

Psychosocial work-environment profiles and depression, anxiety, and stress among hospital nurses: a latent profile analysis

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Research Article

Keywords: Nurses, Psychosocial work environment, Occupational health, Latent profile analysis, Nursing workforce, Workplace stress, Nursing management, Psychological distress

Posted Date: October 21st, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11234611/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Psychosocial work environments in nursing are multidimensional, with demands coexisting with control, supervisory and coworker support, relationships, role clarity, and organizational change. Domain-specific analyses may overlook combinations of conditions experienced by individual nurses. This study used latent profile analysis (LPA) to identify psychosocial work-environment configurations and examine their associations with depression, anxiety, and stress.

Methods

In this analytical cross-sectional study, 220 nurses at hospitals in Semnan, Iran, were recruited using stratified random sampling with proportional allocation across six clinical-unit strata. Seven HSE-derived dimensions (Demands, Control, Manager Support, Peer Support, Relationships, Role, and Change) were entered into 1–5-profile LPA models. Solutions were evaluated using fit, classification, stability, and interpretability criteria. BCH-adjusted distal DASS-21 outcomes were compared across profiles. Multinomial logistic regression examined selected characteristics associated with profile membership, and sensitivity analyses assessed robustness.

Results

Three profiles were identified: a managerial-support constrained profile ($n = 65$, 29.5%), a balanced/intermediate profile ($n = 142$, 64.5%), and a higher-scoring profile ($n = 13$, 5.9%). Profiles represented distinct configurations rather than a simple severity continuum; the first was characterized particularly by low Manager Support, whereas the third had higher scores across most dimensions. BCH-adjusted stress differed across profiles (Wald $\chi^2=7.98$, $p=.019$), including a difference between the first and third profiles ($p=.011$). Depression ($\chi^2=4.81$, $p=.090$) and anxiety ($\chi^2=3.19$, $p=.202$) did not differ significantly. Profile–distress differences were attenuated and became non-significant after adjustment for age and night-shift category or work experience and night-shift category. The three-profile structure was reproduced when domain sums replaced means (adjusted Rand index = 1.00).

Conclusions

Hospital nurses showed heterogeneous psychosocial work-environment configurations that may be obscured by domain-specific or aggregate assessment. The observed stress difference was sensitive to occupational adjustment. Person-centred assessment may help characterize such configurations, while longitudinal research is needed to examine their temporal relationship with psychological distress.

Background

Hospital nursing takes place within a complex work environment in which workload and time pressure coexist with control over work, managerial and coworker support, workplace relationships, role clarity, and organizational change. These conditions are relevant to the nursing workforce because they shape how nurses experience and organize their work and may coexist with psychological symptoms and other aspects of well-being. A scoping review of 171 cohort studies found that nurses' mental health was associated with job demands and resources, social support, shift work, workplace violence, and lifestyle factors [1]. A recent systematic review likewise reported consistent links between psychosocial hospital work environments and nurses' health and well-being [2]. The psychosocial work environment of nurses is therefore best understood as a multidimensional feature of the work context rather than as a single condition.

The Health and Safety Executive (HSE) Management Standards Indicator Tool provides a multidimensional framework for assessing psychosocial work conditions through six broad areas: Demands, Control, Support, Relationships, Role, and Change [3, 4]. In the present study, the Support area was separated analytically into Manager Support and Peer Support, yielding seven HSE-derived profile indicators. This distinction is relevant to nursing workforce research because managerial and coworker support may not vary together. Nurses may experience adequate peer support while perceiving limited managerial support, or relatively favorable control and role clarity alongside less favorable demands. Analysing each dimension separately can identify associations for individual conditions but may overlook combinations of work characteristics that occur together within nurses.

Latent profile analysis (LPA) provides a person-centred approach for identifying such combinations across multiple continuous work-environment indicators. Rather than examining only whether one work characteristic is associated with an outcome, LPA identifies subgroups of nurses with similar patterns across several characteristics [5]. This approach is increasingly relevant to nursing workforce

research because psychosocial work conditions may cluster in different ways across nurses rather than vary along a single overall continuum. The value of LPA in this context is therefore not the use of a novel statistical method itself, but its ability to characterize the multidimensional work environment as experienced by groups of nurses with similar configurations.

Recent nursing studies illustrate this emerging person-centred approach. Portoghese et al. identified five job-demand/resource profiles among 449 nurses, Nam et al. identified four job-characteristic profiles among 544 shift nurses, and Liu et al. identified three demand–resource profiles among 1,804 hospital nurses [6–8]. Although these studies used different indicators, populations, and outcomes, their findings support the presence of heterogeneous combinations of job demands and resources within nursing populations. They also indicate that the number and composition of profiles vary across work settings and measurement frameworks. The present study extends this person-centred nursing literature by focusing on the full HSE-derived configuration of psychosocial work conditions and its relationship with multiple psychological symptom dimensions.

