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LITERATURE REVIEW Open Access

# *Tinjauan Literatur Metode Penilaian Hidrasi pada Populasi Lansia: Kelebihan dan Kekurangan*

# Literature Review Hydration Assessment Methods in the Elderly Population: Advantages and Disadvantages

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***ABSTRAK***

***Latar Belakang:*** *Populasi lansia merupakan kelompok yang rentan terhadap masalah hidrasi dan dapat berdampak buruk pada kondisi kesehatan. Metode penilaian hidrasi yang akurat dan dapat diandalkan menjadi sangat penting untuk mendeteksi, memantau, dan mengelola status hidrasi dengan efektif pada lansia, namun belum ada konsensus mengenai metode yang optimal.*
***Tujuan:*** *Literatur ini bertujuan untuk menganalisis metode penilaian hidrasi yang dipakai pada populasi lansia serta mengevaluasi kelebihan dan kelemahan metode tersebut.*
***Metode:*** *Studi ini mengumpulkan data dari literatur dan penelitian sejenis yang diperoleh dari artikel jurnal dalam database PubMed, Google Scholar, dan Science Direct. Pencarian artikel dilakukan berdasarkan kata kunci seperti "Penilaian Hidrasi", "Penanda Hidrasi", dan "lansia OR usia lanjut". Sumber data mencakup publikasi dari situs web resmi dan jurnal penelitian. Proses penyusunan tinjauan literatur melibatkan pemilihan topik ulasan, pencarian artikel yang relevan, serta analisis dan sintesis literatur yang ada.*
***Ulasan:*** *Beberapa metode penilaian hidrasi pada lansia termasuk parameter biokimia, tanda dan gejala klinis, BIA, dan ultrasonografi. Namun, tidak ada satu metode yang dapat memberikan gambaran lengkap tentang keadaan dehidrasi pada lansia.*
***Kesimpulan:*** *Dalam memilih metode penilaian yang sesuai, perlu mempertimbangkan tujuan penilaian, kelebihan, kelemahan, sensitivitas, spesifisitas, biaya, ketersediaan peralatan, kemudahan penggunaan, dan waktu yang dibutuhkan. Dengan mempertimbangkan faktor-faktor ini, peneliti dapat memilih metode penilaian hidrasi yang paling sesuai untuk populasi lansia, sehingga memperoleh informasi yang akurat dan relevan untuk pengelolaan dan perawatan yang tepat.*

***Kata kunci:*** *Lansia, Penilaian Hidrasi, Metode Hidrasi, Dehidrasi, Status Hidrasi*

**ABSTRACT**

**Background:** The elderly population is vulnerable to hydration problems, which can have adverse effects on their health. Accurate and reliable hydration assessment methods are crucial for effective detection, monitoring, and management of hydration status in the elderly. However, there is currently no consensus on the optimal method.
**Objectives:** This literature aims to analyze the hydration assessment methods used in the elderly population and evaluate their strengths and limitations.
**Methods:** This study gathered data from relevant literature and research articles obtained from journals in databases such as PubMed, Google Scholar, and Science Direct. Articles were searched using keywords such as "Hydration Assessment", "Hydration Markers", and "elderly OR older". Data sources included publications

from official websites and research journals. The literature review process involved selecting the review topic, searching for relevant articles, and analyzing and synthesizing the available literature.
**Discussion:** Several hydration assessment methods in the elderly include biochemical parameters, clinical signs and symptoms, bioimpedance analysis (BIA), and ultrasonography. However, no single method can provide a comprehensive picture of dehydration status in the elderly.
**Conclusions:** When selecting an appropriate assessment method, factors such as assessment goals, strengths, limitations, sensitivity, specificity, cost, equipment availability, ease of use, and time required need to be considered. By considering these factors, researchers can choose the most suitable hydration assessment method for the elderly population, thereby obtaining accurate and relevant information for proper management and care.

***Keywords:*** *Elderly, Hydration Assessment, Hydration Methods, Dehydration, Hydration Status*

## INTRODUCTION

The elderly population is a vulnerable group when it comes to hydration problems, which can have a negative impact on health and quality of life (Volkert *et al.*, 2019; Ekingen *et al.*, 2022). Dehydration can lead to serious complications such as kidney dysfunction, low blood pressure, fatigue, and an increased risk of falls and mortality (Edmonds *et al.*, 2021). Therefore, it is important to have accurate and reliable methods for assessing hydration in the elderly population in order to detect, monitor, and manage hydration status appropriately. However, to date, there is no consensus on the optimal method for assessing hydration in the elderly population (Volkert *et al.*, 2019).

