehydration is common amongst older adults and exacerbated in residential care. Herein we summarise  
6 the reported prevalence of dehydration in this sub-population group and evaluate the associated risks  
7 before reviewing interventions designed to improve hydration. Heterogeneity in methods to assess  
8 dehydration inhibits interpretation of both prevalence and intervention studies (primarily small randomised  
9 control trials and case-control observational studies).

10 The estimated prevalence of dehydration amongst older adults in residential care is 20-38%, with further  
11 increased prevalence of inadequate fluid intake, leading to increased urological, gastrointestinal, circulatory  
12 and neurological disorders or, in extreme cases, death. Multi-component interventions that include  
13 changes to drinks, vessels, placement and drinking opportunity alongside staff training and support are  
14 most effective in tackling dehydration in residential care. The detection and prevention of dehydration is  
15 crucial and a practical, population-specific reference standard for adequate fluid intake is warranted.  
16 Future research should prioritise interventions that are individualised to residents' needs according to  
17 dehydration typology. Ongoing investment in the care sector should address staff-to-resident ratios and  
18 enhance staff training on the detection and prevention of dehydration.

19  
20 Key words: Older adults, elderly, residential care, dehydration, fluid intake, intervention, rehydration,  
21 euhydrated, drinking, thirst

22

23 Key Points: Older adults, particularly those in residential care settings, are susceptible to dehydration.

24 Dehydration is associated with increased morbidity, and in extreme cases premature mortality. As

25 dehydration and/or reduced fluid intake occur with relative frequency amongst older adults in residential

26 care, strategies known to improve hydration are of significant interest. Research in this area is hindered by

27 heterogeneous methods, in particular due to inconsistency in the assessment of dehydration itself.

28 Multicomponent interventions tailored to individual need are likely most effective in tackling dehydration,

29 though such implementation warrants central investment in staffing resource, as well as specific training

30 and support for those providing day-to-day care.

31 Reflective questions:

32 • What three key measures would help you to encourage hydration in older adults?

33 • Consider what barriers prevent adequate hydration in the adults under your care.

34 • Consider whether you have the confidence to recognise dehydration in those who you care for.

35 • What cognitive factors may indicate signs of dehydration?

36 • Which intervention(s)/technique(s) do you employ in your care setting that you believe encourages  
37 adequate hydration?

38 • Which intervention(s)/technique(s) that support hydration require additional support such as  
39 training and/or funding?

40 ○ Of these listed techniques, which one would you be most like to see implemented  
41 or continued?

## 42 **1.0 Introduction**

43 The global population is ageing with over a fifth of people predicted to be over 60 years old by 2050

44 (World Health Organisation 2018). Approximately 8% of older adults live in residential care in Canada

45 (Statistics Canada 2018). In the United Kingdom (UK), as reported by the LaingBuisson report, there are

46 approximately 410,000 people aged over 65 years who live in nursing and residential care homes (Oliver

47 2020). Dehydration, or net fluid loss, is a particular risk in older adults (National Health Service 2019a;  
48 Volkert et al. 2019). Age-related deterioration of neuroendocrine homeostatic mechanisms inhibits normal  
49 physiological responses to maintain hydration including impaired thirst sensation and renal resistance to  
50 antidiuretic-hormone (ADH) which normally stimulates water reabsorption and reduces urine output  
51 preventing body water loss (Phillips et al. 1993). Dehydration risk can be exacerbated in residential care  
52 (Hong 2020) due to physical dependence, dysphagia, morbidities, conscious inhibition of fluid intake due to  
53 fear of incontinence incidents, limited access to fluids, impaired cognitive awareness of when fluids were  
54 last ingested, fluid refusal and use of medications such as diuretics (British Nutrition Foundation n.d.;  
55 Begum and Johnson 2010; Shaw and Cook 2017). Whilst dehydration can result from low fluid intake or  
56 volume depletion (e.g. following sickness or diarrhoea) or both, this paper focusses primarily on low-intake  
57 dehydration amongst older adults in residential care.

