

✱ REVIEW ✱

Maintaining oral hydration in older adults: A systematic review

Brent Hodgkinson BSc(Hons) MSc

*Research Officer, Health Technology Assessment Unit, Department of Public Health, University of Adelaide, Adelaide 5005,
South Australia, Australia*

David Evans DipNsg BN MNS CritCareCert PhD

Lecturer, Department of Clinical Nursing, University of Adelaide, Adelaide 5005, South Australia, Australia

Jacky Wood BN MN

Nursing Director, Royal Adelaide Hospital, Adelaide 5005, South Australia, Australia

Accepted for publication March 2003

Hodgkinson B, Evans D, Wood J. *International Journal of Nursing Practice* 2003; 9: S19–S28

Maintaining oral hydration in older adults: A systematic review

Dehydration is the most common fluid and electrolyte imbalance in older adults. The objectives were to identify the factors that increase the risk of dehydration in older adults, how best to assess the risk and manage oral fluid intake. Data sources included Medline, CINAHL, Cochrane Library, Embase and Current Contents, which were searched until February 2002. Randomized controlled trials for management of adequate fluid intake were undertaken. Cohort and case control studies were used for the identification of risk factors for dehydration. Studies of assessment tools for the identification of dehydration were also considered.

Results show that there is no clear determination of the risk factors for dehydration and decreased fluid intake. The recommended daily intake of fluids should be not less than 1600 mL/24 h in order to ensure adequate hydration. A fluid intake sheet and urine specific gravity might be the best methods of monitoring daily fluid intake. Regular presentation of fluids to bedridden older adults can maintain adequate hydration status. In conclusion, more research is required to determine the optimum method of maintaining adequate oral hydration in older adults.

Key words: aged, dehydration, meta-analysis, nursing care, risk factors.

INTRODUCTION

Dehydration has been reported to be the most common fluid and electrolyte imbalance in older adults.^{1–3} In a study of nursing home residents admitted to hospital with

hypernatraemic dehydration, the admission rate to one hospital with this condition was 6.5 per 1000 admissions and was as high as 22.5 per 1000 admissions at another hospital.⁴ Hospitalized older adults suffering from dehydration have been reported to have mortality rates as high as 45%–46%.^{4,5}

No absolute definition for dehydration exists. One proposed definition is 'the rapid weight loss of greater than 3% of body weight'.⁶ Another refers to dehydration as

Correspondence: Brent Hodgkinson, Health Technology Assessment Unit, Department of Public Health, University of Adelaide, Adelaide 5005, South Australia, Australia.
Email: brent.hodgkinson@adelaide.edu.au

arising from one of two water and electrolyte disorders. The first is water depletion and the other is sodium depletion, where there is a concomitant decrease in water.^{7,8} In biochemical terms, dehydration is most often defined as a condition in which serum sodium is equal to or greater than 148 mmol/L and/or the blood urea nitrogen (BUN): creatinine ratio is greater than or equal to 25.²

Dehydration can be classed into three different categories: isotonic, hypotonic and hypertonic dehydration.⁶ Isotonic dehydration occurs when there is a balanced loss of solutes and water. This can occur during a complete fast or episodes of vomiting or diarrhoea. Hypotonic dehydration occurs when sodium is lost at a greater rate than water resulting in serum sodium concentrations of less than 135 mmol/L. This situation can result from overuse of diuretics. Finally, hypertonic dehydration, often termed hypernatraemia, results when water losses exceed those of sodium. Hypernatraemia is usually diagnosed by a serum sodium concentration in excess of 145 mmol/L and is generally due to excessive water losses such during a fever, or in iatrogenic cases, by decreased fluid intake. In fact, in older adults this form of dehydration, in the absence of any physiological reason, has been described as an indication of fluid deprivation, even neglect.⁴

Older adults have been identified as particularly susceptible to dehydration because of age-related changes. Decreases in renal perfusion and sensitivity to antidiuretic hormone (ADH) have been shown in older adults. The sense of thirst also appears to diminish, even in healthy older adults.⁹ Combined with mobility problems, confusion or dementia, and pathological conditions such as hypertension, heart and renal disease, older adults can become highly sensitive to fluid and electrolyte imbalances.

