

西南交通大学学报
**JOURNAL OF SOUTHWEST
JIAOTONG UNIVERSITY**

Journal homepage
<https://jsju.org>

第 61 卷 第 3 期
2026 年 6 月
Vol. 61 No. 3
June 2026

Research Article
Health Sciences

TRANSFORMATIONAL LEADERSHIP AMONG THAI NURSE PRACTITIONERS IN CKD CARE: CONFIRMATORY FACTOR ANALYSIS

泰国慢性肾脏病护理执业护士变革型领导力：验证性因素分析

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Manuscript Review Process:

Fast Track Status: No

Number of Reviewer Reports: 2

Number of Revision Rounds: 2

Received: April 18, 2026 | Reviewed: April 30, 2026 | Accepted: May 25, 2026 | Final Revised Submission:
May 29, 2026 | Published: June 30, 2026

Abstract:

The purpose of this article is to evaluate the measurement structure of transformational leadership among nurse practitioners providing chronic kidney disease care in primary healthcare settings in Thailand. The article describes a context-specific model based on the four established dimensions of transformational leadership and an additional teamwork dimension, enabling leadership behaviours relevant to coordinated care to be assessed. Using a cross-sectional survey of 516 nurse practitioners, stratified random sampling and second-order confirmatory factor analysis, the authors examined 17 prespecified indicator scores derived from an 80-item questionnaire. The initial model did not converge. A theoretically informed respecification produced acceptable fit to the sample data, with first-order standardised loadings from 0.714 to 0.921, higher-order loadings from 0.865 to 0.988, composite reliability from 0.881 to 0.915 and average variance extracted from 0.650 to 0.826. The findings provide provisional evidence that the respecified five-factor model represents transformational leadership within this sample. The study extends established leadership theory by treating teamwork as a context-specific addition rather than a canonical component. The model may support further research and exploratory leadership development in primary healthcare; however, independent cross-validation, transparent scoring procedures, discriminant-validity testing and measurement-invariance analysis are required before high-stakes assessment or service decisions.

Keywords: leadership; nursing; chronic kidney disease; healthcare; nephrology; Thailand

摘要： 本文旨在评估泰国初级卫生保健环境中参与慢性肾脏病护理的执业护士变革型领导力测量结构。文章构建了一个情境特定模型，该模型以变革型领导力的四个既有维度为基础，并增加团队合作维度，从而能够评估与协调护理相关的领导行为。研究采用横断面调查、分层随机抽样和二阶验证性因素分析，对 516 名执业护士填写的 80 项问卷所形成的 17 个预设指标得分进行了检验。初始模型未能收敛。经理论指导重新设定后，模型与样本数据达到了可接受的拟合水平；一阶标准化载荷为 0.714 至 0.921，高阶载荷为 0.865 至 0.988，组合信度为 0.881 至 0.915，平均方差提取量为 0.650 至 0.826。研究结果为重新设定的五因素模型能够表征本样本中的变革型领导力提供了初步证据。本研究将团队合作视为情境特定的扩展维度，而非经典理论的固有组成部分，从而补充了既有领导理论。该模型可用于后续研究及初级卫生保健领域的探索性领导力发展；然而，在将其用于高风险评估或卫生服务决策之前，仍需开展独立样本交叉验证，公开透明的计分程序，并进行区分效度和测量不变性检验。

关键词： 领导力；护理；卫生保健；肾脏病学；泰国

I. INTRODUCTION

Noncommunicable diseases remain a major source of morbidity and mortality worldwide and in Thailand [18,19]. Chronic kidney disease (CKD) affects more than one in ten adults globally and imposes sustained clinical and service burdens; rural communities in Northeast Thailand carry a substantial documented prevalence [1,2]. Predialysis care therefore emphasises early detection, risk-factor management and continuity of care [3]. Nurse practitioners in primary healthcare contribute to assessment, counselling, follow-up and coordination. Leadership may support those functions, but this measurement study did not test whether leadership changed CKD progression or patient outcomes.

Bass and Avolio's full-range framework describes transformational leadership through four related components: inspirational motivation, intellectual stimulation, idealised influence and individualised consideration [4]. These components concern shared purpose, critical thinking, ethical role modelling and attention to individual development. Comparative organisational research likewise indicates that the interpretation and application of leadership approaches depend on context [5]. Teamwork is not a canonical fifth component of the Bass–Avolio theory. In this study it was specified as a context-sensitive extension intended to capture relational coordination and communication in team-based primary healthcare. The resulting five-factor model should therefore be evaluated as an adapted operationalisation, not as an unmodified test of the original four-component theory.