Dehydration is a condition in which the body loses more fluid than it consumes (Buanasita, Yanto and Sulistyowati, 2015). Dehydration can be caused by inadequate fluid intake (low intake dehydration) or excessive fluid loss (through bleeding, vomiting, diarrhea, etc., referred to as volume depletion), or a combination of both types of dehydration (combined dehydration) (Cheuvront *et al.*, 2013). In clinical practice, dehydration is described as a decrease in the total body water (TBW) from both intracellular and extracellular compartments, with or without electrolyte loss (Bak, Tsiami and Greene, 2017). Low intake dehydration is a pure water deficiency that leads to the loss of both intracellular and extracellular fluid along with increased osmolality in both compartments (intracellular and extracellular). On the other hand, volume depletion is caused by excessive loss of fluid and salt (especially sodium), primarily from the extracellular rather than intracellular fluid, and it can result in normal or low serum (Volkert *et al.*, 2019).

Assessing hydration in the elderly population is more complex compared to young adults or adolescents. Aging-related factors, such as medication use, physiological changes in the body, and decreased activity, can affect the accuracy of hydration assessment (Betomvuko, de Saint-Hubert, and ..., 2018; Puga, Partearroyo and Varela-Moreiras, 2018). Aging can cause changes in drug metabolism and drug interactions, which in turn can affect hydration status. Additionally, physiological changes such as reduced kidney function and impaired water balance regulation in the elderly can also impact accurate hydration assessment. Therefore, an approach to hydration assessment that specifically considers these factors is needed in the elderly population.

Methods have been developed to assess fluid status more accurately in the elderly. However, physical assessments do not always correlate with biochemical assessments, and biochemical assessments have been shown to assess dehydration and water loss accurately in younger adults but with decreased accuracy as age-related changes occur. Furthermore, bioimpedance analysis and ultrasonography still require further research for consistency and accuracy of results (Boccardi *et al.*, 2022). Therefore, a literature review of hydration assessment methods in the elderly population is crucial to provide the necessary information for selecting the most appropriate assessment methods. The aim of this literature review is to analyze the literature on hydration assessment methods in the elderly population and evaluate the strengths and weaknesses of these methods. Thus, this review is expected to provide practical guidance for healthcare professionals in choosing suitable hydration assessment methods. It is hoped that this will improve effective hydration management in the vulnerable elderly population.

## METHOD

This study collected data from various literature and research on the same topic, obtained from journal articles in the PubMed, Google Scholar, and Science Direct databases. The article search strategy was based on the keywords 'Hydration

Assessment,' 'Hydration Markers,' AND '(elderly OR older).' The data sources used included publications from official websites and research journals. The process of conducting the literature review involved selecting the review topic, searching for relevant articles, and analyzing and synthesizing the existing literature (Figure 1).

For inclusion criteria, studies included in the review had to use hydration assessment methods in the elderly population (age above 60 years). Additionally, these studies had to be published within the last 5 years and available in either Indonesian or English. As for the exclusion criteria, studies in languages other than English and Indonesian were excluded. Studies without full-text manuscripts were also not included in the review. Furthermore, studies in the form of books, editorials, reviews, or letters to the editor were also excluded from this research.

## RESULTS AND DISCUSSION

A search was conducted in the database, and a total of 139 articles were found. After removing duplicates and manually searching the reference lists of relevant articles, 131 articles were obtained. From this number, a thorough analysis and review of the abstracts were conducted, resulting in the exclusion of 85 articles that were irrelevant to the topic. Forty-six articles were obtained, but 42 of them were excluded as they did not answer the research question. Finally, there were 4 studies reporting hydration assessment methods in the elderly population (Figure 1).