This paper summarizes the results of a systematic review aimed at determining the best available research

evidence related to maintaining oral hydration in older adults.

METHODS

Review of the literature

The medical literature was searched to identify relevant studies and reviews between 1966 and February 2002. Searches were performed on the databases presented in Table 1 using the general search terms in Table 2.

Inclusion criteria

Patients

This review considered all studies that included adults aged over 60 years in an acute care, residential care or community setting.

Intervention

Interventions of interest were those related to the maintenance of oral hydration in older adults. Subcutaneous fluid replacement, intravenous fluid replacement and fluid replacement via feeding tubes was excluded because of the reduced availability of these techniques in the community or nursing home setting. The review also included studies that identified risk factors for poor fluid intake and dehydration or evaluated assessment tools to assist in determining fluid intake and fluid status in older adults.

Outcomes

The primary outcomes of interest were those related to the identification of dehydration and the maintenance of hydration or the reversal of dehydration.

Eligible study designs

The review considered any randomized control trial that evaluated management strategies to ensure adequate fluid

Table 1 Electronic databases used for literature search

Electronic database	Time period
Medline (Silverplatter)	1966–2/2002
Embase (Embase.com)	1966–2/2002
Current Contents (Ovid)	1993–2/2002
Cochrane Library: including Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effectiveness (DARE), Cochrane Controlled Trials Register, Health Technology Assessment Database, NHS Economic Evaluation Database	Issue 1, 2002
CINAHL (Silverplatter)	1969–2/2002

Table 2 Search terms used for electronic databases

Area of enquiry	Search terms
All headings	MeSH Randomized controlled trial, controlled clinical trial, randomized controlled trials, random allocation, double-blind method, single-blind method, clinical trial, clinical trials, research design, comparative study, evaluation studies, follow-up studies, prospective studies, cohort studies, dehydration, aged
	Text words Clin*, trial*, singl*, doubl*, trebl*, tripl*, blind*, mask*, random*, control*, prospectiv*, dehydration, hydration, fluid* aged, elderly

* These words are truncated to include all possible variations of the root word.

intake in older people. Cohort and case control studies were included for the identification of risk factors of dehydration in older adults. Studies that evaluated assessment tools for the identification of dehydration in older adults were also considered for inclusion in this review.

Assessment of methodological quality

The methodological quality of randomized control trials (RCT) was assessed using a checklist which was based on the work of the Cochrane Collaboration¹⁰ and Centre for Reviews and Dissemination.¹¹ Methodological quality of cohort and case control studies was assessed using a checklist developed for observational studies.

Data extraction and analysis

Data was extracted using a data extraction tool that was developed specifically for this review. For RCTs, evaluating the effectiveness of interventions where possible, odds ratios (for categorical outcome data) or standardized mean differences (for continuous data) and their 95% confidence intervals were calculated for each included study. Due to the heterogeneity of studies, statistical pooling was not appropriate or possible and the findings were summarized in narrative form.

For cohort studies and case control studies that focused on the identification of risk factors, the risk factors were listed and no statistical summary of data was attempted. For studies evaluating assessment tools, sensitivity, specificity, positive predictive value and negative predictive value were listed when data was available.

RESULTS

Only 17 articles met the criteria for inclusion in this review.^{12–28}

Risk factors for dehydration and/or decreased fluid intake

The first step in addressing the problem of dehydration in the elderly is to identify what characteristics, or risk factors, are most likely to be associated with a higher risk of dehydration and/or fluid intake. Possible risk factors that were most frequently cited were age, mobility/functional ability, gender, visual impairment, speaking ability, incontinence and number of ingestion sessions.