Evidence provides an important but contextually distinct comparison. Charzyńska et al. identified five profiles of work-related stress among 297 emergency department nurses and 219 emergency medical services staff during the COVID-19 period [9]. That study demonstrated the usefulness of HSE-based person-centred analysis in an Iranian healthcare workforce, but its population and crisis context differed from those of the present study. In addition, Manager Support and Peer Support were combined before profiling. The present study focuses on nurses across clinical units outside that specific emergency-care context, retains Manager Support and Peer Support as separate indicators, and examines depression, anxiety, and stress as distinct psychological outcomes. These differences address an important gap in understanding how the broader psychosocial work environment may configure among hospital nurses and whether different configurations show similar or different patterns across psychological symptoms.

The Job Demands–Resources (JD-R) framework provides a conceptual basis for interpreting these configurations. In JD-R theory, job demands refer to aspects of work that require sustained effort, whereas job resources help workers meet demands and achieve work goals [10]. In this study, Demands represents the principal demand-related HSE indicator, while Control, Manager Support, Peer Support, Relationships, Role, and Change represent resource-like or organizational conditions. HSE and JD-R are not equivalent measurement systems, and the present study does not test a formal JD-R pathway or causal model. Rather, the framework provides a concise way to interpret why different combinations of demands and resource conditions may occur within the nursing work environment.

Psychological symptoms may differ across work-environment configurations because depression, anxiety, and stress are influenced by overlapping occupational and individual factors. Cohort evidence has linked these outcomes among nurses with work demands and resources, social support, shift work, workplace violence, and lifestyle factors [1], while prospective nursing evidence has identified occupational and individual correlates across depression, anxiety, and stress [11]. Examining these outcomes separately is therefore important because a given psychosocial configuration may show different patterns across symptom dimensions. Treating depression, anxiety, and stress as distal outcomes after profile formation also ensures that psychological symptoms do not determine the profiles themselves.

Despite growing use of person-centred approaches in nursing research, evidence remains limited on how the full set of HSE-derived psychosocial work-environment dimensions jointly configure among hospital nurses when Manager Support and Peer Support are considered separately. It is also unclear whether these configurations are associated similarly with depression, anxiety, and stress or whether observed differences persist after accounting for selected occupational characteristics. This study therefore aimed to identify psychosocial work-environment profiles among hospital nurses using seven HSE-derived dimensions and to examine their associations with depression, anxiety, and stress. A secondary objective was to examine selected demographic and occupational characteristics associated with profile membership. Sensitivity analyses assessed the robustness of the profile structure to alternative HSE scoring and the stability of profile–distress differences after occupational adjustment. By focusing on nurses as members of heterogeneous work-environment configurations, this study sought to extend person-centred nursing workforce research beyond domain-specific descriptions of psychosocial work conditions.

Methods

2.1. Study design and setting

This analytical cross-sectional study was conducted among nurses working at hospitals in Semnan, Iran, during 2025–2026. The study characterized psychosocial work-environment configurations and examined their cross-sectional associations with depression, anxiety, and stress. The final analytic sample comprised 220 nurses.

2.2. Study population, eligibility, and sampling

The study population comprised nurses actively employed in the clinical units during the study period. Eligibility criteria included active employment, at least six months of work experience, willingness to participate, and written informed consent. Nurses with a known psychiatric disorder or a history of psychotropic medication use were excluded. Participants were selected using stratified random sampling with proportional allocation across six predefined hospital-unit strata: ICU, CCU/Post-CCU, emergency, internal medicine, surgical units, and other clinical units. Within each stratum, eligible nurses were randomly selected from available staff lists.

The original study protocol specified a target sample of 220 based on a single-population proportion approach, assuming a 30% prevalence, 95% confidence level ($Z = 1.96$), and 5% precision, with finite-population correction for an estimated eligible population of approximately 380 nurses. The corrected sample size was approximately 218 and was rounded to 220. This calculation was prevalence-based rather than specific to latent profile analysis. No sampling weights were applied in the LPA or subsequent analyses.

2.3. Measures

2.3.1. Sociodemographic and occupational characteristics

Sociodemographic and occupational characteristics included age, sex, marital status, work experience, employment type, hospital unit, and monthly night-shift frequency. Age and work experience were recorded as continuous variables. Employment type was classified as permanent/formal versus non-permanent in the primary multinomial model. Hospital unit was categorized into six predefined groups. Monthly night-shift frequency was entered categorically using the categories recorded in the study dataset (< 4 , 5–7, and ≥ 8 nights/month).