## 58 **2.0 Assessing dehydration**

59 Dehydration research involving older adults living in residential care employs heterogeneous methods  
60 of assessment for dehydration, making interpretation and comparison of published literature challenging.  
61 Table 1 shows a summary of routine assessment methods for assessing hydration status. Serum osmolality,  
62 an invasive measure of osmotic concentration in blood serum, is the reference standard to diagnose  
63 dehydration in older adults living in residential care, as researchers are able to determine individual  
64 hydration status with very low intra- and inter-individual variation (Hooper et al. 2014; Cheuvront et al.  
65 2010). Serum osmolality  $> 300$  mOsm/kg indicates dehydration and 295-300 mOsm/kg impending  
66 dehydration (Hooper et al. 2015). A systematic review assessed different screening tests of dehydration in  
67 older adults against the reference standard and found bioelectric impedance analysis (BIA) at 50 kHz,  
68 missing drinks between meals, and expressing fatigue had the highest sensitivity and specificity. However,  
69 no tests were consistently useful in diagnosis (Hooper et al. 2015). The review was limited due to the  
70 diversity in reference standards and cut-offs, for example in fluid intake (Holben et al. 1999). Fluid intake is  
71 a statistically significant predictor of hydration status (Gaspar et al. 2019), frequently used amongst studies  
72 assessing dehydration, especially when equipment and budget are constrained, but is not synonymous with

73 dehydration. Observational symptoms are often used by care home staff, however, many of these signs are  
 74 used to assess dehydration in children and older adults (Bunn and Hooper 2019); although it is important to  
 75 recognise that both the assessment, and indeed the possible solutions to dehydration management in  
 76 residential care facilities are most effective when individualised (as will be eluded to in sections 4.2 and  
 77 5.0). Bunn and Hooper (2019) concluded that relying on observational symptoms (including mouth, eye,  
 78 skin, cardiovascular, urinalysis, temperature, self-report symptoms) may not accurately identify low-intake  
 79 dehydration in residents living in care homes. Although in a small-scale study of 188 care home residents,  
 80 no observable symptoms could distinguish between those who were dehydrated and those who were not  
 81 (as identified by serum osmolality) (Bunn & Hooper 2019).

82 Table 1.

83 *Reported methods of dehydration assessment adapted from Hooper et al. (2015), Thomas et al. (2008) and*  
 84 *Volkert et al. (2019).*

Physical Tests and Signs	Urinary Analysis	Blood Analysis	Self-reported symptoms	Other analysis
<ul style="list-style-type: none"> <li>● Skin turgor*</li> <li>● Capillary refill</li> <li>● Dry underarm</li> <li>● Dry oral mucosa*</li> <li>● Dry mucus membranes</li> <li>● Tongue Furrows</li> <li>● Sunken eyes</li> <li>● Weight change*</li> </ul>	<ul style="list-style-type: none"> <li>● Urine specific gravity*</li> <li>● Urine colour*</li> <li>● Urine output</li> </ul>	<ul style="list-style-type: none"> <li>● Serum Osmolality</li> <li>● Blood Urea Nitrogen (BUN): creatinine ratio</li> <li>● Serum sodium</li> </ul>	<ul style="list-style-type: none"> <li>● Thirst</li> <li>● Dry mouth</li> <li>● Dizziness</li> <li>● Feeling sick</li> <li>● Weak</li> <li>● Headache</li> </ul>	<ul style="list-style-type: none"> <li>● BIA resistance at 50kHz*</li> <li>● Blood pressure</li> <li>● Fluid intake</li> </ul>

85 \* Not recommended for assessment of hydration status in older adults (Volkert et al. 2019)

## 86 **3.0 Prevalence**

87 Establishing the prevalence of dehydration amongst older adults living in residential care is challenging.  
88 Published figures vary, largely due to heterogeneous methods used in the field. Direct measures (serum or  
89 plasma osmolality) are invasive, though warranted where there is a specific increased risk of dehydration  
90 (such as in acute deterioration in health or significantly diminished appetite). Day-to-day, the monitoring of  
91 hydration in residential care is more subtle and reliant on subjective measures (such as urinary output and  
92 colour) or approximated (via fluid intake records).