Age

Tables 3 and 4 show that conclusions regarding the effect of age on risk of dehydration were found to be variable and dependent on the location of the patient. Dehydrated nursing home residents were significantly older than their adequately hydrated counterparts.^{20,23} In contrast, there was no significant difference in age between dehydrated and normal elderly patients admitted to an emergency ward.^{20,23,24}

Age as a risk factor for decreased fluid intake was contradictory, with one group of nursing home residents showing an inverse relationship with fluid intake^{16,17} while another group was found to have similar fluid intakes in under-and over-85 years age groups.¹⁴

Mobility/functional ability

Bedridden nursing home residents were determined to be significantly more likely to be dehydrated than more mobile residents.²⁰ However, in reality, subjects that were dependent for assistance with eating had similar fluid intake levels as independent residents and had significantly higher water intake when compared to subjects requiring only some assistance.^{16,17} Visual impairment also had a positive correlation with adequate fluid intake because staff

Table 3 Comparison of risk factors in hydrated and dehydrated older adults

Study	Risk factor	Comparison groups		Outcome
Lavizzo Mourey (1988) Snyder (1987) Gross (1992) Seymour (1980)	Age	Dehydration		No evaluation possible WMD (95% CI) 3.0 (1.60, 4.40) Data not given $r = 0.258$, $P < 0.06$
		Dehydrated (N)	Hydrated (N)	
		86.7 (91)	82.6 (173)	
		78 ± 9 (162)	75 ± 9 (4691)	
		—	—	
Gaspar (1988, 1999) Chidester (1997)	Age	Fluid intake		Data not given WMD (95% CI) -253 (-653.1, 117.1)
		< 85 years (N)	> 85 years (N)	
		—	—	
		1783 ± 545 (16)	1530 ± 580 (24)	
Lavizzo Mourey (1988)	Mobility/functional ability	Dehydration		OR (95% CI) 2.9 (1.70, 5.10)
		Mobile resident (N)	Bedridden resident (N)	
Lavizzo Mourey (1988)	Gender	Dehydration		OR (95% CI) 1.4 (0.80, 2.40)
		Male	Female	
		61/161	30/97	
Armstrong Esther (1996)	Mental status	Fluid intake (mL/24 h)		No SD available, authors state that significantly lower intakes of fluids in confused patients
		Lucid (N)	Confused (N)	
		1164 (11)	780 (8)	
		1187 (6)	1094 (17)	
		1141 (15)	(0)	

N, number of participants; RDI, recommended daily intake; WMD, weighted mean difference; r , Pearson's ratio; OR, odds ratio; SD, standard deviation.

Table 4 Comparison of risk factors in hydrated and dehydrated older adults regarding fluid intake

Study	Risk factor	Comparison groups			Outcome
		Fluid intake			
		Low fluid intake (< 76% RDI)			
		Independent	Some assistance	Dependent	
OR (95% CI)					
Gaspar (1988, 1999)	Mobility/functional ability	23/43	25/40	4/16	Independent vs. dependent 0.29 (0.06,1.18)
		—	—	—	Some assistance vs. dependent 0.20 (0.04, 0.84)

N, number of participants; RDI, recommended daily intake; WMD, weighted mean difference; r, Pearson's ratio; OR, odds ratio; SD, standard deviation.

anticipated the needs of subjects with this deficit. This was also found to be the case with subjects who had speech difficulties or evidence of drooling. This suggests that patients most at risk of dehydration are actually semidependent patients that appear to be capable of obtaining their own fluids but are not able to in practice.

However, other research of patients of a long-term care unit, a psychogeriatric unit and a geriatric admission unit, has suggested that there is an inverse relationship between dependency level and fluid intake, that is, the more dependent the subject, the lower the fluid intake.¹³

Gender

Gender as a risk factor of dehydration or decreased fluid intake is also an unresolved issue. Female nursing home residents have been suggested to be dehydrated more often than males; however, the evidence does not support this claim.²⁰ Female nursing home patients were more likely to have a lower percentage of water intake than males.¹⁶ In contrast, elderly male patients (68–90 years), in both a Long-Term Care Unit and a Geriatric Admission Unit, received less fluid intake than elderly female patients while males in a psychogeriatric unit appeared to receive more.¹³ However, the differences were not significant.

Incontinence

In an examination of incontinence in elderly long-term care or nursing home residents, incontinence was not found to be a risk factor for dehydration.²⁰ However, it was a risk factor for significantly lower fluid intake com-

pared to continent subjects.¹³ It has been suggested that the reason for decreased fluid intake in incontinent patients is the conscious decision by the patient to limit fluid intake to reduce periods of incontinence.