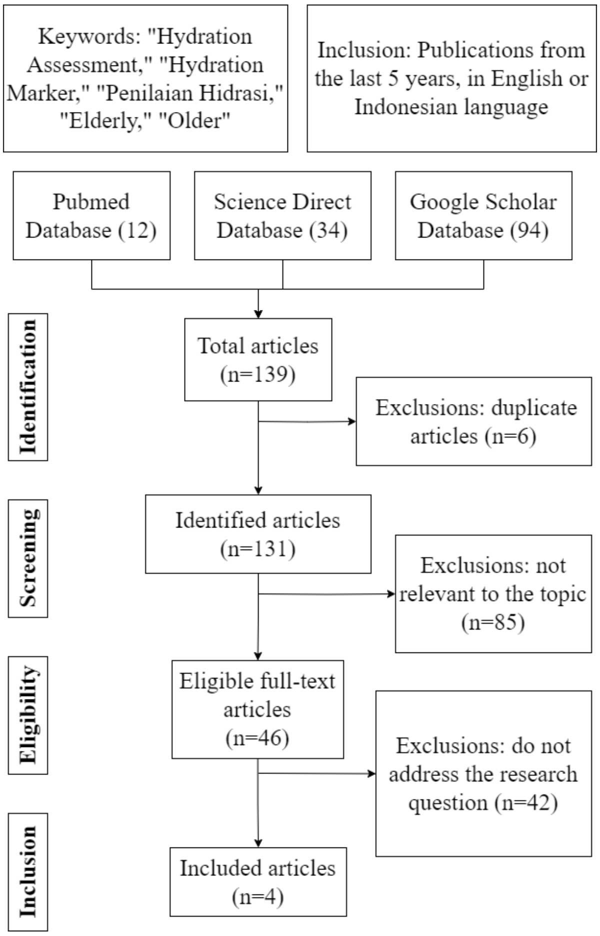


**Figure 1.** Prisma Flow Diagram of Article Selection Process

Based on the 4 studies utilized, there are several hydration assessment methods for the elderly that can be employed, including the use of biochemical parameters such as serum osmolality, sodium, urea, urine specific gravity, hematocrit, creatinine, uric acid, total protein, hemoglobin, and albumin; clinical signs and symptoms parameters such as dry mouth, dry lips, sunken eyes, skin folds, thirst, calf consistency, urine color, dizziness and vertigo, weight loss, systolic blood pressure, capillary refill, and heart rate; BIA parameters such as total body water (TBW), fat mass (FM), fat-free mass (FFM), phase angle (PhA), and TBW/FFM; as well as ultrasonography parameters (Table 1). Although each assessment method employed in the study can yield significant results with specific parameters, there is no single method that can provide a complete picture of dehydration status.

**Table 1.** Studies Using Hydration Assessment Methods in the Elderly

| Authors & year | Setting | Subject | Assessment methods used | Conclusion |
|---|---|---|---|---|
| (Sanson *et al.*, 2021) | Department of Internal Medicine, University Hospital of Trieste, Italy | 5113 elderly | • Standard Diagnosis: Serum Osmolarity.<br>• Significant with assessment of serum Sodium and Urea.<br>• Not significant with assessment of urine specific gravity and hematocrit. | • Initial assessment of calculated serum osmolarity is crucial for identifying dehydration and hyposmolar disorders. |
| (Betomvuko, de Saint-Hubert, and ..., 2018) | Hospital, Acute Geriatric Unit | 112 elderly | • Standard Diagnosis: Weight changes and clinical diagnosis by doctors.<br>• Significant with assessment of urea, creatinine, uric acid, total protein, and hemoglobin, as well as clinical criteria (dry mouth, skin fold, thirst sensation, and calf consistency). | • The triage method (clinical, biological, and clinical diagnosis criteria) is a good method for early diagnosis of dehydration in elderly patients. Overall assessment by clinicians has better predictability than individual clinical signs in diagnosing dehydration. |
| (Puga, Partearroyo and Varela-Moreiras, 2018) | Spain | 96 elderly volunteer | • Signs and symptoms of dehydration (dry mouth, dry lips, sunken eyes, dry eyes, dizziness and vertigo, headache, constipation, weight loss, dry skin, and skin folds).<br>• Urine analysis: color, pH, and urine specific gravity. | • Dehydration status is confirmed through the presence of signs and symptoms of dehydration as well as urine color and chemical markers analysis. Dehydration is also determined by calculating the total body fluid volume (TBW). |
| (Boccardi *et al.*, 2022) | Acute care hospital, Italy | 59 elderly | • Standard Diagnosis: Blood Urea Nitrogen (BUN) to creatinine ratio. Significant with assessment of serum Sodium, serum Osmolarity, and Fat Mass. Not significant with assessment of physical signs (systolic blood pressure, capillary refill, and heart rate), Chloride, Glucose, Creatinine, Albumin, NPR-B, TBW/FFM, PhA, FFM, TBW, ECW, and Ultrasonography parameters. | • Calculated serum osmolarity measurement is a simple method.<br>• A comprehensive clinical and biochemical approach is still recommended over using time-consuming instrumental parameters in identifying dehydration in the geriatric population experiencing acute conditions. |

