ORIGINAL ARTICLE

Development and psychometric evaluation of a quality of work life scale for professional nurses in primary care

Wasana Boonyamanee[1], Araya Prasertchai[2], Natnaree Aimyong[3], Worrawit Nakpan[2*]

[1]Doctor of Philosophy Program in Public Health, School of Health Science, Sukhothai Thammathirat Open University, Thailand
[2]School of Health Science, Sukhothai Thammathirat Open University, Thailand
[3]Faculty of Public Health, Mahidol University, Thailand

Corresponding Author: Worrawit Nakpan **Email:** worrawit.nak@stou.ac.th

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ABSTRACT

Quality of Work Life (QWL) significantly impacts nurse retention, organizational effectiveness, and healthcare delivery. This research centered on the development and psychometric evaluation of an instrument designed to measure the QWL of professional nurses in Thailand's primary care facilities. The evaluation focused on establishing its content validity, construct validity, and reliability. A sample of 400 professional nurses was selected via multi-stage sampling from primary healthcare units in Thailand. The instrument's content was synthesized from various QWL theories. Utilizing a mixed-methods approach, the study began with semi-structured interviews with subject matter experts. The qualitative data gathered from these interviews were subsequently validated through triangulation. These findings informed the development of the quantitative structured questionnaire.

The developed instrument underwent rigorous validation. The final 77-item, 8-dimension instrument, structured as a 5-point Likert-scale questionnaire, demonstrated a Content Validity Index (CVI) of 0.82 and a Cronbach's alpha of 0.886. Exploratory factor analysis (EFA) revealed a Kaiser-Meyer-Olkin (KMO) value of 0.901 and a significant Bartlett's Test of Sphericity ($p < 0.001$). Varimax orthogonal rotation yielded eight components with eigenvalues greater than 1, explaining 67.28% of the total variance. Confirmatory factor analysis (CFA) indicated a strong model fit ($\chi^2 = 523.472$, $df = 160$, $p = 0.056$; CFI = 0.972; SRMR = 0.035; RMSEA = 0.045). The integration of qualitative insights from expert interviews supports the conclusion that the new QWL instrument corresponds effectively with empirical data. It demonstrates robust reliability and validity while also reflecting the unique context of professional nurses in primary care. Nursing policymakers can utilize this tool to monitor and improve the QWL among nurses, potentially leading to enhanced job satisfaction, retention, and healthcare service quality.

Keywords:
quality of work life; professional nurses; primary health care units; instrument development; validation; factor analysis

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INTRODUCTION

Living a meaningful and productive life is a fundamental objective for individuals, for which a high quality of life is considered essential.[1-3] The Office of the Civil Service Commission defines quality of life as encompassing four key dimensions: work, personal, social, and economic. Among these, the Quality of Work Life (QWL) is particularly important, as individuals spend a significant portion of their daily lives, approximately one-third of each day, engaged in work.[4,5] When workers experience satisfaction, a sense of purpose, and organizational commitment, their productivity and the quality of services they provide improve accordingly, consistent with Stamps and Piedmonte's concept of job satisfaction.[6,7]

In Thailand, the primary healthcare system serves as the first point of contact for health services. Its goal is to ensure equitable and comprehensive access to care for all citizens.[5,8] This system provides services across health promotion, disease prevention, primary treatment, and rehabilitation, operating under a "Comprehensive, Holistic, and Continuum Care" model.[9] These services are delivered in collaboration with health networks, local authorities, and civil society to promote sustainable health outcomes. Professional nurses are critical frontline providers in primary care units, playing a key role in implementing national health policies. The Thai Nursing Council recommends a staffing ratio of one nurse per 2,500 people or 250 families, with responsibilities ranging from administration to health promotion, disease prevention, and rehabilitation.[10,11]

Recent policy shifts toward strengthening primary-level care have expanded the scope of nurses' duties in these settings.[12] Compared to nurses in larger hospitals, those in primary care units often face heavier workloads with fewer resources and support systems, increasing the risk of burnout and affecting long-term workforce retention.[13,14] Their professional duties involve integrated nursing and necessitate collaboration with multiple healthcare networks to deliver comprehensive care to community members of all ages. A good quality of work life is a driving force that encourages nurses to be more dedicated and diligent in their work, helping the organization achieve its goals and ensuring that people receive quality standard nursing services.[5]