Mental status

Mental status as a risk factor for dehydration was measured for elderly subjects admitted to a hospital emergency ward.²⁴ Mental scores were found to be inversely correlated to the level of dehydration encountered in these patients ($r = -0.36$, $P < 0.01$). It has been acknowledged that when patients with decreased mentation were excluded from trials, many of the patients suffering from dehydration were eliminated.²⁵

Patients in long-term care who were assessed by the Cognitive Assessment Scale as confused, were found to have significantly lower intakes of fluids over a 24 h period than lucid patients.¹³ In contrast, monitoring total fluid and food intake for three days in elderly nursing home residents found no correlation between cognitive ability and total fluid intake.¹⁴

Other risk factors

Single small observational studies have also hinted at other risk factors for dehydration and/or decreased fluid intake such as the number of diseases present, number of medications, number of ingestion periods and institutionalization.

The presence of multiple diseases and/or medications put elderly nursing home residents at risk for dehydration.²⁰ Being institutionalized was identified as a risk fac-

tor for reduced fluid intake as nursing home residents had significantly lower fluid intakes compared to matched elders living in the community.¹²

The number of available times for fluid ingestion was positively correlated with actual fluid intake. In general, it was determined that if fluids were made available to elderly residents or patients, then the more likely they were to drink higher volumes of fluids.^{16,17}

Finally, discussion papers have discussed other possible risk factors for dehydration such as difficulty in eating and drinking, vomiting and diarrhoea, acute infection, multiple chronic diseases, depression and loss of interest in self-care.^{3,19,29–31} However, none of these factors has been adequately assessed.

Assessment

The next stage of any management of hydration is to be able to identify individuals at high risk of dehydration and institute prevention interventions. Tools that assess general fluid intake to determine if patients are meeting their recommended daily intake (RDI) or identify the possibility of dehydration were poorly evaluated.

Measurement of fluid intake

An in-house Intake/Situation Modifier Sheet (used to determine the actual fluid intake of patients and any situations that would affect that intake) was used in evaluating the fluid intake of nursing home residents.^{16,17} The tool was determined to have an inter-rater reliability of 0.94. The validity, sensitivity or specificity of this tool was not reported and therefore it is difficult to recommend this tool for use. However, the tool did determine that only 8% of subjects met or exceeded their calculated RDI of fluids and indicated that half of subjects were ingesting less than 76% of their RDI of fluids.

What is clear from evaluated research is that there are several different RDIs for fluid intake that are used to compare against actual intake. To date, a single RDI has not been identified. However, numerous studies have used 1600 mL/m²/24 h^{16,17} or 1500 mL/24 h as the RDI for their subjects.^{12,13,19,26} Determination of adequate fluid intake is dependent upon the RDI measure used. When nursing home residents had their actual daily intake compared with three standardized calculations of RDI,¹⁴ actual intake was not significantly different than the RDI recommended by Standard 1, but significantly higher than Standard 2, and significantly lower than Standard 3 (Table 5):

1. Standard 1: RDI 30 mL/kg body weight.
2. Standard 2: 1 mL fluid/kCal consumed.
3. Standard 3:
 - (a) 100 mL/kg for first 10 kg.
 - (b) 50 mL/kg for next 10 kg.
 - (c) 15 mL/kg for the remainder of weight.

It was also observed that the fluids received with medications were found to be essential to many subjects attaining their RDI.

Assessment of dehydration

There is a need to assess dehydration at the bedside using available clinical measures. The majority of the following assessment tools were compared to the accepted biochemical measures of dehydration. A BUN : creatinine ratio > 25 and/or a serum sodium concentration of 148 mmol/L was acknowledged as dehydration.

