Media of Health Research
Vol. 4 No. 2, May 2026, pages: 172-182
e-ISSN 2987-7784
DOI: https://doi.org/10.70716/mohr.v4i2.484

Psychometric Properties of the Indonesian Dialysis Thirst Inventory in Hemodialysis Patients: A Rasch Analysis

Yudi Triguna[1*], Dewi Aryanti[2], Denny K. Sunjaya[3], Moh Faris K. L. Harahap[4], Ida Rosdiana[5], Peni Cahyati[6]

[1,2,4,5]Ministry of Health Polytechnic of Tasikmalaya, Tasikmalaya, West Java, Indonesia
[3]University of Padjajaran, Bandung, West Java, Indonesia
[6]Nursing Department, Poltekkes Kemenkes Tasikmalaya, Indonesia
**Corresponding Author: ydtrgn@gmail.com*

Article History

Manuscript submitted:
20 April 2026
Manuscript revised:
16 May 2026
Accepted for publication:
18 May 2026
Manuscript published:
25 May 2026

Keywords

dialysis thirst inventory;
hemodialysis;
rasch analysis;
reliability;
validity.

Abstract

Although thirst severely impacts hemodialysis patients, a validated Indonesian measurement tool remained unavailable, limiting standardized clinical assessments. This study aimed to evaluate the validity and reliability of the Indonesian Dialysis Thirst Inventory (DTI) using Rasch analysis. A cross-sectional design involved 145 hemodialysis patients from two Indonesian centers. Following a cross-cultural translation protocol, psychometric properties were analyzed using Winsteps software. The results confirmed strong unidimensionality, with 77.8% of variance explained by Rasch measures. All seven items fit the model well, showing a mean outfit mean-square of 0.98. The instrument demonstrated excellent reliability (person = 0.92, item = 0.99) and a person separation index of 3.42, which discriminated four distinct levels of thirst severity. Furthermore, differential item functioning analysis indicated minimal gender bias. In conclusion, the Indonesian DTI proved to be a highly valid and reliable instrument. Its implementation provided a standardized method for comprehensively assessing thirst, yielding crucial data to guide targeted fluid management interventions and prevent interdialytic weight gain in hemodialysis care.

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How to Cite: Triguna, Y., Aryamti, D., Sunjaya, D. K., Harahap, M. F. K. L., Rosdiana, I., & Cahyati, P. (2026). Psychometric Properties of the Indonesian Dialysis Thirst Inventory in Hemodialysis Patients: A Rasch Analysis. *Media of Health Research, 4*(2), 172-182. https://doi.org/10.70716/mohr.v4i2.484

Introduction

Thirst is one of the most prevalent and distressing symptoms in patients undergoing chronic hemodialysis, arising from strict fluid restrictions and impaired physiological fluid regulation. Uncontrolled thirst has been consistently associated with elevated interdialytic weight gain (IDWG), a clinical indicator of poor fluid adherence that significantly increases cardiovascular risk and long-

term morbidity in this population (Bossola et al., 2020). Moreover, thirst frequently co-occurs with xerostomia, further amplifying fluid intake between dialysis sessions and compounding the burden of fluid management (Teuwafeu et al., 2025). Given these consequences, systematic and accurate assessment of thirst is essential to support clinical monitoring, patient stratification, and the design of targeted symptom management interventions.

Thirst measurement in hemodialysis patients has evolved through several approaches. The Dialysis Thirst Inventory (DTI), originally developed by Bots et al. (2004), remains one of the few disease-specific instruments designed to assess thirst complaints across time periods and dialysis phases. In contrast, the Thirst Distress Scale (TDS) developed by Welch (2002) focuses primarily on the subjective distress component of thirst, including xerostomia. These instruments reflect an emerging recognition that thirst in hemodialysis is a multidimensional construct encompassing physical, perceptual, and psychosocial dimensions, and that no single generic scale can adequately capture this complexity (Cin et al., 2024).

Despite the availability of the original DTI, its adaptation and rigorous psychometric validation in the Indonesian context remain absent. Existing Indonesian studies on hemodialysis symptom burden have largely relied on generic quality-of-life instruments or single-item thirst questions, which lack the domain-specific sensitivity required for clinical decision-making (Fan et al., 2013). Furthermore, prior DTI validation studies were conducted in Western populations, where linguistic and cultural interpretations of thirst — particularly its social and behavioral consequences — may differ substantially from those of Indonesian patients (Beaton et al., 2000). This gap leaves clinicians and researchers in Indonesia without a validated, culturally appropriate tool for measuring thirst severity and its impact on hemodialysis outcomes.