**Blood Sampling**

Plasma osmolality is an important indicator in maintaining hydration balance within human cells (Lacey *et al.*, 2019). When an individual consumes less fluid than the amount lost from the body, the extracellular fluid volume will decrease while electrolyte content remains stable. This leads to an increase in osmolality (number of solute particles per kilogram of solvent) and osmolarity (number of solute particles per liter of solution). If direct measurement of plasma osmolality is not feasible, serum osmolarity can be calculated using validated formulas in the elderly population (Hooper *et al.*, 2015), such as the Krahn and Khajuria formula as follows (Khajuria and Krahn, 2005):

$$1{,}86 \text{ x } (Na^+ + K^+) + 1{,}15 \text{ x glucose} + \text{urea} + 14$$

The result obtained using this formula is in mmol/L and is classified based on the calculated serum osmolarity levels: (i) normal hydration range

(275-295 mmol/L), (ii) potential dehydration (296-300 mmol/L), (iii) established dehydration (>300 mmol/L), and (iv) low osmolarity (<275 mmol/L) (Sanson *et al.*, 2021).

Blood sampling methods may not be the most suitable parameter for field research as blood sampling is considered an invasive procedure for subjects (Baron *et al.*, 2015). Although serum osmolality is a good marker for assessing acute changes in hydration status in the elderly, it should be noted that this assessment does not represent chronic hydration as the values are constantly changing (Sanson *et al.*, 2021). Additionally, this method also incurs high laboratory costs and time, requires a long processing time, and may be impractical for the elderly population due to their vulnerable health status (Barley, Chapman and Abbiss, 2020). On the other hand, BUN/Creatinine assessment can be accurately used in younger age groups due to increased urea levels in hypercatabolic conditions (sepsis, major surgery, starvation), upper gastrointestinal bleeding, and high-dose glucocorticoid administration (Lacey *et al.*, 2019).

**Urine Sampling**

In dehydration conditions, the body tries to retain water by reabsorbing as much available water as possible in urine, resulting in concentrated urine. This is one of the body's mechanisms to maintain fluid and prevent excessive water loss from the body through urine (Nakamura *et al.*, 2020). Therefore, hydration can be assessed by measuring urine concentration. There are three common assessments in urine collection methods to evaluate urine concentration, including urine osmolality, urine specific gravity, and urine color.

Urine osmolality refers to the concentration of osmotic substances present in urine. Measurement of urine osmolality can be done using a freezing point osmometer or vapor pressure reduction method (Bron and Willshire, 2021). Urine osmolality depends on two parameters: the amount of solutes and the volume of water. Sodium (Na), potassium (K), and urea are the most abundant solutes in urine. Urine specific gravity can be determined using dipstick tests or refractometry (Kang *et al.*, 2019). Urine color can be assessed using a urine color chart (Hahn, 2022).

Urine assessment has advantages as a non-invasive, simple, fast, and cost-effective method (Baron *et al.*, 2015). This method can be used to assess chronic dehydration, such as in individuals who drink insufficient fluids or experience progressive dehydration due to fluid deficiency. This is because urine concentration will change as an adaptation by the kidneys to maintain water balance in the body. However, there are some limitations in urine assessment, including the influence of urinary protein metabolites, medication consumption, and age-related decline in kidney function (Baron *et al.*, 2018; Puga, Partearroyo and Varela-Moreiras, 2018). Nevertheless, urine assessment remains a good choice for evaluating hydration status.

**Clinical Physical Signs**

The most common clinical signs include dry tongue, tongue furrows, dry oral mucosa, upper body muscle weakness, confusion, speech difficulties, sunken eyes, decreased skin elasticity, thirst, urine color, weight loss, dry axilla, postural hypotension, tachycardia, and calf muscle consistency (Betomvuko, de Saint-Hubert, and ..., 2018). Clinical physical assessment is a non-invasive and affordable method commonly used by doctors to screen for dehydration in hospitalized patients. However, this method has limitations in sensitivity and specificity, especially in the elderly population who often have comorbidities, take various medications, and experience age-related changes in the skin and mucous membranes (Bruno *et al.*, 2021). The physical signs observed in the elderly may not always provide clear indications of their hydration status (Boccardi *et al.*, 2022). Therefore, in conducting an initial assessment of hydration status in the elderly population, the use of other more objective and specific methods or indicators is necessary.