OBRA MDS evaluation

The Omnibus Budget Reconciliation Act (OBRA) Minimum Data Set (MDS) has been used in the U.S.A as a check sheet for health history and examines any recent changes in health status.²⁷ Part of the form focuses on fluid intake and hydration and highlights any triggers for risk of

Table 5 Assessment of hydration status in comparison with recommended daily intake standards¹⁴

Actual intake (N=40)	Fluid intake (mL, mean $\pm$ SD)			Outcome
	RDI standard 1	RDI standard 2	RDI standard 3	WMD (95% CI)
1632 $\pm$ 573	1754 $\pm$ 383	1399 $\pm$ 342	2077 $\pm$ 192	Actual vs. standard 1 – 122.0 (33.7, 94.9). Actual vs. standard 2 233.0 (22.9, 443.0). Actual vs. standard 3 – 445.0 (–635.2, –254.7)

N, number of participants; SD, standard deviation; RDI, recommended daily intake; WMD, weighted mean difference; CI, confidence interval.

dehydration. This form does not definitively identify subjects suffering dehydration but it is used as a screening tool only to highlight the possibility for further investigation.

Axillary moisture

This method, to determine the skin moisture content, was compared to a biochemical assessment of dehydration (BUN: creatinine ratio and plasma and urine osmolalities).²⁸ This tool was determined to be 80% reliable between assessors. However, the sensitivity of the tool (the percentage of dehydrated patients determined to have dry skin) was only 50% (Table 6). The specificity was 82% (patients not dehydrated identified as having moist skin). Positive predictive value was 45% (percentage of subjects who were determined to have dry skin who were dehydrated). The negative predictive value was 84% (percentage of subjects who were determined to have moist skin who were not dehydrated). Therefore, the tool provides reproducible results but can identify only half of patients who are dehydrated and can eliminate 82% of patients who are not dehydrated.

Table 6 Assessment of hydration status using axillary moisture²⁸

Observer grading of hydration status	Biochemical hydration status		Outcome
	Dehydrated	Not dehydrated	
Dry	10	12	Sensitivity 50%
Moist	10	54	Specificity 82%
			PPV 45%
			NPV 84%

PPV, positive predictive value; NPV, negative predictive value.

Intraocular pressure

No correlation between intraocular pressure measured by a tonometer, and changes in serum osmolality or urea concentration, have been found.³²

Febrile episodes

One or more febrile episodes (37.8°C if taken orally and 38.3°C if taken rectally), may be an indicator of impending or existing dehydration (Table 7).²¹

Clinical evaluation

When a specific 38 item dehydration assessment tool was used by nurses on elderly emergency ward patients, clinical indicators including longitudinal tongue furrows, sunken eyes, dry mucous membranes, upper body muscle weakness, speech difficulty and confusion, were found to be indicators of dehydration when compared with a biochemical assessment.²⁵ A physician evaluation that incorporated biochemical tests was found to identify all dehydrated patients but to overestimate the number of dehydrated patients (Table 9).

Biochemical assessment of dehydration

When biochemical tests such as haematocrit and serum osmolality were compared with a test of urine specific gravity, only the BUN:creatinine ratio was determined to be an accurate indicator of early dehydration (Table 8).¹⁵

Management of hydration

When the food and fluid intake of totally dependent nursing home residents was measured against the body position (standing or sitting) of the feeder, it was concluded that the position had no effect.¹⁸

In the only study that attempted to address the issue of improving the hydration of non-ambulatory nursing home residents, presenting fluids directly into the hands of res-

Table 7 Assessment of hydration status using febrile episodes as an indicator²¹

Outcome	Number of patients		Result RR (95% CI)
	Febrile	Non-febrile	
BUN/Cr (>25)	9/40	2/37	3.8 (0.9, 16.5)
Serum sodium (>146 mmol/L)	10/40	1/37	9.2 (1.2, 68.8)
Impaired oral intake	11/40	0/37	10.0 (1.4, 77.1)

BUN, blood urea nitrogen; RR, relative risk; CI, confidence interval.

idents every 1.5h throughout the waking day was determined to significantly improve hydration (as measured by urine specific gravity) when compared to normal care by the institution.²²

DISCUSSION

Despite the high risk of dehydration in the elderly population of western countries, very little quality research has been performed to determine the risk factors for dehydration, the best assessment tool(s) to identify risk or the presence of dehydration, or ultimately, the management of hydration status in this population. The majority of studies identified in the systematic review found shortcomings in research design and poor data reporting. Most studies were observational or non-randomized and presented little in the way of validated data. Therefore, any of the following conclusions must be regarded with caution until higher-quality research can be performed to verify the results.