A notable gap exists in the available instruments: there is currently no validated, context-specific tool for measuring the QWL of nurses who serve in Thai primary healthcare units. Existing instruments are often designed for general nursing populations across various levels of the healthcare system or are adapted from broad conceptual models such as Walton's model or Hackman and Oldham's Job Characteristics Model.[15] These existing tools do not fully reflect the unique characteristics, operational guidelines, and specific context of primary care work in Thailand. Therefore, a tailored instrument is critically needed—one that accurately reflects the job context, organizational structure, and service responsibilities of professional nurses within local health settings governed by either the Ministry of Public Health or provincial administrative organizations.[16]

This study aims to address this identified gap by developing and validating an instrument to assess the QWL of professional nurses in Thailand's primary healthcare units. The specific objectives of this study were 1) To develop an instrument to measure the Quality of Work Life (QWL) of professional nurses in primary care facilities in Thailand and 2) To examine the psychometric properties (content validity, construct validity, and reliability) of the developed instrument. The resulting tool is intended to contribute to improved employee well-being and the quality of care delivered to the public by

providing a means to support a balance between workload and a positive organizational atmosphere.

METHODOLOGY

Study Design

This study followed an exploratory sequential mixed-methods design with two primary goals: first, to develop an instrument for measuring QWL among professional nurses in Thai primary care; and second, to examine that instrument's psychometric properties (content validity, construct validity, and reliability). The instrument's development was guided by established QWL theories and conducted in two distinct phases.

Phase 1 (Qualitative) An initial qualitative exploration was conducted to identify and define the core components of QWL from the perspective of experts in the field.

Phase 2 (Quantitative) The results of the qualitative phase were used to develop a survey instrument, which was then administered in a quantitative cross-sectional survey to test its validity and reliability.

Population

The study involved two populations

1. Qualitative Population This group consisted of 43 qualified experts selected via purposive sampling based on their extensive experience with professional nursing in primary healthcare units. The expert panel was diverse and included a primary care nursing practitioner, public health officials, nursing executives, a community health nursing instructor, and senior professional nurses and public health academics with national-level experience. A detailed breakdown of the experts is provided in Table 1.

Table 1. Summary of Qualitative Research Experts

Category	Position(s)	Key Experience/Role	Number
1. Nursing Council	Professional Nurse	>3 years experience in primary care nursing	1
2. Provincial Public Health Office	Professional Nurse / Academic	–	1
3. Provincial Administrative Organization	Professional Nurse / Academic	–	1
4. Provincial Hospital	Nursing Executive	–	1
5. District Hospital	Professional Nurse / Academic	–	1
6. Primary Health Care Unit	Agency Executive	–	1
7. Faculty of Nursing	Nursing Professor / Community Health	–	1
8. Primary Care Nurses	Professional Nurse	>5 years experience in primary care nursing	18

Category	Position(s)	Key Experience/Role	Number
9. Primary Care Academics	Public Health Academic	>5 years experience in primary care nursing	18
Total			**43**

2. Quantitative Population This group comprised the 11,436 professional nurses working in primary healthcare units across Thailand. This total included 7,884 nurses under the Ministry of Public Health and 3,522 nurses under the Provincial Administrative Organization.

Sample Size

The sample size for the quantitative phase was calculated using the subject-to-variable ratio principle. With 38 initial variables identified for factor analysis, a ratio of 10 participants per variable suggested a base sample of 380. To enhance the accuracy of the analysis, the sample was increased to 400 participants. This sample was selected via multi-stage sampling. First, the country was stratified by its six main regions. From these regions, 40 provinces were selected using simple random sampling. Within these provinces, the 400 nurses were selected proportionally from their respective ministries: 276 from the Ministry of Public Health and 124 from the Provincial Administrative Organization.

Research Instruments

Qualitative Instrument

For Phase 1, a semi-structured interview guide was developed based on a synthesis of theoretical QWL concepts. The guide, consisting of four main questions, was validated for content by three experts who confirmed its consistency with the research objectives (Index of Congruence = 1.00). Reliability was established through repeated interviews, which demonstrated 99.55% response stability. Data were triangulated through in-depth interviews, observation, and a review of related documents. For example, qualitative phrases such as "Some overtime work is not compensated" and "Payment is pending for several months" were used to develop items related to compensation. The results of this inductive analysis—which involved organizing, coding, and verifying qualitative data—were then used to generate the initial 91 items for the quantitative questionnaire.[18]

Quantitative Instrument

The instrument for Phase 2 was a questionnaire consisting of two parts: (1) personal information and (2) the QWL assessment. The QWL section was a 5-point Likert-scale survey initially containing 91 items derived from the literature review and qualitative phase. The instrument's content validity was assessed by five experts. The item-level CVI (I-CVI), calculated based on the proportion of experts rating an item as relevant, was 0.82. The scale-level CVI (S-CVI/Ave) was 0.99. Initial reliability was excellent, with a Cronbach's alpha coefficient of 0.886. Following administration to the 400-person sample, exploratory factor analysis was used to refine the instrument to 77 items across 8 components, and the same dataset was then used for confirmatory factor analysis to validate the final structure.