### 93 *3.1 Serum Osmolality and Osmolarity*

94 It is acknowledged that a direct measure of serum osmolality >300 mOsm/kg should be used to  
95 identify low-intake dehydration in older adults. Where this is not possible, careful calculation of serum  
96 osmolarity for 'suitable' individuals (free from diabetes with adequate renal function), 65 years and older,  
97 including those in residential care, may be employed as a substitute for direct measurement providing the  
98 equation used is appropriate for the sub-population group (Volkert et al. 2019).

99 Up to 38% of older adults living in residential care have serum osmolality levels that indicate  
100 dehydration or impending dehydration (Marra et al. 2016; Gaspar et al. 2019). The UK Dehydration  
101 Recognition In Our Elders (DRIE) study found prevalence of dehydration and impending dehydration to be  
102 20% and 28% respectively (Hooper et al. 2016). Participants were younger and better nourished than  
103 typical older adults living in residential care and those who are cognitively impaired were under-  
104 represented. Other studies (also under-representing cognitively impaired individuals) found higher  
105 prevalence of dehydration and impending dehydration of 38% and 30-38% respectively (Marra et al. 2016;  
106 Gaspar et al. 2019). These study cohorts included only those with memory-care and caloric  
107 supplementation needs. The study sample sizes analysed are small making generalisation inappropriate.  
108 We have found there is a paucity of large-scale studies exploring the prevalence of dehydration in older  
109 adults living in residential care, although best estimates to date suggest a likely range of 20-38%.

## 110 3.2 Fluid Intake

111 Daily fluid from drinks guidance for adults from the European Society for Clinical Nutrition and  
112 Metabolism (ESPEN) recommends 2.0L and 1.6L of fluid drinks per day for males and females of all ages  
113 respectively (Volkert et al. 2019). This represents approximately 80% of the recommended adequate intake  
114 (EFSA 2010) with the remaining 20% assumed to come from foods. No differentiation in fluid intake needs  
115 by age has been established, despite typically lower energy intakes in older adults in residential care and  
116 age-related inhibition of key homeostatic mechanisms previously described. Evidence-based fluid  
117 calculators can be used to compare intake against individualised daily targets for those most at risk,  
118 however, globally accepted specific guidelines for fluid intake for older adults in residential care settings do  
119 not currently exist. This is evident from qualitative interview and questionnaire reports of care home staff  
120 whereby inconsistencies were apparent in the recommendations of the quantity of fluid residents should  
121 consume (Cook et al. 2018). This may contribute to the risk of dehydration for some residents.

122 Published studies indicate the prevalence of inadequate fluid intake in older adults in residential  
123 care to be between 39-100% (Kayser-Jones et al. 1999; Holben et al. 1999). These equivocal findings result  
124 from heterogeneity of standards used to determine 'adequate fluid intake'. Standards and findings are  
125 summarised in Table 2. All of these studies, apart from the multi-site study undertaken by Namasivaya-  
126 Macdonald et al. (2018), have very small sample sizes and few are recent. The more contemporary, larger  
127 study by Namasivaya-Macdonald and colleagues (2018) recruited a representative sample of older adults in  
128 residential care, and observations were carried out by trained research personnel.

129 Older adults who do not drink sufficient amounts of fluids are consequently at risk of dehydration  
130 (Volkert et al. 2019). Typically, estimates of fluid intake from staff assessment compared to direct  
131 observation are poorly correlated (Volkert et al. 2019). It is timely for experts to agree one practical  
132 universal reference standard for adequate fluid intake for older adults specifically suited to residential care  
133 settings *and* an agreed, accurate methodology for monitoring fluid intake, in order to enable meaningful  
134 research in this area to progress.