Beyond the need for cultural adaptation, methodological limitations of Classical Test Theory (CTT) in instrument validation have become increasingly recognized. CTT-based approaches conflate item difficulty with sample characteristics, limiting the generalizability of psychometric estimates across different populations and clinical settings (Tennant & Conaghan, 2007). Rasch analysis, by contrast, provides sample-independent estimates of item difficulty and person ability, enables rigorous evaluation of unidimensionality, item fit, and rating scale functioning, and generates interval-level measurements suitable for parametric statistical analysis (Bond & Fox, 2012). Despite these advantages, Rasch-based validation of hemodialysis-specific thirst instruments remains rare in the Indonesian nursing and nephrology literature.

The selection of Rasch analysis in this study is motivated by three interrelated considerations. First, unlike Classical Test Theory (CTT) — which yields sample-dependent statistics and treats raw Likert scores as if they were interval-level — the Rasch model produces sample-independent item calibrations and transforms ordinal responses into interval-level logit measures, a prerequisite for valid parametric inference (Boone, 2016; Cabrero-García & Muñoz-Mendoza, 2024). Second, Rasch analysis allows simultaneous evaluation of properties that CTT cannot disentangle, including unidimensionality, item-person targeting, rating-scale category functioning, and differential item functioning (DIF) across subgroups (Penkofer et al., 2022). Third, in the context of cross-cultural adaptation, Rasch provides a stringent test of measurement invariance between the original and adapted instruments, which is essential before clinical use in a new population (Boone, 2016).

Accordingly, the present Rasch analysis pursued four explicit psychometric objectives: (1) to confirm that the seven DTI-ID items measure a single underlying construct of thirst experience; (2) to verify that each item contributes productively to measurement (acceptable infit/outfit MNSQ); (3) to determine the discriminative capacity of the instrument across thirst-severity strata via person separation; and (4) to detect any gender-related DIF that could bias clinical interpretation. The expected outcomes were a unidimensional, gender-equivalent, interval-scaled instrument capable of

stratifying Indonesian hemodialysis patients into ≥ 3 clinically meaningful thirst-severity levels — a stratification needed to individualize fluid-management interventions.

Therefore, this study aimed to evaluate the construct validity, reliability, and psychometric properties of the Indonesian version of the Dialysis Thirst Inventory (DTI-ID) using Rasch analysis, thereby providing a robust, culturally validated measurement tool for thirst assessment in Indonesian hemodialysis patients.

Materials and Methods

Study Design and Setting

This study employed a quantitative cross-sectional design, which is appropriate for evaluating psychometric properties of a measurement instrument at a single point in time without manipulating variables (Polit & Beck, 2008). Data were collected between May and June 2025 at two hemodialysis centers in West Java, Indonesia: RSUD Dr. Soekardjo Tasikmalaya and RS BLUD Kota Banjar. These sites were selected based on their patient volume and accessibility, ensuring a sufficiently large and heterogeneous sample for psychometric analysis.

Participants and Sampling

The study population comprised all patients receiving maintenance hemodialysis at both sites during the data collection period (N = 217). A purposive sampling method was used to ensure that participants met the predefined eligibility criteria for the construct being measured. The final sample consisted of 145 participants. For Rasch analysis, a minimum sample of 108 participants is recommended to achieve stable item calibration with 99% confidence and ±0.5 logit precision (Linacre, 1994); the present sample therefore exceeded this threshold. Inclusion criteria were: (1) age ≥ 18 years; (2) confirmed diagnosis of end-stage renal disease (ESRD); (3) duration of hemodialysis ≥ 6 months; (4) ability to understand and complete the DTI-ID independently or with minimal assistance; and (5) provision of written informed consent. Patients were excluded if they experienced acute clinical deterioration during dialysis, including decreased consciousness, hemodynamic instability, or respiratory distress, as these conditions would prevent valid questionnaire completion.

Instrument: Cross-Cultural Adaptation of the DTI

The instrument used in this study was the Indonesian version of the Dialysis Thirst Inventory (DTI-ID), adapted from the original seven-item English DTI developed by Bots et al. (2004). The DTI assesses three domains of thirst experience in hemodialysis patients: frequency of thirst, subjective perception of thirst, and the social impact of thirst on daily life. Each item is rated on a five-point Likert scale ranging from 1 (never) to 5 (always).