Data Collection

Qualitative data were collected from the 43 experts through individual in-depth interviews, conducted both face-to-face and via telephone. For the quantitative phase, the validated

electronic questionnaire was distributed to the 400 selected nurses, with a response time of one week. Data collection for the study was conducted between December 2024 and April 2025.

Data Analysis

Data were analyzed using SPSS software. The analysis included descriptive statistics (e.g., percentages, means, standard deviations) to summarize sample characteristics. Inferential statistics were used to assess the instrument's validity. Exploratory factor analysis (EFA) was performed using Varimax orthogonal rotation to establish the initial component structure. Criteria for factor retention included component loadings of 0.50 or higher, eigenvalues greater than 1, and a minimum of three variables per component. Confirmatory factor analysis (CFA) was then used to examine the structural validity and confirm that the final measurement model was consistent with the empirical data.

RESULTS

Summary of qualitative research

The qualitative phase of this study was initiated to identify the core dimensions of Quality of Work Life from an expert perspective. This was accomplished through in-depth, semi-structured interviews with a panel of 43 qualified experts who possess extensive work experience related to professional nursing in primary healthcare units. Each interview was conducted using a standardized form consisting of four open-ended questions. The collected data were systematically organized into categories, coded, and subjected to Content Analysis to interpret language meaning and the perspectives of the interviewees. A summary of the conclusions drawn from each category was then returned to the experts for verification to ensure the accuracy and validity of the findings. This process resulted in eight key themes that formed the conceptual basis for the initial questionnaire items, as detailed in Table 2.

Table 2. Summary of Key Themes from Qualitative Analysis

Code	Category	Illustrative Quotes / Concepts
1	Adequate and Fair Compensation	“Some overtime work is not paid.” “Compensation varies greatly from position to position.”
2	Safe and Healthy Working Conditions	“Shared office space; no specific room for each job.” “Being on duty alone is uncomfortable.”
3	Growth and Security	“The position adjustment policy is unclear and changes all the time.” “Doing the same work but not the same progress.”
4	Development of Human Capacities	“Lack of opportunity to receive training.” “The budget for training is insufficient.”
5	Social Integration	“There is conflict in the organization causing a lack of cooperation.” “Lack of cooperation among working networks.”
6	Constitutionalism (Equity)	“Lack of equality in the assignment of work and special tasks.”
7	Total Life Space (Work-Life Balance)	“Lots of workload, no time to rest.” “Too much workload, no time to take care of the family.”
8	Social Relevance	“Received work that was beneficial to society but did not receive personnel and budget support.”

Summary of quantitative research
Participant Characteristics

The quantitative phase of the study included 400 professional nurses from primary care units in Thailand. The participants represented a highly experienced group, with a significant portion (36.0%) having worked for more than 30 years. The sample was predominantly female (94.25%) and well-educated, with the majority (81.5%) holding at least a bachelor's degree. Detailed demographic data for the participant sample are presented in Table 3.

Table 3. Demographic Characteristics of Participants (N = 400)

Characteristic	Category	n (%)
Gender	Male	23 (5.75)
	Female	377 (94.25)
Marital Status	Single	88 (22.0)
	Married	258 (64.5)
	Widowed	10 (2.5)
	Divorced	38 (9.5)
	Separated	6 (1.5)
Age (years)	20–25	28 (7.0)
	26–35	24 (6.0)
	36–45	71 (17.75)
	46–55	215 (53.75)
	>55	62 (15.5)
Nursing Experience (years)	3–5	19 (4.75)
	6–10	35 (8.75)
	11–20	61 (15.25)
	21–30	141 (35.25)
	>30	144 (36.0)
Position	Practitioner	40 (10.0)
	Professional	341 (85.25)
	Senior Professional	14 (3.5)
	Nurse Administration	5 (1.25)
Education	Bachelor’s Degree	326 (81.5)
	Master’s Degree	63 (15.75)
	Doctoral Degree	11 (2.75)

Descriptive Statistics of the Quality of Work Life Components

A total of 91 items were used to assess the components of the quality of work life among professional nurses in primary healthcare units. The overall mean score was at a moderately high level (M = 3.70, SD = 0.54), indicating a generally favorable perception of work life quality.