2.3.2. Psychosocial work environment

The psychosocial work environment was assessed using the Health and Safety Executive (HSE) Management Standards Indicator Tool [12]. The HSE Management Standards framework comprises six broad areas: Demands, Control, Support, Relationships, Role, and Change. For the present analysis, Support was separated into Manager Support and Peer Support, yielding seven HSE-derived profile indicators: Demands, Control, Manager Support, Peer Support, Relationships, Role, and Change. Domain scores were calculated as the mean of their respective items, with higher scores indicating more favorable psychosocial work-environment conditions. The verified item structure comprised 8 items for Demands, 6 for Control, 5 for Manager Support, 4 for Peer Support, 4 for Relationships, 5 for Role, and 3 for Change. The entered item coding was directionally harmonized; therefore, no additional reverse-coding was applied. Internal consistency was assessed using Cronbach's alpha and corrected item–total correlations. All seven dimensions were retained as theoretically relevant profile indicators irrespective of their individual reliability estimates.

2.3.3. Psychological symptoms

Psychological symptoms were assessed using the 21-item Depression Anxiety Stress Scale (DASS-21) [13]. The instrument comprises three seven-item subscales depression, anxiety, and stress with each item scored from 0 to 3, producing a raw score of 0–21 for each subscale; higher scores indicate greater symptoms. Depression, anxiety, and stress were analysed as continuous outcomes. The DASS-21 was used to quantify symptom severity rather than establish psychiatric diagnoses. Depression and anxiety analyses included 220 participants; the strict stress analysis included 216 participants after exclusion of invalid or unresolved stress responses identified during data-quality checks.

2.4. Potential sources of bias

Several measures were used to address potential sources of bias. Selection bias was reduced through stratified random sampling with proportional allocation across all predefined clinical-unit strata and random selection within strata. Standardized questionnaires, predefined scoring procedures, and systematic data-quality checks were used to reduce measurement variability. Anonymous questionnaire completion was used to protect confidentiality and may have reduced pressure for socially desirable responses. All principal measures were self-reported, and exclusion of nurses with known psychiatric disorders or psychotropic medication use may have introduced selection differences from the broader nursing workforce. The number of eligible nurses who declined participation was not retained in the analysis dataset; therefore, the magnitude of nonresponse bias could not be quantified.

2.5. Data management and quality control

Before analysis, the dataset was screened for completeness, valid response ranges, variable structure, and consistency of derived scores. No blank values were identified in the supplied questionnaire item fields. The seven HSE dimensions were reconstructed from their verified item groupings and scored as domain means. The DASS-21 depression, anxiety, and stress subscales were constructed from their predefined seven-item sets using the documented 0–3 response scale.

Data-quality review identified two participants with clearly invalid stress questionnaires, for whom all seven stress responses were outside the permitted 0–3 range; their stress scores were treated as missing. Two additional participants had isolated stress-item values of 4. Because the source documentation did not provide a defensible recoding rule, these responses were not modified and were excluded from the strict stress analysis. Raw responses were retained in the audit dataset. Accordingly, depression and anxiety analyses included $n = 220$, whereas the publication-analysis stress models used $n = 216$.

2.6. Statistical analysis

Analyses were conducted using Mplus version 8.11 according to a prespecified sequence: descriptive and measurement analyses, latent profile analysis (LPA), BCH distal-outcome comparisons, multinomial logistic regression of profile membership, and sensitivity analyses. The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies.

2.6.1. Descriptive and measurement analyses

Continuous variables were summarized using means and standard deviations or medians and interquartile ranges, as appropriate, and categorical variables using frequencies and percentages. The seven HSE domain scores were examined using summary statistics and skewness. Internal consistency of each HSE dimension was assessed using Cronbach's alpha and corrected item–total correlations.

2.6.2. Latent profile analysis

LPA was performed using the seven HSE psychosocial work-environment domain mean scores as the sole profile indicators. The DASS-21 depression, anxiety, and stress scores were not included in profile estimation and were introduced subsequently as distal outcomes. Candidate models specifying one through five latent profiles were estimated using a Gaussian profile model with a diagonal covariance structure; within-profile covariances were fixed to zero and domain-specific variances were constrained to be equal across profiles.

Model enumeration considered the log-likelihood, Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-size-adjusted BIC (aBIC), entropy, class size, likelihood-ratio tests, replication and stability across alternative starting values, average posterior probabilities, and substantive interpretability. The likelihood-ratio comparison used the ad hoc adjusted Lo–Mendell–Rubin calculation used in the analysis, and parametric bootstrap likelihood-ratio testing was performed independently with 500 bootstrap replications for the two- versus one-profile comparison and 300 for subsequent comparisons.