**Weight Changes**

Rapid weight changes are recognized as a sign for diagnosing dehydration. In the study by Betomvuko et al. (2018), it was found that an increase in body weight of more than 3% was strongly associated with a fluid gain of over 20% in laboratory parameters in individuals experiencing dehydration after one week. This indicates that clinically significant weight gain can correlate with improvements in hydration status as observed through laboratory assessments measuring hydration status.

Weight changes cannot differentiate between intracellular and extracellular dehydration. Body weight is influenced by total body water, which can decrease in the elderly population, especially due to low water intake or loss of intracellular and extracellular fluids (Baron *et al.*, 2015). In acutely ill elderly patients, weight gain is not solely caused by increased hydration but can also be due to improved nutrition, medication infusions, and organ failure-related fluid retention (Betomvuko, de Saint-Hubert, and ..., 2018). Weight loss becomes an indicator of worsening dehydration as, before these symptoms appear, one can prevent it by observing urine for early indications of fluid deficiency (Sumeru and Mustikasari, 2020). It is difficult to ensure that all factors and conditions remain exactly the same as during the initial measurement when conducting a second measurement. This can affect the accuracy of the second measurement and add complexity to the assessment of dehydration.

**Bioelectrical Impedance Analysis (BIA)**

BIA is a method used to assess the amount of water in the body non-invasively, portably, and affordably (Zeni *et al.*, 2022). This method involves passing an electrical current through the body to measure electrical resistance, which is then used to estimate the amount of water in the body (Total Body Water/TBW). The hydration assessment results include total body water (TBW), extracellular water (ECW), muscle mass (FFM), fat mass (FM), cell mass (BCM), phase angle (PhA), and hydration index (TBW/FFM%) (Boccardi *et al.*, 2022).

The measurement of the ICW/ECW ratio using bioelectrical impedance analysis (BIA) can predict outcomes for older patients better than the BUN/Cr ratio, enabling timely interventions to prevent the adverse effects of mild fluid loss or reduce the incidence of more severe dehydration with serious health consequences (Wood *et al.*, 2021). However, BIA has limitations in its sensitivity to detect small changes in TBW. This method is more suitable for measuring larger and significant changes in body hydration status (Mandalà *et al.*, 2023).

**Table 2.** Summary of the Advantages and Disadvantages of Hydration Assessment Methods in the Elderly

| Methods Used | Assessment of Hydration Status | Risks for Respondents | Advantages | Disadvantages |
|---|---|---|---|---|
| **Blood Sampling** | Serum osmolality | Invasive | • Good markers for assessing acute changes in hydration status in the elderly. | • Does not represent chronic hydration status as it is constantly changing.<br>• Laboratory costs and time would be significantly high without additional resources. |
| | BUN/creatinine ratio | | • Can be accurately used in younger age groups. | • Urea increase in hypercatabolic conditions (sepsis, major surgery, starvation), upper gastrointestinal bleeding, and with high-dose glucocorticoid administration. |
| **Urine Sampling** | Urine osmolality<br>Urine specific gravity<br>Urine color | Non-Invasive | • Simple, fast, and cost-effective.<br>• Can assess chronic dehydration. | • Affected by urinary protein metabolites, medication use, and age-related decline in kidney function. |
| **Clinical Physical Sign** | Dry mouth<br>Skin folds<br>Thirst<br>Calf muscle consistency<br>Tachycardia | Non-Invasive | • Affordable<br>• Commonly used by doctors for dehydration screening in hospitals. | • Less sensitive and specific in the elderly population due to comorbidities, multiple medication use, and age-related changes in skin and mucosa.<br>• Depends on the severity and individual tolerance. |
| **Weight Changes** | | Non-Invasive | • Requires short time and does not require technical expertise. | • Cannot assess hydration for long periods.<br>• Used to assess water loss during short-term physical exercise. |
| **BIA** | Total Body Water, ICW/ECW, FM | Non-Invasive | • Portable and affordable | • Not sensitive in detecting small changes in TBW and more suitable for measuring larger and significant changes. |

## CONCLUSION

When choosing the right assessment method, several factors should be considered, such as assessment objectives, advantages, limitations, sensitivity, specificity, cost, equipment availability, ease of use, and time requirements. By carefully considering these factors, researchers can select the most suitable hydration assessment method for the elderly. This ensures accurate and relevant information, facilitating proper management and care for this population. Making an informed decision in method selection is crucial to enhance the quality of assessment and promote optimal health outcomes in the elderly.

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