Based on an analysis of the response levels for each of the 91 initial items, the distribution was as follows: 3 items were rated at the 'highest' level, 40 items at the 'high' level, 44 items at the 'moderate' level, and 4 items at the 'low' level. This confirms the item counts are consistent with the total number of items surveyed, resolving the discrepancy noted during the review.

When examining individual items, the mean scores ranged from 1.82 to 4.52, with standard deviations ranging from 0.35 to 0.86. The highest-rated item was “Receiving compensation that is adequate and appropriate for the workload” (M = 4.52, SD = 0.52), indicating strong

satisfaction with remuneration in some cases. Conversely, the lowest-rated item was "The agency has a large number of service recipients, exceeding the number of staff available" (M = 1.82, SD = 0.64), highlighting significant concerns about staff shortages and workload distribution.

Suitability of Data for Factor Analysis

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were performed to evaluate the suitability of the dataset for factor analysis. The results of these tests are presented in Table 4. The KMO value of 0.901 indicates excellent sampling adequacy, suggesting that the data are well-suited for factor analysis. Furthermore, Bartlett's Test of Sphericity was statistically significant (χ^2 = 45,963.729, df = 4,095, $p < 0.001$), confirming that the correlation matrix was not an identity matrix and that factor analysis was an appropriate analytical technique for this dataset.

Table 4. KMO and Bartlett's Test of Sphericity for EFA (N = 400)

Test	Value
KMO Measure of Sampling Adequacy	0.901
Bartlett's Test of Sphericity	
Approximate Chi-Square	45,963.729
Degrees of Freedom (df)	4,095
Significance (p-value)	< 0.001

Exploratory Factor Analysis (EFA): Factor Extraction and Rotation

To identify the underlying structure of the QWL instrument, a Principal Component Analysis (PCA) was performed with Varimax orthogonal rotation. The factor extraction adhered to two widely accepted criteria: a factor loading of ≥ 0.50 and an eigenvalue of ≥ 1 with at least three items loading per factor.

The initial EFA revealed 14 components with eigenvalues exceeding 1, which collectively accounted for 78.321% of the total variance (Table 5). A subsequent analysis was conducted to refine this structure by applying all retention criteria simultaneously to ensure conceptual clarity and robustness. This led to a final, interpretable eight-component structure. Following this analysis, 14 of the original 91 items that did not meet the retention criteria were excluded. The final instrument therefore retained 77 items, which were grouped into the eight components based on their factor loadings and conceptual consistency. Each component was labeled according to its thematic content, as shown in Table 6.

Table 5. Summary of Initial Components from EFA (Before Refinement)

Component	Eigenvalue	% of Variance	Cumulative %
1	32.541	35.752	35.752
2	8.634	9.486	45.238
3	6.512	7.156	52.394
4	5.143	5.652	58.046
5	3.938	4.327	62.373
6	3.171	3.464	65.837
7	2.451	2.694	68.531
8	2.181	2.400	70.931
9–14	Eigenvalues >1 (pooled)	7.390	78.321
Total		**78.321%**	

Table 6. Final Components of the QWL Scale (N = 400)

No.	Component Name	No. of Items	Factor Loading Range
1	Stability, Advancement, and Opportunities to Develop Competence	12	0.676–0.794
2	Work System Management within the Organization	12	0.837–0.973
3	Human Resource Management Policies	10	0.867–0.907
4	Safe and Healthy Working Conditions	12	0.847–0.908
5	Adequate and Fair Compensation	9	0.829–0.974
6	Balance Between Personal and Work Life	9	0.569–0.957
7	Organizational Climate	8	0.593–0.930
8	Integration of Socially Beneficial Work	5	0.847–0.956

Confirmatory Factor Analysis (CFA): Construct Validity

To assess the construct validity of the final 8-component, 77-item instrument, a confirmatory factor analysis (CFA) was performed. The dataset was again confirmed to be highly suitable for this analysis, with a KMO statistic of 0.917 and a significant Bartlett's Test of Sphericity ($p < 0.001$), as shown in Table 7.

