

Need for a consensus definition of chronic dehydration: A scoping review

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SUMMARY Dehydration is common in older adults and impacts their clinical outcomes. Chronic dehydration is especially important as it has been under-recognized. This scoping review aimed to summarize the available definitions of chronic dehydration to identify gaps between each definition and discuss future research needs. Four databases (Pubmed, CINAHL, Cochrane Library, Science Direct) were systematically searched for peer-reviewed articles that clearly described the definition of chronic dehydration published from inception to June 8th, 2023. Two researchers reviewed the articles independently, and any disagreement was solved upon discussion. We identified five articles with a wide range of subjects from children to older adults. Chronic dehydration was defined as a state of persistently elevated blood urea levels; weight loss $\geq 1\%$ as a result of fluid loss; a ratio of blood urea nitrogen to creatinine > 20 ; serum osmolarity ≥ 295 mOsm/kg; and a dehydrated state lasting 72 hours or longer. The definition varied among studies, indicating the need to establish an international consensus on the definition of chronic dehydration.

Keywords water, dehydration, review, aging, diagnosis

1. Introduction

Water is an essential nutrient for human life, comprising 60% of the human body and playing a key role in numerous physiological processes such as digestion, absorption and use of nutrients, detoxication and excreting waste products, and whole-body thermoregulation (1). Total body water is closely regulated and distributed throughout the body in the intra- and extra-cellular compartments (2).

Dehydration is a condition with a depletion of total body water content primarily due to excessive fluid loss, lack of intake, or a combination of both (3,4). Older adults are especially at higher risk of dehydration. The prevalence of dehydration in older adults is approximately 20-38% in long-term care (5-7) and 19-20% in the community (7,8). Dehydration is associated not only with frailty (2,9), sarcopenia (10), and diminished physical and cognitive performance (1,11) but also with morbidity and mortality (12,13). Dehydration also causes higher medical care costs (13,14). Thus, appropriate assessment and intervention are necessary for preventing dehydration (15).

Dehydration can be either acute or chronic (1).

Acute dehydration is relatively easily noticed and subject to treatment because it can be severe and caused by acute medical events that require medical intervention, such as infection, vomiting and diarrhea (16). In contrast, chronic dehydration is implicit because its severity is often mild and asymptomatic (16,17). Chronic dehydration is common, being found in approximately 17% of older adults living in nursing homes, and is related to dementia and higher body mass index (18). Since chronic dehydration is asymptomatic, in contrast to the notable symptoms of acute dehydration, its pathophysiology may differ from acute dehydration.

Therefore, there is an urgent need for further study regarding the prevalence, clinical impacts, and pathophysiology of chronic dehydration. Defining chronic dehydration is the first step to initiate research on chronic dehydration. However, researchers have applied various operational definitions of chronic dehydration as there is no international consensus definition yet. Therefore, this scoping review aimed to summarize the available definitions of chronic dehydration to identify gaps between each definition and discuss future research needs.

2. Materials and Methods

2.1. Research design and methods

This scoping review was conducted per the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Review (PRISMA-ScR) guideline (19). The study protocol was developed by YH and KK and reviewed by a senior researcher (TM) prior to conducting the study.

2.2. Literature search

Four databases (Pubmed, CINAHL, Cochrane Library, and Science Direct) were searched on June 8th, 2023 for all previous records for all previous records with no date limits. There was a limited number of records when searching the terms ("chronic dehydration" AND defin* AND English[la]). Therefore, we used the search terms ("chronic dehydration" AND English[la]) to maximize our literature search and reviewed the definition of chronic dehydration.

2.3. Inclusion and exclusion criteria

Studies were eligible for inclusion if they were peer-reviewed research articles, the subjects were either human, mammals or laboratory animals, written in English, and included a clear statement of the definition of chronic dehydration. Both quantitative and qualitative research and research with experimental approaches were included. We included studies with human subjects and experimental animals to comprehensively capture the definition of

chronic dehydration. The articles for inclusion were original articles, reviews, clinical reports, brief reports, comments, letters, editorials, short communications, and conference abstracts. Articles were excluded if they were written in languages other than English and not peer-reviewed. For review articles, we assessed the reference lists for additional references manually.

2.4. Data extraction

All retrieved citations were imported into Rayyan (Qatar Computing Research Institute, Doha, Qatar), and any duplicates were removed. Two reviewers (YH and KK) independently screened the titles and abstracts. Disagreements were resolved by consensus or discussed with a third reviewer if needed. Potentially eligible literature was subjected to a full-text review by the same reviewers. Reference lists were also reviewed for potentially relevant studies. After the full-text review, data on the author, year of publication, study design, subjects and a definition of chronic dehydration were collected by two authors (YK and KK) and validated by each other. No quality assessment was performed as this is a scoping review.