135 Table 2.

136 *Heterogeneity in fluid intake recommendations historically and a paucity of contemporary data has led to*  
 137 *inconsistent estimates of fluid intake inadequacy*

Standard number	Volume of liquid recommended per day	Prevalence of studied older adults in residential care settings <u>not</u> meeting standard
1	30mL/kg body weight	<ul style="list-style-type: none"> <li>● 50% (Holben et al. 1999)</li> <li>● 52% (Chidester and Sprangler 1997)</li> <li>● 95% (Kayser-Jones et al. 1999)</li> </ul>
2	1mL/kcal energy consumed	<ul style="list-style-type: none"> <li>● 39% (Holben et al. 1999)</li> <li>● 60% (Chidester and Sprangler 1997)</li> <li>● 98% (Kayser-Jones et al. 1999)</li> </ul>
3	100mL/kg for the first 10kg, 50mL/kg for the next 10kg and 15mL/kg for the remaining kilograms of bodyweight	<ul style="list-style-type: none"> <li>● 49% (Holben et al. 1999)</li> <li>● 90% (Chidester and Sprangler 1997)</li> <li>● 100% (Kayser Jones et al. 1999)</li> </ul>
4	30mL/kg bodyweight with a minimum of 1500mL	<ul style="list-style-type: none"> <li>● 50% (Holben et al. 1999)</li> <li>● 74% (Hendry and Ogden 2016)</li> </ul>
5	1,600mL/m <sup>2</sup> body surface area	<ul style="list-style-type: none"> <li>● 92% (Gaspar 1999)</li> </ul>
6	1,500mL	<ul style="list-style-type: none"> <li>● 85% (Namasivaya-MacDonald et al. 2018)</li> <li>● 98% (Kayser-Jones et al. 1999)</li> </ul>
7	2.0L and 1.6L of fluids per for males and females of all ages respectively (*ESPEN/EFSA (food contributing to an additional 20% of fluids)	<ul style="list-style-type: none"> <li>● 45% (Jimoh et al. 2019)</li> </ul>

138 \*The European Society for Clinical Nutrition (ESPEN)/European Food Safety Authority (EFSA)

#### 139 **4.0 Risks associated with chronic and acute dehydration in older adults living in residential** 140 **settings**

141 A seminal paper from the 1990s reported observed associations between dehydration and acute  
 142 infections. This included respiratory illnesses and urinary system infections, in addition to chronic  
 143 conditions such as frailty, cancer, diabetes, and most importantly mortality, established using data from all  
 144 elderly Medicare beneficiaries in the United States (US) in 1991 (Warren et al. 1994). More contemporary  
 145 literature has established a link between dehydration with urological, gastrointestinal, circulatory and  
 146 neurological disorders as outlined in Table 3. In most cases evidence lacks consistency, is largely associative



147 and the bi- or multi- directional relationships involved add complexity which inhibits interpretation (Bunn  
148 and Hooper 2019; Begum and Johnson 2010; El-Sharkawy et al. 2015).

149 Table. 3

150 *Disorders associated with dehydration, adapted from El-Sharkawy et al. (2015)*

Urological	Gastrointestinal	Circulatory	Neurological
<ul style="list-style-type: none"> <li>● Urinary tract infections</li> <li>● Urolithiasis</li> <li>● Chronic kidney disease</li> <li>● Bladder cancer</li> </ul>	<ul style="list-style-type: none"> <li>● Functional constipation</li> <li>● Colorectal cancer</li> <li>● Gallstones</li> </ul>	<ul style="list-style-type: none"> <li>● Deep vein thrombosis</li> <li>● Cerebral infarct</li> <li>● Coronary heart disease</li> <li>● Orthostatic hypotension</li> <li>● Mitral valve prolapse</li> </ul>	<ul style="list-style-type: none"> <li>● Delirium</li> <li>● Headache</li> </ul>

151

152 Hereafter we consider the literature linking dehydration in older adults living in residential care  
153 settings to mortality and cognitive function specifically.