Cross-cultural adaptation followed the standardized five-stage protocol recommended by Beaton et al. (2000), comprising: (1) forward translation from English into Indonesian by two independent bilingual translators, one with a clinical background and one without; (2) synthesis of the two forward translations into a single reconciled version; (3) back-translation into English by two independent translators naive to the original instrument; (4) expert panel review for semantic, idiomatic, experiential, and conceptual equivalence, conducted by a committee comprising an English language specialist, two clinical hemodialysis nurses, an academic nephrology expert, and a psychologist; and (5) pre-testing of the pre-final version on a small patient group (n = 10) to assess comprehension and acceptability (Table 1). Content validity was evaluated by the expert panel using the Content Validity Index (CVI), with item-level CVI (I-CVI) ≥ 0.78 and scale-level CVI (S-CVI) ≥ 0.90 adopted as minimum thresholds (Polit & Beck, 2006). The resulting instrument, DTI-ID, was verified for conceptual equivalence with the original prior to full-scale data collection.

Table 1.
Original English and Indonesian versions of the Dialysis Thirst Inventory (DTI-ID)

Item Code	Original English Version (DTI)	Indonesian Version (DTI-ID)
DTI-1	Thirst is a problem for me	Rasa haus merupakan masalah bagi saya
DTI-2	I am thirsty during the day	Saya kehausan selama siang hari
DTI-3	I am thirsty during the night	Saya kehausan selama malam hari
DTI-4	My social life is influenced because of my thirst feelings	Interaksi saya dengan orang lain terpengaruh karena haus
DTI-5	I am thirsty before dialysis	Saya kehausan sebelum melakukan cuci darah
DTI-6	I am thirsty during dialysis	Saya kehausan selama melakukan cuci darah
DTI-7	I am thirsty after dialysis	Saya kehausan setelah melakukan cuci darah

Ethical Considerations

This study was conducted in full accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was granted by the Health Research Ethics Committee of Poltekkes Kemenkes Tasikmalaya (Reference No. DP.04.03/F.XVIII.20/KEPK/69/2025). Institutional research permissions were obtained from both study sites prior to data collection. All participants received written and verbal explanations of the study purpose, the voluntary nature of participation, data confidentiality, and their right to withdraw at any time without consequence. Written informed consent was obtained from all participants prior to enrollment. Data were anonymized and stored securely, accessible only to the research team.

Data Collection Procedure

Data collection was conducted by trained research nurses at each hemodialysis center. The DTI-ID was administered to eligible participants during their routine hemodialysis sessions, as symptom recall during dialysis reflects the instrument's intended measurement context (Bots et al., 2004). For participants who required assistance due to visual impairment or low literacy, the data collector read items aloud verbatim, without providing interpretive guidance, to minimize interviewer bias. Completed questionnaires were reviewed for missing responses immediately after administration; participants were asked to complete any unanswered items before leaving the session. Data were subsequently coded and entered into a structured spreadsheet for analysis.

Data Analysis: Rasch Modeling

Data were analyzed using the Rasch Rating Scale Model (RSM), implemented in Winsteps software version 5.6 (Linacre, 2023), which is appropriate for polytomous items with ordered response categories (Wright, 1982). The following psychometric parameters were evaluated:

Unidimensionality was assessed using Principal Component Analysis of Residuals (PCAR). A variance explained by Rasch measures of ≥ 50% and a first residual contrast eigenvalue of < 2.0 were adopted as criteria for an acceptable unidimensional structure (Linacre, 2023).

Item fit was evaluated using the infit and outfit mean-square (MNSQ) statistics. Items with MNSQ values between 0.5 and 1.5 were considered acceptable, with values between 0.5–0.7 indicating overfitting (less productive for measurement) and values > 1.5 indicating underfitting (degrading measurement) (Bond & Fox, 2012; Wright & Linacre, 1994).

Reliability and separation were assessed using person reliability and item reliability indices, analogous to Cronbach's alpha in classical test theory, with values ≥ 0.80 considered acceptable for group-level research purposes (Fisher, 1992). Person and item separation indices were computed to determine the number of statistically distinct strata discernible by the instrument.

Rating scale functioning was evaluated according to Linacre's (2002) criteria: (1) a minimum of 10 observations per category; (2) monotonically increasing average measures across categories; (3) outfit MNSQ < 2.0 for each category; and (4) step calibrations advancing by at least 1.4 logits between categories.