Risk factors

The most discussed risk factor was age. Interestingly, despite age restrictions being imposed on the inclu-

sion criteria for the review, no study identified had involved subjects under the age of 60 years. The results of these studies were contradictory. Several studies determined that increased age was a risk factor for dehydration^{20,23} while in other studies, notably emergency department admissions, age was not a risk factor.^{24,25}

When fluid intake of older adult subjects was examined, again the results were contradictory. It was assumed that fluid intake would be a good surrogate indicator of dehydration as adequate intake, under standard physiologic conditions, would prevent dehydration. One study determined that age was inversely related to fluid intake^{16,17} and another found no correlation.¹⁴

Patient mobility and functional capability as a risk factor of both dehydration and decreased fluid intake was also examined in several studies. It would be expected that more dependent, older people would be at risk of dehydration because of reliance on others for presentation of fluids. This was found to be the case in one study with higher prevalence of dehydration.²⁰ However, in a further study it was discovered that significantly more dependent residents had high fluid intakes in comparison to semi-independent and fully-independent residents.^{16,17} The authors suggested that dependent residents are easily identifiable by clinical staff as requiring assistance and therefore are provided with ample opportunity to drink. Apparently, the subjects most at risk of dehydration because of decreased fluid intake might be the semi-independent residents. These residents appear capable enough to obtain fluids when they so desire but for one reason or another are actually incapable of doing so.

No evidence strongly supported gender as a risk factor.^{13,16,20}

Incontinence was not proven to be a risk factor of dehydration. Interestingly, reduced intake of fluids by inconti-

Table 8 Assessment of hydration status using physician rating²⁵

Physician grading of dehydration	Biochemical hydration status		Outcome
	Dehydrated	Not dehydrated	
Mild to severe dehydration	13	23	Sensitivity 100%
No dehydration	0	2	Specificity 9% PPV 36% NPV 100%

PPV, positive predictive value; NPV, negative predictive value.

Table 9 Indicators of dehydration status compared to using urine specific gravity as an indicator

Measure	Urine specific gravity		Outcome OR (95% CI)
	Specific gravity > 1.03 (N)	Specific gravity < 1.03 (N)	
Haematocrit	47.7 ± 3.2 (186)	48.1 ± 2.2 (49)	-0.4 (-1.3, 0.5)
Serum osmolality (mOsm/kg)	290.8 ± 6.0 (186)	291.3 ± 5.5 (48)	-0.5 (-2.4, 1.4)
Serum urea/creatinine	13.6 ± 3.1 (185)	14.9 ± 4.0 (49)	-1.3 (-2.3, -0.2)

N, number of participants; mOsm/kg, milli osmoles per kilogram; OR, odds ratio; CI, confidence interval.

nent older adults might be due to a voluntary decision by the person in an attempt to reduce the likelihood of an incontinent episode.¹³

Finally, one study concluded that being an institutionalized older person led to an increased risk of a significantly lower fluid intake compared to older adults residing in the community.¹² In a discussion paper,⁴ it has been suggested that the decreased fluid intake in institutionalized older adults is actually a sign of neglect by the clinical staff.

Assessment

In order to assess the adequacy of fluid intake of study subjects, most studies included in this review compared actual patient intake of fluids with some predetermined value of the RDI. This RDI value varied somewhat from study to study but, in general, was identified as either 1500 mL fluids/24 h^{12,13,19,26} or 1600 mL fluids/m² of body surface area/24 h.^{16,17} The generally accepted method for measuring fluid intake is simply to chart total fluids ingested over a 24 h period.^{14,16,17} However, a problem arises when a particular RDI for fluids is chosen. The determination of whether a subject is receiving adequate fluids can be dependent upon the RDI calculation or value that is chosen. This was displayed in a study where three different RDI values were compared to actual fluid intake.¹⁴ Dependent upon the RDI chosen, actual fluid intake of nursing home residents was either lower, the same as, or higher than the RDI.