#### 154 *4.1 Mortality*

155 Warren et al. (1994) found that amongst the elderly who were hospitalised with a principal  
156 diagnosis of dehydration, almost half died within a year. Mortality rates have also been shown to be higher  
157 amongst older adults living in residential care who are suffering from hypernatremia (Chassange et al.  
158 2006) and high plasma osmolality (O'Neil et al. 1990). In case-control studies, statistical significance was  
159 only reached in hypernatremic participants. Where measured, plasma osmolality was high amongst both  
160 cases and controls; median survival time for the highest osmolality group was significantly reduced (O'Neil  
161 et al. 1990). Another case-control study found no association between mortality and dehydration in older  
162 adults, however, almost none of the study population were admitted for hypernatremia (volume-depletion  
163 was used) and all were male (Wakefield et al. 2008). Unsurprisingly, mortality risk in older adults living in  
164 residential care is highest in the hottest weeks of the year (Mackenbach et al. 1997).

## 165 *4.2 Cognitive Function*

166 It has been established that dehydration can be associated with delirium in older adults living in  
167 residential care (Volkert et al. 2019; Culp et al. 1997). Delirium (i.e. acute confusion) is a transient,  
168 reversible indicator of cognitive dysfunction (Fong et al. 2009). Analysis of data from US nursing homes  
169 found inadequate fluid intake was significantly associated with delirium episodes (Mentes et al. 1999). This  
170 study used a large, representative sample of older adults living in residential homes; however, there was no  
171 definitive diagnosis of delirium and no quantitative measure of fluid intake. Mentes and Culp (2003) carried  
172 out a case-control study to determine if an eight-week hydration intervention reduced occurrence of  
173 delirium. There was a lower incidence of delirium in the treatment group, however, this was non-significant  
174 (perhaps due to selection bias, as the treatment group had significantly greater risk of delirium) (Mentes  
175 and Culp 2003). In another study, Cacchione et al. (2003) recruited 74 adults (83% women; mean age 82  
176 years) from two long-term care facilities. Participants either had no cognitive impairment, a diagnosis of  
177 dementia or a recent change in mental status. Following the analysis of clinical assessment profiles  
178 specifically for acute confusion, infection followed by dehydration was the most common cause (Cacchione  
179 et al. 2003). Stratified sampling ensured a representative sample of older adults living in residential care  
180 were recruited to participate, however, the authors reiterate the multifactorial aetiology of delirium and  
181 the importance of avoiding assuming a causal relationship. Multidisciplinary interventions that incorporate  
182 hydration strategies may be effective in preventing delirium (Volkert et al. 2019).

183 Significant associations have been found between dehydration and cognitive function (Hooper et  
184 al. 2016), dementia (Chassange et al. 2006; van der Steen et al. 2007), confusion and speech difficulties  
185 (Gross et al. 1992). In addition, older adults with impaired cognition living in residential care received  
186 significantly less fluid than their more lucid counterparts when observed (Armstrong-Esther et al. 1996),  
187 making it difficult to determine the direction of this relationship. Typically, dementia can interfere with an  
188 individual's ability to recognise thirst, as well impeding their ability to remember where to get drinks, and  
189 to drink them when they are provided (Hooper 2020; Shaw and Cook 2017). Studies that have found only  
190 non-significant associations between dehydration and cognitive function (Culp et al. 2003; Mccrow et al.  
191 2016) tend to have small sample sizes, and/or missing data, or poor compliance. Refusal to drink remains a

192 specific problem for some with dementia, not least where this is complicated by dysphagia (Shaw and Cook  
193 2017).