Differential Item Functioning (DIF) by gender was analyzed using the Mantel-Haenszel procedure within Winsteps. Items with a DIF contrast ≥ 0.5 logits and a probability value < 0.05 were considered to exhibit meaningful DIF (Linacre, 2023).

Results and Discussions

Participant Characteristics

A total of 145 hemodialysis patients participated in this study (response rate: 66.8%). The majority were male (n = 84, 57.9%), with a mean age of 52.3 years (SD = 11.7). The mean duration of hemodialysis was 34.6 months (SD = 28.1). All participants completed the DTI-ID in full, with no missing item responses recorded. The demographic profile of this sample is broadly consistent with the epidemiology of end-stage renal disease in Indonesia, where middle-aged male patients constitute the predominant hemodialysis population (Indonesian Renal Registry, 2023).

Unidimensionality

Principal Component Analysis of Residuals (PCAR) revealed that the Rasch measures explained 77.8% of total variance, with a first residual contrast eigenvalue of 1.6 and all subsequent unexplained contrasts below 10% (Figure 1). These values satisfactorily meet the criteria for unidimensionality proposed by Linacre (2023), which requires variance explained ≥ 50% and a first contrast eigenvalue < 2.0. The scree plot shows a steep decline from the first to the second factor, with subsequent factors contributing negligibly, confirming that the seven DTI-ID items collectively represent a single dominant latent construct — namely, the thirst experience of hemodialysis patients. This finding is theoretically coherent: although the DTI spans three domains (frequency, perception, and social impact of thirst), these domains appear empirically inseparable, consistent with the view that thirst in hemodialysis is an integrated biopsychosocial experience rather than a collection of independent symptoms (Bossola et al., 2020). Comparable unidimensionality values have been reported in Rasch-based validations of other nephrology-specific symptom instruments, including the Kidney Disease Quality of Life Short Form, in which Rasch measures explained 68–75% of the variance (Peipert et al., 2019).

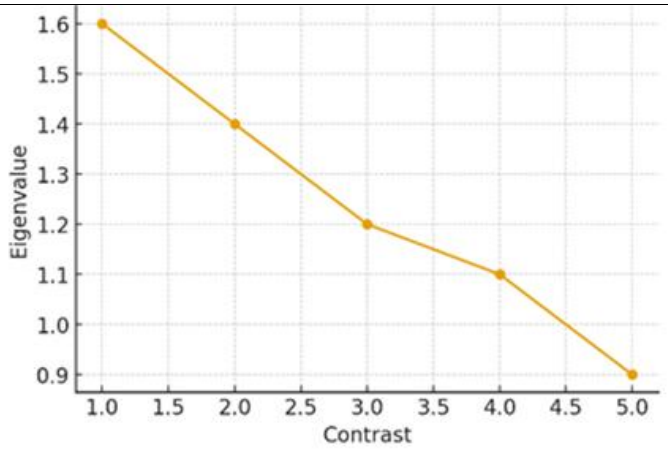

Figure 1. *Scree plot of eigenvalues from Principal Component Analysis of Residuals (PCAR) of the DTI-ID.*

Item Fit and Difficulty Hierarchy

All seven items demonstrated acceptable fit to the Rasch model, with infit and outfit MNSQ values ranging from 0.66 to 1.47 (mean outfit MNSQ = 0.98), as presented in Table 2. No item exceeded the critical threshold of 1.5, indicating that all items contributed productively to the measurement of thirst without introducing construct-irrelevant noise (Wright & Linacre, 1994). DTI-4 (social impact of thirst) and DTI-1 (thirst as a problem) showed the highest MNSQ values (1.47 and 1.39, respectively), suggesting slightly greater response variability on these psychosocial items. This pattern is consistent with findings from Sanabria-Arenas et al. (2017), who similarly observed that psychosocial items in hemodialysis patient surveys tend to yield more heterogeneous response patterns due to individual differences in coping capacity and social support structures — a phenomenon that reflects true construct complexity rather than item deficiency.