Transformational leadership has been associated with nursing work environments, job satisfaction and some patient-related outcomes, although much of that evidence is observational and does not establish causality [12,17]. Thai studies have also examined leadership measurement and organisational performance [14–16]. Evidence remains limited, however, for the factorial structure of this specific adaptation among nurse practitioners involved in CKD care. Confirmatory factor analysis (CFA) can assess whether a prespecified measurement model is consistent with observed covariance data, but satisfactory fit alone cannot prove theoretical truth or external validity [6].

II. RESEARCH OBJECTIVE

The objective was to evaluate a prespecified second-order measurement model of transformational leadership

among nurse practitioners providing CKD-related care in primary healthcare settings. The model comprised the four Bass–Avolio dimensions and a context-specific teamwork factor.

III. METHODS

A. Design and Setting

An analytical cross-sectional study was conducted from April to May 2025 in Health Region 7, central Northeast Thailand, covering Roi Et, Khon Kaen, Maha Sarakham and Kalasin provinces. The design was appropriate for evaluating the covariance structure at one time point; it cannot establish temporal or causal relations.

B. Population and Sampling

The sampling frame was assembled from official workforce records obtained from the four Provincial Administrative Organisations. For facilities in Kalasin that remained under the Provincial Public Health Office, supplementary workforce records were obtained from that office. The combined frame contained 1,227 nurse practitioners. The target sample was informed by conventional CFA guidance on the ratio of observations to estimated parameters [7,8]. A total of 516 participants were selected by stratified random sampling by province. Province-specific allocation, the number invited, the response rate and non-response comparisons were not available in the supplied study record.

C. Instrument and Operationalisation

The structured questionnaire had three sections: 14 items on participant characteristics; an 80-item transformational-leadership section using a five-point Likert response scale and informed by Srisa-ard [9]; and two items on perceived competency-development needs. Expert review yielded a reported content-validity index of 0.95. Cronbach's alpha for the 80-item leadership section was 0.982. Because alpha increases with scale length and assumes a particular reliability model, it should not be treated as sufficient evidence of dimensionality or validity.

The reported CFA did not analyse 80 separate item responses. Instead, the analysis file represented the leadership section by 17 prespecified indicator scores: three for inspirational motivation, four for intellectual stimulation, four for idealised influence, four for individualised consideration and two for teamwork. The supplied materials did not preserve a complete item-to-indicator scoring key. The results below therefore evaluate

the 17-score representation and do not constitute item-level validation of all 80 questions. The demographic and competency-development sections were not included in the CFA.

D. Data Collection and Ethics

Eligible nurse practitioners were invited to complete an online questionnaire administered through Google Forms. Electronic informed consent preceded participation. Access to the study data was restricted to the researcher. The Human Research Ethics Committee of the College of Asian Scholars approved the study on 25 December 2024 (CASHE670043), and relevant administrative permissions were obtained.

E. Statistical Analysis

Pearson correlations were calculated among the 17 observed indicator scores. The Kaiser–Meyer–Olkin (KMO) statistic and Bartlett’s test of sphericity were reported as supplementary checks of factorability; neither statistic is a measure of CFA model fit. A second-order CFA was estimated by maximum likelihood in Mplus version 8.11 [10]. Fit was interpreted jointly using χ^2 , χ^2/df , the comparative fit index (CFI), Tucker–Lewis index (TLI), standardised root mean square residual (SRMR) and root mean square error of approximation (RMSEA), with conventional benchmarks used as guides rather than rigid decision rules [11].

The prespecified model did not converge. The final reported model was obtained after consulting modification indices and theoretical considerations; it allowed correlated first-order disturbances between inspirational motivation and intellectual stimulation, and between individualised consideration and teamwork. This is a post-hoc respecification and was not evaluated in an independent holdout sample. The supplied record did not report missing-data frequency or handling, multivariate-

normality diagnostics, estimator corrections, or a complete modification log; those aspects could not be independently assessed.

IV. RESULTS

A. Preliminary Diagnostics

All pairwise correlations among the 17 indicator scores were positive and statistically significant ($p < .001$), ranging from 0.438 to 0.821. The KMO statistic was 0.969; individual measures of sampling adequacy ranged from 0.942 to 0.984. Bartlett’s test was significant, $\chi^2(136) = 8,608.47$, $p < .001$. These statistics indicated substantial shared covariance but did not establish the proposed factor structure.