3. Results

The literature search identified 776 articles, and an additional 7 were included manually (Figure 1). After duplicates were removed, 730 articles were screened for title and abstract. Of these, 134 articles were eligible for full-text screening, and 129 articles were excluded because the definition of chronic dehydration was not

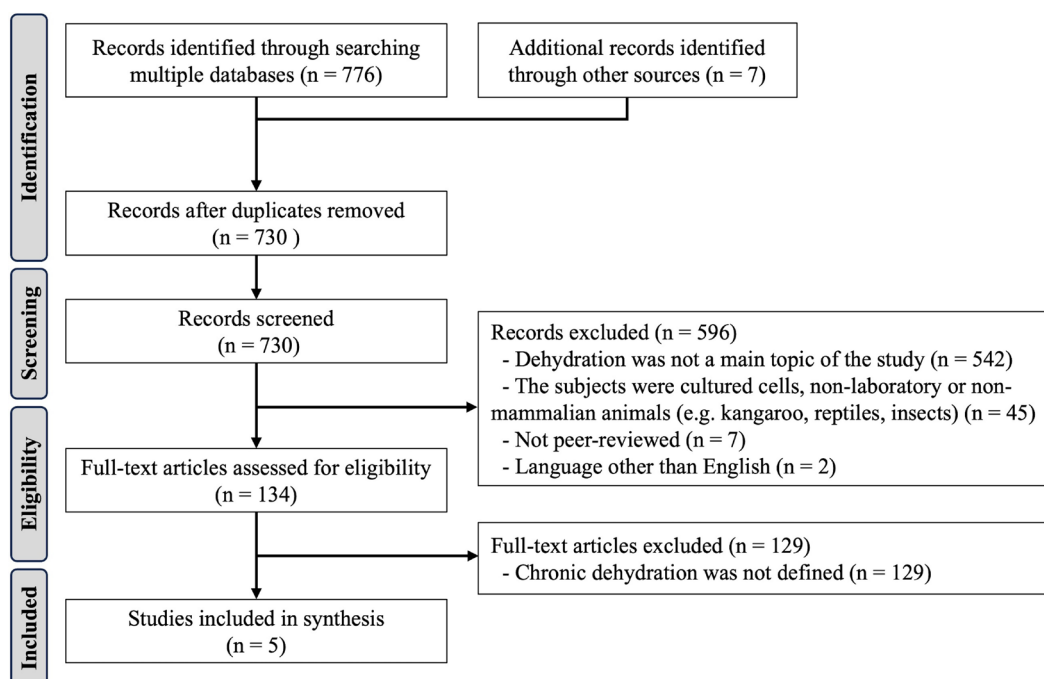


Figure 1. Flow diagram of scoping review.

Table 1. The definitions of chronic dehydration

No.	Article	Study design	Subjects	Definition of chronic dehydration
1	Udassin R. <i>et al.</i> (1992)	Prospective cohort study	Children with familial dysautonomia underwent Nissen fundoplication and gastrostomy	Persistently elevated blood urea levels No specific numerical values were mentioned
2	Kleiner SM. (1999)	Review	Not specified	1% or greater loss of body weight as a result of fluid loss
3	Bennett JA. <i>et al.</i> (2004)	Prospective cohort study	Patients age 75 or older who were admitted to the hospital or sent home from the emergency department of a hospital	A ratio of blood urea nitrogen to creatinine > 20
4	Nagae M. <i>et al.</i> (2020)	Prospective cohort study	Residents aged ≥ 65 years living in nursing homes for ≥ 1 week without requiring urgent medical care for an acute illness	Serum osmolality ≥ 295 mOsm/kg
5	Katz B. <i>et al.</i> (2020)	Systematic review	Healthy or diseased adults aged older than 18 years	Chronic hydration status was defined as dehydrated states lasting 72 hours or longer

described. Finally, 5 articles met the inclusion criteria for this review.

3.1. Study characteristics

Table 1 presents the characteristics of the included studies. All included studies were human-based research articles, including two with older adults, one with adults, and another with children. The study designs were three prospective cohort studies and a systematic review. No experimental studies with animal subjects defined chronic dehydration.