Table 2.
Item fit statistics and difficulty estimates of the DTI-ID based on Rasch analysis

Item	Item Description	Measure (Logit)	Infit MNSQ	Outfit MNSQ
DTI-4	Social impact of thirst	3.77	1.39	1.47
DTI-6	Thirst during dialysis	2.50	0.98	0.83
DTI-3	Thirst during the night	1.69	0.94	0.91
DTI-7	Thirst after dialysis	−1.23	0.86	0.79
DTI-1	Thirst is a problem	−1.73	1.26	1.39
DTI-5	Thirst before dialysis	−2.07	0.72	0.66
DTI-2	Thirst during the day	−2.92	0.78	0.78

Acceptable range: Infit/Outfit MNSQ 0.5–1.5 (Bond & Fox, 2012)

Item difficulty estimates span a logit range of −2.92 to 3.77, reflecting broad, well-distributed coverage of the thirst continuum. DTI-2 (daytime thirst) is the easiest item to endorse, indicating that virtually all patients with any level of thirst severity will affirm this experience — consistent with the chronic physiological fluid restriction central to hemodialysis management (Bossola et al., 2020). DTI-

4 (social impact) is the most difficult item, reflecting that significant social disruption due to thirst is experienced only by patients at the upper end of symptom severity. This item hierarchy is clinically interpretable and aligns with the multidimensional progression of thirst burden described in the literature, wherein physical symptoms typically precede psychosocial consequences (Cin et al., 2024). Notably, the difficulty spread of the DTI-ID (6.69 logits) is wider than that reported for the original Dutch DTI (approximately 4.5 logits; Bots et al., 2004), potentially reflecting the broader heterogeneity of thirst experience within the Indonesian sample, where variations in dietary practice, climate, and fluid management adherence may amplify symptom diversity.

Reliability, Separation, and Rating Scale Functioning

Table 3 presents the reliability and separation indices. Person reliability was 0.92 and item reliability was 0.99, both substantially exceeding the 0.80 threshold recommended for group-level research (Fisher, 1992). The person separation index of 3.42 indicates that the DTI-ID can discriminate approximately four statistically distinct levels of thirst severity among respondents — a clinically meaningful stratification that supports patient triage and individualized intervention planning. The item separation index of 12.91 confirms that the item difficulty hierarchy is highly stable and replicable across samples with different demographic or clinical profiles, a critical property for an instrument intended for use across diverse Indonesian hemodialysis settings.

Table 3.
Person and item reliability and separation indices of the DTI-ID based on Rasch analysis

Parameter	Real RMSE	True SD	Separation Index	Reliability
Item	0.19	2.40	12.91	0.99
Person	1.00	3.43	3.42	0.92

These reliability values compare favorably with those reported for the Thirst Distress Scale (TDS), which has demonstrated Cronbach's alpha values of 0.78–0.81 in hemodialysis populations (Cin et al., 2024). The superiority of the DTI-ID reliability indices reflects both the precision of Rasch-based estimation and the instrument's strong structural validity following cross-cultural adaptation. The five-point Likert rating scale functioned appropriately: all five categories were used, with ≥ 10 observations each; category measures increased monotonically; and step calibrations advanced in an ordered fashion, confirming that the response format is functioning as intended and that no category collapsing is necessary (Linacre, 2002).

Differential Item Functioning by Gender

DIF analysis revealed that five of seven items (DTI-1, DTI-2, DTI-3, DTI-5, DTI-7) showed no meaningful DIF by gender (DIF contrast < 0.5 logits, $p > 0.05$), indicating measurement equivalence for male and female patients on these items (Figure 2). DTI-6 (thirst during dialysis) demonstrated significant DIF (contrast > 0.5, $p < 0.05$), with male patients finding this item more difficult to endorse than female patients. DTI-1 (thirst as a problem) showed moderate DIF. These findings suggest that the experience of intra-dialytic thirst may be perceived differently across genders, potentially reflecting physiological differences in fluid regulation or differential tolerance of thirst-related discomfort between male and female patients — a pattern also observed by Cin et al. (2024), who reported gender as a significant moderator of thirst distress severity in hemodialysis populations. Several plausible mechanisms may explain the observed gender-related differences in DTI-6 (thirst during dialysis) and DTI-1 (thirst as a problem). Physiologically, estradiol lowers the osmotic threshold for arginine vasopressin (AVP) release and for thirst onset, while cyclical and life-stage fluctuations in estradiol and progesterone modify the operating set-point for body-fluid and tonicity

regulation (Stachenfeld, 2008; Stachenfeld & Taylor, 2014). Women, therefore, tend to perceive thirst at a lower plasma osmolality than men exposed to the same osmotic stimulus, which may translate into more frequent endorsement of intra-dialytic thirst items even at comparable ultrafiltration loads.