B. Measurement Model

In the respecified model, all 17 first-order standardised loadings were statistically significant and ranged from 0.714 to 0.921 (Table 1). The two teamwork indicators had the largest first-order loadings (0.896 and 0.921), whereas the innovation indicator of intellectual stimulation had the smallest (0.714). Indicator R^2 values ranged from 0.510 to 0.848. First-order composite reliability ranged from 0.881 to 0.915 and average variance extracted from 0.650 to 0.826, supporting convergent reliability within the fitted model. These indices do not test discriminant validity.

Second-order loadings ranged from 0.865 to 0.988. Idealised influence had the largest loading on the higher-order factor (0.988), followed by individualised consideration (0.960), intellectual stimulation (0.936), teamwork (0.917) and inspirational motivation (0.865). The very high second-order loadings and the added disturbance correlations may reflect strong common variance, but they may also indicate incomplete empirical separation among dimensions; alternative models were not reported.

Table 1.

Standardised confirmatory factor analysis results for the respecified transformational-leadership model

Latent construct	Indicator	β	SE	t	p	R^2	CR	AVE
First-order CFA								
Inspirational motivation (IM)	Trust and confidence (im1)	0.767	0.027	28.88	<.001	0.588	0.881	0.713
	Inspirational enhancement (im2)	0.888	0.014	61.87	<.001	0.789		
	Positive thinking (im3)	0.873	0.016	53.41	<.001	0.762		
Intellectual stimulation (IS)	Solving problems in new ways (is1)	0.846	0.017	50.99	<.001	0.716	0.881	0.650
	Creativity (is2)	0.830	0.018	45.65	<.001	0.689		
	Challenging assignments (is3)	0.829	0.017	47.49	<.001	0.688		
	Innovation (is4)	0.714	0.023	30.91	<.001	0.510		
Idealised influence (II)	Vision (ii1)	0.818	0.017	48.44	<.001	0.669	0.892	0.674
	Role modelling (ii2)	0.823	0.019	42.87	<.001	0.678		
	Adherence to principles (ii3)	0.843	0.015	54.59	<.001	0.710		
	Organisational engagement (ii4)	0.800	0.023	35.01	<.001	0.641		
Individualised consideration (IC)	Attention to the individual (ic1)	0.860	0.018	49.10	<.001	0.740	0.915	0.729
	Appropriate flexibility (ic2)	0.876	0.015	57.22	<.001	0.768		
	Individual advice (ic3)	0.878	0.015	60.20	<.001	0.771		
	Opportunity to utilise capabilities (ic4)	0.800	0.022	36.02	<.001	0.640		
Teamwork (TW)	Relationships and coordination (tw1)	0.921	0.013	73.64	<.001	0.848	0.904	0.826