Assessment of dehydration was primarily performed using biochemical measures such as BUN:creatinine ratios, serum sodium and haematocrit values. However, these are not results that can be independently evaluated at the bedside by nursing staff as they require time for analysis. Therefore, other studies evaluated dehydration by available clinical indicators and compared their accuracy with the biochemical benchmark values.^{21,25,28,32}

According to corresponding biochemical determination of dehydration, measurement of axillary moisture was only able to identify 50% of dehydrated subjects,²⁸ intraocular pressure was not a useful measure³² and febrile episodes in older adults might be an indicator of impending or existing dehydration.²¹ A physicians' rating tool was found to overestimate the number of subjects suffering from dehydration but was still reliant on biochemical tests for final scoring.²⁵ Finally, a hydration examination looking for clinical signs of dehydration at the bedside found that the appearance of a dry tongue and mucous membranes,

sunken eyes, evidence of confusion and weakness were all indicators of dehydration.

Interestingly, in a study of army personnel on exercise, urine specific gravity was used as the benchmark to determine the accuracy of other biochemical tests to identify patients with dehydration.¹⁵ Only an increase in the BUN:creatinine ratio was found to be correlated with an increase in urine specific gravity.

Importantly, it was discovered that a significant proportion of nursing home subjects' fluids were obtained when receiving medication, so if not for this source, most of the subjects would fall short of their RDI.^{16,17}

Management

Only two studies on management of hydration in older adults satisfied the inclusion criteria in this review. In an unusual study, the position of the feeder (standing or sitting) made no significant difference to the fluid intake of dependent nursing home residents.¹⁸ Using urine specific gravity as the benchmark, a single crossover RCT determined that simply offering fluids every 1.5h throughout the waking day to bedridden residents maintained hydration at a significantly higher level than three hourly bed checks with no prompting of residents to drink fluids.²² However, this study was small and did not address the issue of patients who are uncooperative and refuse to drink. In these cases, more invasive methods might be required.

CONCLUSION

Despite the available research, there is no clear determination of the risk factors for dehydration and decreased oral fluid intake. However, there is common agreement in the research literature that the recommended daily oral intake of fluids should be not less than 1600 mL/24 h in order to assure adequate hydration. A simple oral fluid intake sheet and/or a bedside urine specific gravity test might be the best methods of monitoring daily fluid intake. What seems most logical is that the regular presentation of fluids to bedridden and semidependent older adults can help to maintain adequate hydration status.

ACKNOWLEDGEMENTS

This systematic review was conducted as part of the Joanna Briggs Institute Program and was funded by the Joanna Briggs Institute.