Structural and compositional differences also contribute. Men generally exhibit a higher total body water fraction, a larger lean-mass-to-fat-mass ratio, and different sodium-handling kinetics than women, which influence both the osmotic shifts experienced during ultrafiltration and the subjective perception of dryness (Bossola et al., 2020; Fernandes & Davenport, 2025). In maintenance hemodialysis cohorts, female patients have been reported to have a numerically higher overall symptom burden — including thirst, dry mouth, and headache — than male patients, even after adjustment for dialysis adequacy (Parsons et al., 2024; Shankar et al., 2024).

Beyond biology, sociocultural and behavioral factors may further widen the response gap on the affective item DTI-1 ("thirst is a problem"). Women on hemodialysis in low- and middle-income settings often carry greater domestic and caregiving responsibilities, which can amplify the perceived disruptiveness of a chronic symptom (Sex and gender differences in HRQoL on hemodialysis; Clin Kidney J, 2024). The convergence of neuroendocrine, compositional, and sociocultural determinants therefore offers a coherent explanation for the modest but consistent DIF observed in this study. Importantly, because the DIF contrasts did not exceed the threshold that compromises group-level validity, the DTI-ID retains its utility for population-level monitoring; however, clinicians applying the instrument for individualized assessment should interpret DTI-1 and DTI-6 with gender in mind. While these two items with DIF do not compromise the overall validity of the DTI-ID for group-level comparisons, gender-stratified scoring or interpretive caution is advisable when applying the instrument for individual clinical assessment.

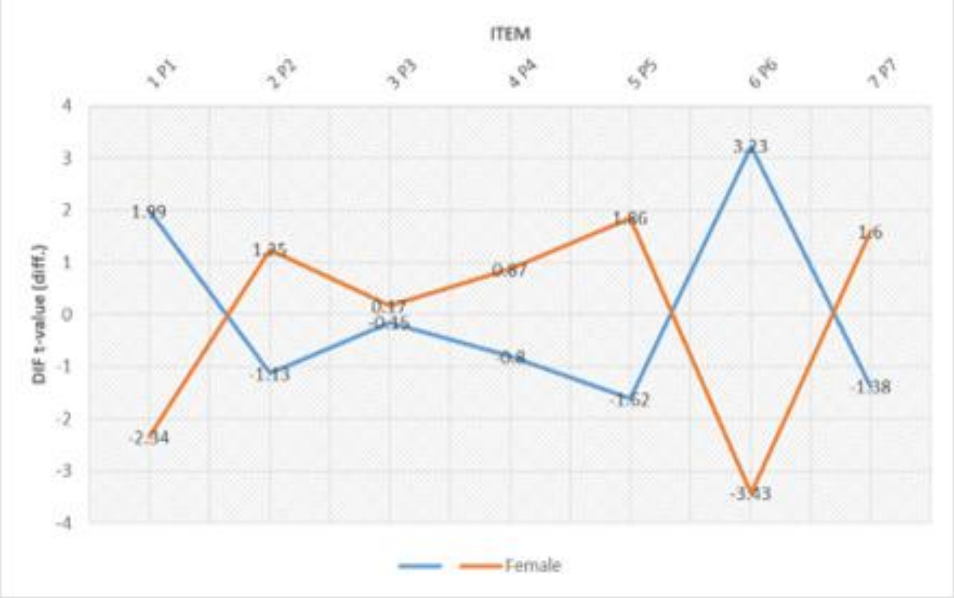

Figure 2. *Differential Item Functioning (DIF) plot of DTI-ID items by gender.*

Clinical Relevance and Implications for Practice

The validated DTI-ID addresses a critical measurement gap in Indonesian nephrology nursing practice. Prior to this study, clinicians lacked a disease-specific, psychometrically robust tool for quantifying thirst severity — a symptom that directly influences IDWG, fluid adherence, and cardiovascular risk in this population (Bossola et al., 2020; Cin et al., 2024). The four-level

discriminative capacity of the DTI-ID enables clinicians to stratify patients into meaningful severity tiers, supporting the prioritization of targeted interventions such as oral moisturizing strategies, behavioral fluid management coaching, and dietary sodium restriction for high-burden patients. Furthermore, the stable item hierarchy and high item reliability suggest that DTI-ID scores can serve as longitudinal outcome indicators to evaluate the effectiveness of such interventions across treatment cycles — a functionality that single-item thirst questions or generic quality-of-life scales cannot provide. Future research should examine the DTI-ID's responsiveness to clinical change over time and its utility for predicting IDWG and hospitalization outcomes in the Indonesian context.