194 Brain tissue fluid (related to volume changes of the whole brain, white matter,  
195 hypothalamus/thalamus) has shown *in vivo* to decrease when dehydrated (Biller et al. 2015) resulting in  
196 cellular dehydration. This effect is exacerbated in older adults in residential care as a result of ageing-  
197 related physiological brain deterioration (Peters 2006). Dehydration has also shown to significantly increase  
198 cortisol levels (Castro-Sepulveda et al. 2018) which is also negatively associated with cognitive function  
199 (Vedhara et al. 2000; Comijs et al. 2010). There appears to be a cyclic nature to cognitive decline and  
200 dehydration, with both likely causing exogenous effects on the other.

201 Although many of the studies reported cannot assume cause and effect of dehydration on delirium  
202 and cognitive effects, it is apparent that the cognitive status of older adults living in care homes requires  
203 careful monitoring. Associated signs of possible dehydration, including acute confusion, speech and  
204 memory should be carefully monitored by staff. Subtle changes in these factors, although may be linked to  
205 other neurodegenerative disease, could possibly be minimised through hydration interventions. Further  
206 investigative studies are warranted to provide further evidence for the causal effects in conjunction with  
207 dehydration preventative interventions.

## 208 **5.0 Interventions**

209 A recent editorial published in 'Nursing and Residential Care' highlighted that support to avoid  
210 dehydration in older residents in care settings warranted careful attention and that multiple strategies,  
211 ideally in combination, may be effective (Hong 2020). Similar suggestions are eloquently offered in an  
212 article by Shaw and Cook from 2017. From drinking vessel type, drink range and proximity, drinking  
213 opportunity frequency and environment, to continence support, staff training and provision of 'wet foods',  
214 there are multiple ways in which dehydration risk can be addressed. Each intervention comes with specific  
215 challenges for staff and residents, and in reality, a multi-pronged approach individualised to each resident is  
216 likely to be most successful (Ashurst 2011; Hong 2020; Volkert et al. 2019; Shaw and Cook 2017).

217           A systematic review found multicomponent strategies tackling dehydration in older adults living in  
218 residential care were most effective, particularly increased staff assistance and choice/availability of fluids  
219 (Bunn et al. 2013). Results were inconclusive for adjustments to advice given to residents, dining  
220 environment, presentation of beverages and their drinking vessel. High risk of bias was found amongst  
221 studies that differed in length of observation, assessment method and employed varying definitions of  
222 “fluids” (Bunn et al. 2013). It acknowledged that high drink availability coupled with varied beverage choice  
223 is important (Volkert et al. 2019).

224           One observational study generated a typology of oral hydration problems, categorising participants  
225 into subgroups, determined by the cause of dehydration and suggesting interventions to tackle each  
226 subgroup as shown in Table 4 (Mentes 2006). Although these interventions were not tested for their  
227 effectiveness, the descriptive longitudinal approach combined quantitative and qualitative data simplified  
228 the complex issue, identifying the importance of individualised care. Future research may draw inspiration  
229 from this typology to address the need for large-scale case-control studies. Assessing and categorising the  
230 risk of dehydration in older adults living in residential care would allow associated interventions to be  
231 implemented, alongside increased staff support for drinking and for incontinent residents (discussed later),  
232 in order to enhance our understanding of this important issue.

233

234 Table 4.

235 *Typology of hydration problems among frail nursing home residents with suggested interventions (Taken*  
 236 *from Mentes 2006).*