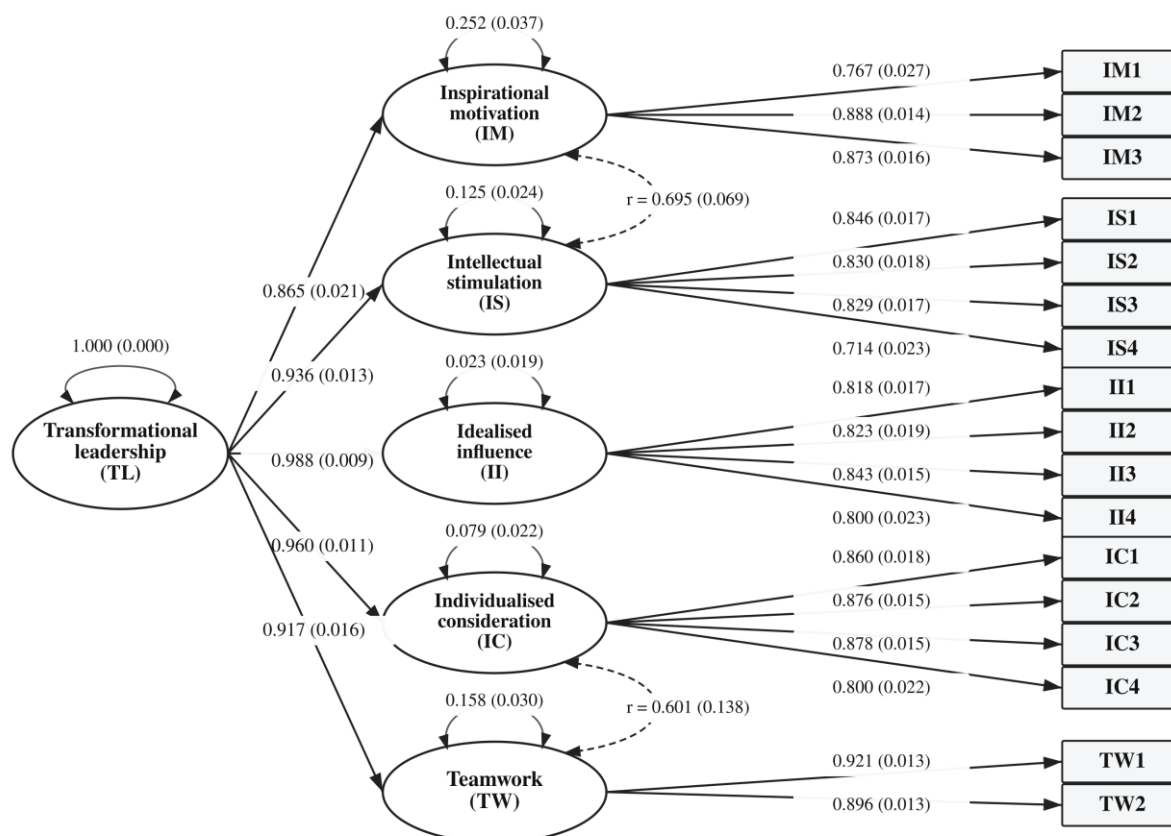
Latent construct	Indicator	β	SE	t	p	R ²	CR	AVE
	Effective communication (tw2)	0.896	0.013	67.83	<.001	0.803		
Second-order CFA								
Transformational leadership (TL)	IM → TL	0.865	0.021	40.72	<.001	0.748	0.972	0.873
	IS → TL	0.936	0.013	71.69	<.001	0.875		
	II → TL	0.988	0.009	104.50	<.001	0.977		
	IC → TL	0.960	0.011	84.23	<.001	0.921		
	TW → TL	0.917	0.016	55.87	<.001	0.842		

Note: $N = 516$. β = standardised factor loading; SE = standard error; R² = squared multiple correlation; CR = composite reliability; AVE = average variance extracted. CR and AVE are reported once per construct. All loadings $p < .001$.

Table 2.
Model-fit indices before and after respecification

Fit index	Reference criterion	Initial model	Respecified model
χ^2	$p > .05$	Not converged	195.46
df	—	Not converged	100
χ^2/df	< 3.00	—	1.95
CFI	≥ 0.95	—	0.985
TLI	≥ 0.95	—	0.979
SRMR	≤ 0.08	—	0.027
RMSEA (90% CI)	≤ 0.06	—	0.043 (0.034–0.052)

Note: CFI = comparative fit index; TLI = Tucker–Lewis index; SRMR = standardised root mean square residual; RMSEA = root mean square error of approximation; CI = confidence interval. Criteria are interpretive guides. The initial model did not yield a proper converged solution.



Values are standardised estimates; standard errors are shown in parentheses.

Loops denote factor variances; dashed double-headed paths denote correlated first-order disturbances.

$N = 516$

Figure 1.
Respecified second-order confirmatory factor model

The respecified model fitted the observed covariance data, $\chi^2(100) = 195.46$, $p < .001$, $\chi^2/df = 1.95$, CFI = 0.985, TLI = 0.979, SRMR = 0.027 and RMSEA = 0.043 (90% CI 0.034–0.052) (Table 2). The significant χ^2 is unsurprising at $N = 516$, but the other indices were within conventional ranges. Because the same sample informed and evaluated the respecification, these results provide provisional within-sample support rather than an independent confirmation of the modified structure.

V. DISCUSSION

The findings support a respecified hierarchical representation of the 17 indicator scores in this sample. They do not show that the original prespecified model was confirmed: that model did not converge, and the acceptable solution required two added disturbance correlations. The distinction is material because modifications chosen after inspecting the data can improve apparent fit through sample-specific accommodation. Replication should therefore begin with the final specification reported here and test it without further data-driven changes.