Conclusion

This study addressed the absence of a psychometrically validated, culturally adapted thirst measurement instrument for Indonesian hemodialysis patients — a gap that has constrained evidence-based symptom management in Indonesian nephrology practice. Rasch analysis confirmed that the Indonesian version of the Dialysis Thirst Inventory (DTI-ID) meets rigorous psychometric standards: the instrument demonstrated strong unidimensionality (77.8% variance explained; first residual contrast eigenvalue = 1.6), acceptable item fit across all seven items (outfit MNSQ range: 0.66–1.47), high person reliability (0.92), and exceptional item reliability (0.99). The person separation index of 3.42 indicated that the DTI-ID can meaningfully discriminate four levels of thirst severity, supporting its application in both clinical stratification and intervention evaluation. Differential item functioning analysis revealed that two items showed gender-related response differences, a finding that warrants interpretive consideration in individual-level clinical use.

These results confirm that the DTI-ID is a valid, reliable, and culturally appropriate instrument for assessing thirst in Indonesian hemodialysis patients and is ready for integration into routine nephrology nursing practice and health program evaluation. Future studies should examine the responsiveness of the DTI-ID to clinical change across treatment cycles, investigate its predictive validity regarding interdialytic weight gain and hospitalization outcomes, and extend its validation to other chronic kidney disease populations beyond maintenance hemodialysis, such as peritoneal dialysis and predialysis patients. Cross-site validation across diverse Indonesian healthcare settings — including community health centers and regional hospitals — is also recommended to confirm the generalizability of the item difficulty hierarchy reported here.

Acknowledgments

The authors thank the hemodialysis patients of RSUD Dr. Soekardjo Tasikmalaya and RS BLUD Kota Banjar for their participation, and the nursing and clinical staff of both sites for facilitating data collection. This study was conducted as part of the Nursing Department's research program at Poltekkes Kemenkes Tasikmalaya. The authors declare no conflict of interest.

References

Beaton, D. E., Bombardier, C., Guillemin, F., & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine, 25*(24), 3186–3191. https://doi.org/10.1097/00007632-200012150-00014

Bond, T. G., & Fox, C. M. (2012). Applying the Rasch model: *Fundamental measurement in the human sciences* (2nd ed.). Routledge.

Boone, W. J. (2016). Rasch analysis for instrument development: Why, when, and how? CBE—Life Sciences Education, *15*(4), rm4. https://doi.org/10.1187/cbe.16-04-0148

Bossola, M., Calvani, R., Marzetti, E., Picca, A., & Antocicco, E. (2020). Thirst in patients on chronic hemodialysis: What do we know so far? *International Urology and Nephrology, 52*(4), 697–711. https://doi.org/10.1007/s11255-020-02401-5

Bots, C. P., Brand, H. S., Veerman, E. C. I., Valentijn-Benz, M., Van Amerongen, B. M., Valentijn, R. M., Vos, P. F., Bijlsma, J. A., Bezemer, P. D., Ter Wee, P. M., & Nieuw Amerongen, A. V. (2004). Interdialytic weight gain in patients on hemodialysis is associated with dry mouth and thirst. *Kidney International, 66*(4), 1662–1668. https://doi.org/10.1111/j.1523-1755.2004.00933.x

Cin, A., Demirağ, H., Daştan, B., & Hintistan, S. (2024). The relationship between thirst distress and severity and compliance with fluid control and interdialytic weight gain in hemodialysis patients. *Bezmialem Science, 13*(2), 129–139. https://doi.org/10.14235/bas.galenos.2024.04764

Fan, W. F., Zhang, Q., Luo, L. H., Niu, J. Y., & Gu, Y. (2013). Study on the clinical significance and related factors of thirst and xerostomia in maintenance hemodialysis patients. *Kidney and Blood Pressure Research, 37*(4–5), 464–474. https://doi.org/10.1159/000355717

Fernandes, V., & Davenport, A. (2025). Determinants of thirst in peritoneal dialysis patients. *Journal of the International Society for Peritoneal Dialysis, 46*(3), https://doi.org/10.1177/08968608251343766

Fisher Jr, W. P. (1992). Reliability statistics. Rasch measurement transactions. Chicago, *USA: MESA Press, 6*, 238.

Indonesian Renal Registry. (2023). 11th report of Indonesian Renal Registry. Indonesian Society of Nephrology.