Typology	Subgroups	Suggested intervention
Can Drink	Independent	<ul style="list-style-type: none"> <li>● Educate</li> <li>● Use graduated cup</li> <li>● Provide preferred beverages</li> </ul>
	Forgets (Cognitively Impaired)	<ul style="list-style-type: none"> <li>● Frequent offers</li> <li>● Fluid during activities</li> <li>● Teatime/happy hours</li> <li>● Beverage cart</li> </ul>
Can't Drink	Dysphagic	<ul style="list-style-type: none"> <li>● Swallowing exercises</li> <li>● Foods rich in fluid (smoothies)</li> <li>● Oral care</li> <li>● Educate family to help</li> </ul>
	Physically Dependant	<ul style="list-style-type: none"> <li>● Sports cup with straw</li> <li>● Physical aids to assist with drinking</li> </ul>
Won't Drink	Sipper	<ul style="list-style-type: none"> <li>● Frequent small amounts at each contact</li> <li>● Fluid with activities</li> <li>● Provide preferred beverages</li> </ul>
	Fears Incontinence	<ul style="list-style-type: none"> <li>● Educate about maintaining fluid intake</li> <li>● Kegels, urge inhibition</li> <li>● Medication as last resort</li> </ul>
End of Life (Terminally ill)		<ul style="list-style-type: none"> <li>● Resident and family preference</li> <li>● Advance directive</li> </ul>

237

238 Mixed methodologies have been used to investigate the effectiveness of intervention strategies,  
 239 reflecting the diverse needs of older adults in residential care, but compounding the difficulty of  
 240 determining the effectiveness of individual intervention methods.

### 241 *5.1 Drinking Vessels*

242 Various studies have found improvements in hydration of older adults in residential care as a result  
 243 of changing the type and/or colour of drinking vessels. A phased intervention involving alternative drinking  
 244 vessels that had been evaluated and rated highly by residents (phase 1) reported a significant increase in  
 245 mean fluid intake compared to baseline measurements (number of drinks provided, volume of fluids at

246 breakfast) (Bak et al. 2018). The amount of fluids served was also significantly higher with the new drinking  
247 vessels. Baseline measurements were taken from the fluid intakes recorded from routine measurements  
248 and compared to phase 2 intervention measures taken over three consecutive days. It was suggested that  
249 results were partly due to increasing the size of the drinking vessel and using vessels that were easier to  
250 hold. Replacing white for high-contrast drinking vessels increased fluid intake in residents with Alzheimer's  
251 disease (Dunne et al. 2004) in a small study, not necessarily generalisable to all older adults living in  
252 residential care, though similar results have been found in other populations including community-dwelling  
253 elderly and hospital patients (Gordon and Henson 2017; Hollis 2011). Allen et al. (2011) found significantly  
254 more oral nutritional supplement drinks were consumed and deemed acceptable by residents who were  
255 provided with a glass or beaker rather than the container with a straw. This method is found to be effective  
256 for some older adults living in residential care. Those residents with mobility or dexterity difficulties  
257 predominantly benefitted when vessel type was changed, whereas those with cognitive dysfunction  
258 benefited more from changes made to vessel colour.

259 Mode of delivery for fluids in residential care settings continues to be challenging. Provision of  
260 water-rich foods can be useful for residents with dementia alongside prompts/encouragement to drink and  
261 regular provision of drinking opportunities irrespective of thirst (Hooper 2020). Ongoing research supports  
262 evolution of existing methods, and emergence of new and novel solutions in line with developing  
263 technologies, as evidenced by the development of jelly 'sweets' containing 90% water offering an attractive  
264 alternative to drinking (Bakar 2019) for example.

## 265 *5.2 Prompting, Choice and Support*

266 Expanding the range of fluid choices available (Volkert et al. 2019) and/or embedding a rigorous  
267 ritual of prompts to drink have been shown to be effective in improving hydration for older adults living in  
268 residential care. One contemporary study increased the range and offering of drinks to older adults  
269 (Wilson et al. 2019) across two residential homes. One home sustained a mean fluid intake greater than  
270 1500 mL/day for three months, whereas the other did not achieve this target. A significant reduction in  
271 average daily laxative use was observed across both care homes suggesting that the intervention may be

272 effective for decreasing the incidence of constipation. Conclusions were drawn that increasing drinking  
273 opportunities was beneficial for independent residents who tended to be in communal spaces when drinks  
274 were offered, however adequate staffing and support for the plan-do-study-act approach is required for  
275 such interventions to be sustainable.