At the second-order level, idealised influence was the strongest marker of the common leadership factor. At the first-order level, the two teamwork indicators had the largest loadings. These are different statements and should not be conflated. The high second-order loadings indicate a strong common factor, but they also raise the possibility that respondents did not sharply distinguish some leadership dimensions. The model's convergent reliability was adequate; discriminant validity, competing-factor structures and common-method effects were not evaluated.

Teamwork may be practically relevant in primary healthcare, where CKD services involve coordination across practitioners, patients, caregivers and community services [3]. A Thai study associated depression, comorbidity and caregiver support with quality of life among patients with predialysis CKD [13]; this motivates attention to coordinated support but does not demonstrate an effect of leadership. Related Thai research has included collaborative action in context-specific leadership models [14], and prior Thai work has examined transformational leadership measurement and organisational performance [15,16]. Nevertheless, teamwork remains an adaptation to the Bass–Avolio framework rather than one of its four classical dimensions [4]. Future reports should justify this extension explicitly and compare the five-factor model with theoretically plausible alternatives, including the canonical four-factor model and models that treat teamwork as an outcome or correlate of leadership.

Systematic and integrative reviews associate transformational leadership with nursing work environments, job satisfaction and patient-related outcomes [12,17]. Those reviews do not make the present cross-sectional measurement data evidence that leadership improves CKD outcomes. The study measured self-reported leadership indicators, not patient status, care quality, service continuity or team performance. Any clinical or policy implication should therefore be framed as a hypothesis for subsequent longitudinal or intervention research.

VI. CONCLUSION

Among 516 nurse practitioners in Health Region 7, a respecified second-order CFA model comprising the four canonical transformational-leadership dimensions and a context-specific teamwork factor fitted the reported 17 indicator scores. The original specification did not converge, and the final model was not cross-validated. The evidence therefore supports provisional use of the respecified structure for further research, not definitive validation of the full 80-item questionnaire or immediate use in high-stakes workforce decisions.

VII. IMPLICATIONS AND FUTURE RESEARCH

Subsequent studies should publish the complete 80-item instrument and scoring key, preregister the measurement specification, report missing-data and distributional diagnostics, and evaluate the model in an independent sample. Comparisons with alternative factor structures, item-level modelling where appropriate, discriminant-validity assessment and measurement-invariance tests across provinces and professional subgroups are needed. Longitudinal or intervention designs should separately test whether measured leadership predicts team processes, care continuity, quality indicators or patient outcomes. Because nurse-practitioner role development can also depend on role clarity, stakeholder perceptions and organisational barriers [20], leadership development should complement rather than replace adequate scope definition, staffing and institutional support. Until then, the scale may inform exploratory professional-development research but should not determine employment appraisal, credentialing or service policy.

VIII. LIMITATIONS

The cross-sectional, self-report design is vulnerable to common-method and response biases and cannot establish temporality or causality. The sample was confined to one Thai health region, and province-level response information was unavailable, limiting assessment of selection and non-response bias. The initial model failed to converge, while the final specification was modified and evaluated in the same sample. The item-to-indicator scoring key, missing-data procedures, multivariate-normality diagnostics and full respecification log were unavailable. The reported evidence addresses convergent reliability but not discriminant validity, measurement invariance, predictive validity or clinical outcomes. These limitations constrain generalisability and operational use.

ACKNOWLEDGEMENTS

The authors thank Professor Krasae Chanawongse, the Faculty of Nursing and the College of Asian Scholars for institutional support. They also thank the academic advisers, the experts who reviewed the research instrument and the nurse practitioners who participated in the study.

DECLARATIONS

A. Author Contributions

Suwakon Kurata and Chulaporn Sota conceived and designed the study. Suwakon Kurata analysed the data and drafted the manuscript. Chulaporn Sota, Chanaphol

Sriruecha and Kissadapan Pongboriboon provided supervision, critical revision and project resources. All five authors contributed to data collection, reviewed and approved the final manuscript, and accept responsibility for the work.

B. Funding

The College of Asian Scholars provided institutional and financial support. No grant number was reported.

C. Ethics Approval and Consent to Participate

The Human Research Ethics Committee of the College of Asian Scholars approved the study on 25 December 2024 (CASHE670043). All participants provided electronic informed consent; participation was voluntary, and confidentiality and anonymity were maintained.

D. Data Availability

The data are available from the corresponding author on reasonable request, subject to ethics approval and applicable confidentiality restrictions.

E. Conflicts of Interest

The authors declare no conflicts of interest.

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