REFERENCES

- 1 Martin JH, Larsen PD. Dehydration in the elderly surgical patient. *AORN Journal* 1994; **60**: 666–671.
- 2 Hoffman NB. Dehydration in the elderly: insidious and manageable. *Geriatrics* 1991; **46**: 35–38.
- 3 Kositzke JA. A question of balance: dehydration in the elderly. *Journal of Gerontological Nursing* 1990; **16**: 40–41.
- 4 Himmelstein DU, Jones AA, Woolhandler S. Hypernatremic dehydration in nursing home patients: an indicator of neglect. *Journal of the American Geriatrics Society* 1983; **31**: 466–471.
- 5 Mahowald JM, Himmelstein DU. Hypernatremia in the elderly: relation to infection and mortality. *Journal of the American Geriatrics Society* 1981; **29**: 177–180.
- 6 Weinberg AD, Minaker KL. Dehydration. Evaluation and management in older adults. Council on Scientific Affairs, American Medical Association [see comments]. *Journal of the American Medical Association* 1995; **274**: 1552–1556.
- 7 Lavizzo Mourey RJ. Dehydration in the elderly: a short review. *Journal of the National Medical Association* 1987; **79**: 1033–1038.
- 8 Turner J, Brown A, Russell P, Scott P, Browne M. 'Pushing fluids'—Can current practices of maintaining hydration in hospital patients be improved? *Journal of the Royal College of Physicians London* 1987; **21**: 196–198.
- 9 Phillips PA, Johnston CI, Gray L. Disturbed fluid and electrolyte homeostasis following dehydration in elderly people. *Age and Ageing* 1993; **22**: S26–S33.
- 10 Mulrow CD, Oxman AE. (eds). The Cochrane collaboration handbook. In: *The Cochrane Collaboration Library*. Oxford: Update Software, 1997.
- 11 National Health Service Centre for Reviews and Dissemination. Undertaking systematic reviews of research on effectiveness. *CRD Guidelines for Those Carrying Out or Commissioning Reviews* York: University Of York, 1996.
- 12 Adams F. How much do elders drink? *Geriatric Nursing: American Journal of Care for the Aging* 1988; **9**: 218–221.
- 13 Armstrong Esther CA, Browne KD, Armstrong Esther DC, Sander L. The institutionalized elderly: dry to the bone! *International Journal of Nursing Studies* 1996; **33**: 619–628.
- 14 Chidester JC, Spangler AA. Fluid intake in the institutionalized elderly. *Journal of the American Dietetic Association* 1997; **97**: 23–30.
- 15 Francesconi RP, Hubbard RW, Szlyk PC, Schnakenberg D, Carlson D, Leva N et al. Urinary and hematologic indexes of hypohydration. *Journal of Applied Physiology* 1987; **62**: 1271–1276.
- 16 Gaspar PM. What determines how much patients drink? *Geriatric Nursing: American Journal of Care for the Aging* 1988; **9**: 221–224.
- 17 Gaspar PM. Water intake of nursing home residents. *Journal of Gerontological Nursing* 1999; **25**: 23–29.
- 18 Holzapfel SK, Ramirez RF, Layton MS, Smith IW, Sagl Massey K, DuBose JZ. Feeder position and food and fluid consumed by nursing home residents. *Journal of Gerontological Nursing* 1996; **22**: 54–55.
- 19 Iggulden H. Dehydration and electrolyte disturbance. *Nursing Standard* 1999; **13**: 48–56.
- 20 Lavizzo Mourey R, Johnson J, Stolley P. Risk factors for dehydration among elderly nursing home residents. *Journal of the American Geriatrics Society* 1988; **36**: 213–218.
- 21 Weinberg AD, Pals JK, Levesque PG, Beal LF, Cunningham TJ, Minaker KL. Dehydration and death during febrile episodes in the nursing home. *Journal of the American Geriatrics Society* 1994; **42**: 968–971.
- 22 Spangler PF, Risley TR, Bilyew DD. The management of dehydration and incontinence in nonambulatory geriatric patients. *Journal of Applied Behavioral Analysis* 1984; **17**: 397–401.
- 23 Snyder NA, Feigal DW, Arieff AI. Hypernatremia in elderly patients. A heterogeneous, morbid, and iatrogenic entity. *Annals of Internal Medicine* 1987; **107**: 309–319.
- 24 Seymour DG, Henschke PJ, Cape RD, Campbell AJ. Acute confusional states and dementia in the elderly. The role of dehydration/volume depletion, physical illness and age. *Age and Ageing* 1980; **9**: 137–146.
- 25 Gross CR, Lindquist RD, Woolley AC, Granieri R, Allard K, Webster B. Clinical indicators of dehydration severity in elderly patients. *Journal of Emergency Medicine* 1992; **10**: 267–274.
- 26 Reedy DF. How can you prevent dehydration? *Geriatric Nursing* 1988; **9**: 224–226.
- 27 Welch TK, Campbell S, Crowley R. Oral hydration solution effects on fluid status of the elderly. *Journal of Nutrition for the Elderly* 1996; **16**: 1–10.
- 28 Eaton D, Bannister P, Mulley GP, Connolly MJ. Axillary sweating in clinical assessment of dehydration in ill elderly patients. *British Medical Journal* 1994; **308**: 1271.
- 29 Trotto NE. Keeping dehydrated patients out of the hospital. *Patient Care* 1999; **33**: 81.
- 30 Silver AJ. Aging and risks for dehydration. *Cleveland Clinical Journal of Medicine* 1990; **57**: 341–344.
- 31 Miller M. Fluid and electrolyte homeostasis in the elderly: Physiological changes of ageing and clinical consequences. *Bailliere's Clinical Endocrinological Metabolism* 1997; **11**: 367–387.
- 32 Rhodes KM. Can the measurement of intraocular pressure be useful in assessing dehydration and rehydration? [Letter]. *Journal of the American Geriatrics Society* 1995; **43**: 589–590.