276 A sub-study of DRIE found that beverage intakes were greater at non-mealtimes, demonstrating  
277 the need for more opportunities to drink outside of scheduled meals times (Jimoh et al. 2019).  
278 Observations from this study found that although 75% of DRIE care homes reported residents could help  
279 themselves to drinks, and all reported that they could ask staff for drinks, residents would seldom do so.  
280 All individuals, irrespective of age, should be supported to express personal preference with regard to  
281 beverage choice, including when and what they most prefer to drink and how they like their drink to be  
282 served (Volkert et al. 2019; Shaw and Cook 2017). This is of particular relevance to care settings where it is  
283 encouraged that careful plans detailing such preferences and any barriers to beverage consumption are  
284 kept.

285 In a small, nine-week study individualised care plans were developed for elderly residents based on  
286 their specific needs. These plans incorporated colourful beverage charts, pitchers, glasses and carts to  
287 enhance residents' interest in drinking; the choice of four beverages at each encounter (any special  
288 requests were also honoured); and support from a caregiver knowledgeable in the techniques for fluid  
289 administration (Robinson and Rosher 2002). Results showed that residents' total body water increased  
290 significantly with the provision of an additional two glasses of fluid daily. Laxative use was decreased,  
291 number of bowel movements significantly increased, and a decline in costs of negative outcomes due to  
292 dehydration occurred. BIA was also used, a non-invasive technique which has shown to accurately  
293 estimate total body water in geriatric patients (Ritz 2001). Once the intervention ended, residents total  
294 body water significantly declined, demonstrating the effectiveness of the intervention and the need for  
295 continuation. Although multiple variables used in this intervention led to difficulties identifying which  
296 influenced the results, from a research perspective, it reflects best practice in caring for individuals with  
297 differing and sometimes conflicting needs (Robinson and Rosher 2002).

298 Significant increases in fluid intake and toileting frequency were found when subjects were offered  
299 toileting assistance and choice of fluids every two hours (Schnelle et al. 2010). Concurrent results were  
300 found following similar interventions in both ambulant and non-ambulant residents (Tanka et al. 2009;  
301 Sprangler et al. 1984). However, Sprangler et al.'s (1984) study used urine specific gravity to determine  
302 dehydration status. Although in this study it is difficult to determine if prompting and choice of drinks, or  
303 the increased frequency of toileting support resulted in improvement, the combined interventions were  
304 found effective in tackling one of the main causes of dehydration in older residents living in care homes,  
305 which may dramatically improve the quality of life of residents with incontinence. In 2019 the European  
306 Society for Clinical Nutrition and Metabolism (ESPEN) issued strong consensus guidance that both staff  
307 support for drinking, and ensuring older adults are supported to visit the toilet quickly when needed were  
308 recommended to support hydration of older adults in residential care (Volkert et al. 2019).

## 309 **6.0 Conclusion**

310 Dehydration is both preventable and treatable but occurs ubiquitously amongst older residents  
311 living in care homes throughout the western world. Convenient and non-invasive methods for initial  
312 detection of dehydration risk need to be agreed for use in combination with a practical, internationally  
313 recognised reference standard for adequate fluid intake in older adults living in residential care specifically.  
314 The risks associated with dehydration are multiple and include loss of cognitive function but can ultimately  
315 result in premature mortality. In tackling dehydration amongst older residents living in care homes multi-  
316 component strategies have been shown to be most effective. Relatively simple interventions including  
317 changing drinking vessel shape and/or colour, prompting drinking, and management of toileting visits have  
318 shown to increase fluid intake and reduce dehydration in residential care dwelling elderly. However, under  
319 resourcing of the care sector, particularly in relation to staffing ratios and continued professional  
320 development are acknowledged barriers to the implementation of some of these strategies. Future  
321 research should incorporate interventions personalised to residents needs according to their dehydration  
322 typology.



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