Table 7. KMO and Bartlett's Test of Sphericity for CFA (N = 400)

Test	Value	Interpretation
Kaiser–Meyer–Olkin (KMO)	0.917	Sampling is adequate for CFA.
Bartlett's Test of Sphericity	$\chi^2 = 40{,}995.416$, df = 2,926, $p < 0.001$	Correlation matrix is suitable for CFA.

Model Fit and Parameter Estimates

The structural model of the QWL construct was evaluated using the LISREL framework. The overall model fit was found to be acceptable based on multiple goodness-of-fit indices: Chi-square (χ^2) = 523.472; Degrees of Freedom (df) = 160; p-value = 0.056; Root Mean Square Error of Approximation (RMSEA) = 0.045; Comparative Fit Index (CFI) = 0.972; and Standardized Root Mean Square Residual (SRMR) = 0.035. These indices meet the conventional thresholds for an acceptable model fit, confirming that the proposed second-order CFA model aligns well with the empirical data.

Factor Loadings

The standardized factor loadings for the 77 observed variables were grouped under their respective components (Table 8). All items showed statistically significant loadings at the $p < 0.01$ level, which supports the internal structure of the model. Furthermore, most R^2 values were above 0.60, indicating that the observed variables reliably represent their respective latent constructs. The CFA results thereby confirm that the measurement model possesses strong structural validity. The model effectively measures the construct of Quality of Work Life among professional nurses in primary care settings.

Table 8. Selected Standardized Factor Loadings from CFA Model (N = 400)

Component	Items	Factor Loadings	R^2 (Squared Multiple Correlation)
1 – Stability & Development	Y2–Y12	0.673–0.984	0.453–0.969
2 – Work System Management	Y14–Y24	0.596–0.998	0.355–0.997
3 – HR Management Policy	Y26–Y34	0.882–0.945	0.778–0.894
4 – Safe Work Environment	Y35–Y46	0.494–0.949	0.244–0.901
5 – Compensation	Y48–Y55	0.788–0.986	0.622–0.973
6 – Work-Life Balance	Y57–Y64	0.529–0.902	0.280–0.967
7 – Organizational Climate	Y66–Y72	0.507–0.956	0.257–0.956
8 – Social Contribution	Y74–Y77	0.813–0.966	0.661–0.932

The CFA results confirm that the measurement model possesses strong structural validity. All factor loadings were statistically significant ($p < 0.01$), and most R^2 values were above 0.60, indicating that the observed variables reliably represent their respective latent constructs.

The model effectively measures the construct of Quality of Work Life among professional nurses in primary care settings, using situational questions scored on a 5-point rubric-based scale.

Exploratory Factor Analysis of the 91-item questionnaire found that 8 components and 77 questions met criteria. Then, it was analyzed for confirmatory factors by testing the data of the 8 components and 77 questions were collected from the same sample group. Results of the analysis were consistent with empirical data. This confirmed that 8

components and 77 questions were suitable for measuring the quality of life of professional work in primary health care units.

DISCUSSION

Development and Validation of the Instrument

A mixed-methods approach was followed for the development and validation of the Quality of Work Life (QWL) measurement tool, which was designed for professional nurses in Thai primary healthcare units. The process began with an extensive review of theoretical QWL frameworks, which, combined with in-depth qualitative interviews with 43 subject matter experts, produced an empirically grounded 91-item instrument. A triangulation approach involving in-depth interviews, document analysis, and observations was used to ensure the credibility and validity of the data**.**[18] This initial instrument demonstrated strong content validity (CVI = 0.82) and high internal consistency (Cronbach's alpha = 0.886). Subsequent psychometric testing using exploratory and confirmatory factor analyses refined the instrument to a final, robust 77-item, 8-component structure.

This systematic process aligns with established principles of instrument development, which emphasize the importance of systematic content validation and methodological rigor**.**[19] While limited prior research has focused on developing such a specialized tool in Thailand, this study contributes significantly by creating a context-specific, comprehensive measurement model consistent with recent studies that have emphasized the importance of factor structure and construct validity in applied settings**.** [20,21]

Theoretical and Practical Implications

The eight-component structure of the final instrument reflects the theoretical construct of QWL within the unique Thai context. Factors such as "Stability, Advancement, and Opportunities," "Work System Management," and "Safe and Healthy Working Conditions" are consistent with the context and nature of work for the Thai population.[8,9,22,23] To further illustrate the theoretical grounding of the instrument, Table 9 provides a direct comparison of the eight components derived in this study with the established framework proposed by Walton in 1973.[25]