Linacre, J. M. (1994). Sample size and item calibration stability. *Rasch Measurement Transactions, 7*(4), 328. Extrait de http://www. rasch. org/rmt/rmt74m. htm.

Linacre, J. M. (2002). Optimizing rating scale category effectiveness. *Journal of Applied Measurement, 3*(1), 85–106.

Linacre, J. M. (2023). Winsteps® Rasch measurement computer program (Version 5.6) [Computer software]. Winsteps.com.

Parsons, G., Liu, S., & Chang, T. I. (2024). In-center hemodialysis symptom burden: Differences between men and women. *Kidney Medicine, 6*(10), 100881. https://doi.org/10.1016/j.xkme.2024.100881

Peipert, J. D., Bentler, P. M., Klicko, K., & Hays, R. D. (2019). Psychometric properties of the Kidney Disease Quality of Life 36-item short-form survey (KDQOL-36) in the United States. *Mayo Clinic Proceedings, 94*(11), 2165–2178. https://doi.org/10.1016/j.mayocp.2019.04.034

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health, 29*(5), 489–497. https://doi.org/10.1002/nur.20147

Polit, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice*. Lippincott Williams & Wilkins.

Riehl-Tonn, V. J., MacRae, J. M., Dumanski, S. M., Elliott, M. J., Pannu, N., Schick-Makaroff, K., Drall, K., Norris, C., Nerenberg, K. A., Pilote, L., Behlouli, H., Gantar, T., & Ahmed, S. B. (2024). Sex and gender differences in health-related quality of life in individuals treated with incremental and conventional hemodialysis. *Clinical Kidney Journal, 17*(10), sfae273. https://doi.org/10.1093/ckj/sfae273

Sanabria-Arenas, M., Marín, J. T., Certuche-Quintana, M. C., & Sánchez-Pedraza, R. (2017). Validation of an instrument for measuring satisfaction of patients undergoing hemodialysis. *BMC Health Services Research*, *17*(1), 321. https://doi.org/10.1186/s12913-017-2251-y

Shankar, M., Sankarasubaiyan, S., Kasiviswanathan, S., Shah, K. D., & Luyckx, V. (2024). Gender disparity in hemodialysis practices and mortality: A nationwide cross-sectional observational study. *Indian Journal of Nephrology, 34*(6), 609–616. https://doi.org/10.25259/ijn_559_23

Stachenfeld, N. S. (2008). Sex hormone effects on body fluid regulation. *Exercise and Sport Sciences Reviews, 36*(3), 152–159. https://doi.org/10.1097/JES.0b013e31817be928

Stachenfeld, N. S., & Taylor, H. S. (2014). Challenges and methodology for testing young healthy women in physiological studies. *American Journal of Physiology-Endocrinology and Metabolism, 306*(8), E849–E853. https://doi.org/10.1152/ajpendo.00038.2014

Stolt, M., Kottorp, A., & Suhonen, R. (2022). The use and quality of reporting of Rasch analysis in nursing research: A methodological scoping review. *International Journal of Nursing Studies, 132*, 104244. https://doi.org/10.1016/j.ijnurstu.2022.104244

Tennant, A., & Conaghan, P. G. (2007). The Rasch measurement model in rheumatology: What is it and why use it? When should it be applied, and what should one look for in a Rasch paper? *Arthritis Care and Research, 57*(8), 1358–1362. https://doi.org/10.1002/art.23108

Teuwafeu, D. G., Fonyuy, V. F., Bandolo, N. V., Mahamat, M., Nkoke, C., Fouda Menye, H., & Halle, M. P. (2025). Prevalence and determinants of thirst distress amongst patients on maintenance haemodialysis. *BMC Nephrology*, *26*(1), 441. https://doi.org/10.1186/s12882-025-04369-9

Verdú-Soriano, J., & González-de la Torre, H. (2024). Rasch analysis implementation in nursing research: A methodological approach. *Enfermería Clínica (English Edition), 34*(6), 493–506. https://doi.org/10.1016/j.enfcle.2024.11.009

Welch, J. L., & Molzahn, A. E. (2002). Development of the thirst distress scale/commentary and response. *Nephrology Nursing Journal*, *29*(4), 337.

Wright, B. D., & Linacre, J. M. (1994). Reasonable mean-square fit values. *Rasch Measurement Transactions, 8*(3), 370.

Wright, B. D. (1982). Rating scale analysis. *Measurement, Evaluation, Statistics, and Assessment Press*.