3.2. Definition of chronic dehydration

Udassin *et al.* defined chronic dehydration as persistently elevated blood urea levels in children with familial dysautonomia who underwent Nissen fundoplication and gastrostomy, but no specific numerical values were defined (20). Kleiner *et al.* defined chronic dehydration as 1% or greater loss of body weight as a result of fluid loss (1). Bennett *et al.* used the definition of a blood urea nitrogen to creatinine ratio (BUN/Cr) > 20 in the patients aged 75 or older who were admitted to the hospital or sent home from the emergency department (21). Nagae *et al.* defined chronic dehydration as serum osmolality ≥ 295 mOsm/kg in older adults living in nursing homes (18). They included only the residents in the nursing homes for ≥ 1 week without requiring urgent medical care for an acute illness. Katz *et al.* defined chronic dehydration in a systematic review to examine studies investigating the spectrum of hydration status and executive function in healthy or diseased adults as the dehydrated states lasting 72 hours or longer (22).

4. Discussion

This scoping review included five studies that stated

the definition of chronic dehydration. All studies were human-based, with a wide range of subjects from children to older adults. The definitions employed in the included articles were (i) a state of persistently elevated blood urea levels, (ii) weight loss $\geq 1\%$ as a result of fluid loss, (iii) BUN/Cr > 20, (iv) serum osmolality ≥ 295 mOsm/kg, and (v) a dehydrated state lasting 72 hours or longer.

The definition of chronic dehydration varied among studies. Udassin *et al.* (20) and Bennett *et al.* (21) define chronic dehydration using blood urea levels and BUN/Cr ratio, respectively. These parameters are elevated with dehydration but also in cases of kidney failure, gastrointestinal bleeding, and heart failure, while parameters are lower in cases of malnutrition (23). These conditions are common in older adults; therefore, the definition including these parameters might not be best for defining chronic dehydration. Kleiner defined chronic dehydration as weight loss $\geq 1\%$ due to fluid loss (1); however, this definition cannot distinguish acute and chronic dehydration. Similarly, serum osmolality is difficult to differentiate acute and chronic dehydration, although it is considered the most reliable biomarker to determine a state of overall dehydration (15). Katz *et al.* (22) defined chronic dehydration as the dehydrated states lasting 72 hours or longer, but it is uncertain whether 72 hours is long enough to define chronicity. Considering Nagae *et al.* (18) exclusively studied older adults institutionalized for ≥ 1 week without requiring urgent medical care for an acute illness to differentiate from acute dehydration, chronic dehydration may be developed over a longer period than Katz *et al.* examined. Taken together, there has been no definitive definition of chronic dehydration yet.

This scoping review identified the need to establish an international consensus on the definition of chronic dehydration that can differentiate acute and chronic

states to support future research. Concurrently, we identified the need to apply an operational definition to research chronic dehydration at this stage. Because none of the indicators included in this review could discriminate acute and chronic dehydration by themselves, it would be useful to define chronic dehydration by narrowing down the subjects to exclude those with possible acute dehydration. Nagae *et al.* included only the residents living in the nursing homes for ≥ 1 week who did not require urgent medical care for an acute illness; this eliminated subjects with possible acute dehydration and specifically included those with chronic dehydration. Although the duration of absence of acute illness and urgent medical care is controversial, it is reasonable to define chronic dehydration by such a methodology. More detailed pathophysiology of chronic dehydration needs to be elucidated in order to reach a consensus definition.

The limitation of this study is that we included articles published only in English, which might omit some important studies defining chronic dehydration. However, we searched multiple databases for peer-reviewed articles, including reviews, conference abstracts, letters and editorials to maximize our literature search. This is the first scoping review that specifically summarizes the definition of chronic dehydration.

5. Conclusion

This scoping review identified the existing definition of chronic dehydration in five human subject studies. Chronic dehydration was defined as a state of persistently elevated blood urea levels; weight loss $\geq 1\%$ as a result of fluid loss; BUN/Cr > 20 ; serum osmolality ≥ 295 mOsm/kg, and a dehydrated state lasting 72 hours or longer. The definition varied among studies, indicating the need to establish an international consensus on the definition of chronic dehydration.

Acknowledgements

The authors thank Cambridge English Correction Service (<https://cambridge-correction.com/>) for editing and proofreading the manuscript for the English language.

Funding: This work was supported by Japanese Society for the Promotion of Science (JSPS) KAKENHI Grant Number 23K16789.

Conflict of Interest: Y.H. and K.O. belong to the department sponsored by Saraya Co. Ltd. (Osaka, Japan).

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- Received March 6, 2024; Revised April 15, 2024; Accepted April 20, 2024.
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- Released online in J-STAGE as advance publication April 25, 2024.