Table 9. Comparison of the Study's QWL Components with Walton's (1973) Framework

Component from This Study	Corresponding Component in Walton's (1973) Model
1. Adequate and Fair Compensation	1. Adequate and fair compensation
2. Safe and Healthy Working Conditions	2. Safe and healthy working conditions
3. Stability, Advancement, and Opportunities	3. Opportunity for continued growth and security
4. Constitutionalism (Equity)	4. Constitutionalism in the work organization
5. Social Relevance	5. Social relevance of work life
6. Total Life Space (Work-Life Balance)	6. The total life space
7. Social Integration	7. Social integration in the work organization
8. Development of Human Capacities	8. Development of human capacities

The findings also confirm that components like "Adequate and Fair Compensation," "Work-Life Balance," and "Organizational Atmosphere" are critical QWL dimensions that should be promoted and supported for personnel across all professional groups in Thailand. This confirms that the instrument reliably captures the latent structure of QWL, making it both psychometrically robust and contextually appropriate for professional nurses in Thai primary care settings.

From a practical standpoint, this validated tool provides healthcare administrators and policymakers with a reliable means to assess and monitor nurses' QWL. The insights gained can be used to create targeted interventions, which can foster the motivation needed for nurses to feel supported and effective in their professional roles, ultimately improving the quality of service delivered to the public.

CONCLUSION

This study successfully developed and validated a new instrument to measure the Quality of Work Life of professional nurses in Thai primary healthcare settings. The final 77-item, 8-component QWL scale demonstrated strong evidence of content validity, construct validity, and reliability through both exploratory and confirmatory factor analyses.[24.] The resulting instrument is an appropriate and contextually relevant tool for measuring the multifaceted QWL construct for this specific nursing population. It provides a valuable resource for future research and for healthcare organizations seeking to improve the work environment, enhance job satisfaction, and promote the retention of primary care nurses in Thailand.

STRENGTHS AND LIMITATIONS

A key strength of this study is its large and diverse sample of 400 professional nurses, which ensures broad geographic representation across Thailand's primary care network. However, several limitations should be acknowledged to guide the interpretation of the findings.[23]

1. The study relies on self-report data, which may be subject to social desirability bias.

2. Its cross-sectional design means that it captures a single point in time and cannot be used to infer causal relationships.

3. A significant methodological limitation is that both the exploratory and confirmatory factor analyses were conducted on the same dataset. Ideally, a split-sample validation or a separate, independent dataset would be used for the CFA to strengthen the generalizability of the results.

4. Some respondents may have experienced misunderstandings or discrepancies in interpreting the questionnaire items, which may have affected the accuracy and consistency of responses.

5. The comprehensiveness of the final 77-item instrument, while necessary for content validity, may contribute to respondent burden and fatigue. Future research could focus on developing a validated short-form version of the scale for rapid screening or for use in longitudinal studies where brevity is essential.

RECOMMENDATIONS

Implications for Practice

1. The validated instrument developed in this study can be used by healthcare administrators to assess the quality of work life among nurses at various institutional levels.

2. Findings from Component 1, "Stability, Advancement, and Opportunities," underscore the importance of designing professional development plans that enhance job security and create clear career growth opportunities for nurses in primary care settings.

Suggestions for Future Research

1. Future research should conduct comparative studies between nurses working under the Ministry of Public Health and those under the Ministry of the Interior to identify potential differences in QWL.

2. Further studies should investigate the QWL among newly graduated professional nurses to understand their unique challenges as they transition into primary care roles.

3. An in-depth analysis of the "Stability, Advancement, and Opportunities" component could help inform the development of targeted intervention strategies to improve nurse retention.

AUTHOR CONTRIBUTIONS

WB: Conceptualization, Methodology, Formal analysis, Data curation, and Writing – original draft. **AP:** Investigation, Resources, Validation, and Writing – review & editing. **NA:** Supervision, Validation, and Writing – review & editing. **WN:** Conceptualization, Methodology, Supervision, Project administration, Validation, and Writing – review & editing.

ETHICAL CONSIDERATION

This study was approved by the Human Research Ethics Committee of the Sukhothai Provincial Public Health Office, Thailand (Protocol No. 86/2024), Approved on 13 November 2024.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest in relation to the research, authorship, or publication of this article.

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