No single fit statistic was used as the sole basis for class enumeration. The retained solution was selected by jointly considering statistical fit, classification precision, adequacy and stability of class sizes, replication across starting values, and substantive interpretability. Profile labels were assigned after examining the estimated HSE domain means and were intended to describe observed configurations rather than prespecified clinical or risk categories.

2.6.3. Distal psychological outcomes

After selection of the final profile solution, depression, anxiety, and stress were treated as distal continuous outcomes. Profile-specific estimated means were compared using the Bolck–Croon–Hagenaars (BCH) procedure to account for uncertainty in profile assignment while preserving the selected profile model. Estimated means and standard errors were obtained together with omnibus Wald tests and pairwise profile comparisons. Depression and anxiety analyses included 220 participants; the stress analysis included 216 participants. Pairwise comparison adjustment for multiple testing was not applied.

2.6.4. Demographic and occupational characteristics associated with profile membership

Associations between participant characteristics and latent profile membership were examined using multinomial logistic regression, with Managerial-support constrained (Profile 1) as the reference category. The primary model included age, sex, monthly night-shift category, and employment type. Age was entered continuously; night-shift frequency was entered categorically; and employment type was classified as permanent/formal versus non-permanent. Adjusted odds ratios (ORs), 95% confidence intervals, and p-values were estimated for Profile 2 versus Profile 1 and Profile 3 versus Profile 1.

The predictor set was intentionally parsimonious given the small size of Profile 3. Marital status and hospital unit were not included in the primary model because their inclusion would increase model complexity and potentially produce sparse cells. Work experience was examined in a separate sensitivity model replacing age because age and work experience were strongly collinear. The multinomial analysis was based on assigned profile membership and did not use R3STEP or another classification-uncertainty correction.

2.6.5. Sensitivity analyses

Two sensitivity analyses were undertaken. First, the LPA was repeated using HSE domain sum scores rather than domain means to determine whether the latent structure depended on score parameterization. Agreement between the resulting classification and the primary solution was evaluated using entropy, adjusted Rand index, and comparison of the recovered profile configuration.

Second, profile differences in psychological symptoms were examined after adjustment for key occupational characteristics. Because of strong collinearity between age and work experience, two parallel models were estimated: Model A included age and night-shift category, whereas Model B replaced age with work experience while retaining night-shift category. Profile membership remained the primary grouping variable, and covariate-adjusted regression-standardized DASS-21 means were estimated for each profile. These estimates were treated as secondary sensitivity analyses and were distinct from the BCH-adjusted distal-outcome estimates.

2.7. Ethical considerations

The study was approved by the Research Ethics Committee of Semnan University of Medical Sciences (Ethics Approval No. IR.SEMUMS.REC.1404.182). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and relevant institutional and national regulations. Participation was voluntary, and all eligible nurses were provided with adequate information about the study objectives and procedures before providing written informed consent. Participants were informed that they could decline participation or withdraw from the study at any time without any adverse consequences. The questionnaires were completed anonymously, and the confidentiality of participants' information was strictly maintained throughout data collection, data management, analysis, and reporting.

Results

3.1. Participant characteristics

A total of 220 nurses were included in the analysis. The mean age was 35.01 years (SD 6.92), and mean work experience was 10.10 years (SD 6.58). Most participants were female (176, 80.0%) and held permanent/formal positions (125, 56.8%). Participants were distributed across ICU (48, 21.8%), CCU/Post-CCU (18, 8.2%), emergency (46, 20.9%), internal medicine (44, 20.0%), surgical wards (26, 11.8%), and other clinical units (38, 17.3%). Monthly night-shift frequency was < 4 nights for 58 nurses (26.4%), 5–7 nights for 89 (40.5%), and ≥ 8 nights for 73 (33.2%) (Table 1).

The available analysis dataset did not retain the numbers of eligible nurses approached, assessed for eligibility, or declining participation, and therefore intermediate recruitment counts and reasons for non-participation could not be quantified. The reported sample represents the final analytic cohort of 220 nurses.

Table 1
Sociodemographic and occupational characteristics of nurses (N = 220)

Variable	Category / statistic	n (%) or Mean $\pm$ SD
Age, years	Continuous	35.01 $\pm$ 6.92
	Median (IQR)	34 (29–40)
	Range	25–50
Sex	Female	176 (80.0%)
	Male	44 (20.0%)
Marital status	Married	167 (75.9%)
	Single	53 (24.1%)
Work experience, years	Continuous	10.10 $\pm$ 6.58
	Median (IQR)	9 (4–15)
	Range	1–25
Employment type	Permanent/formal	125 (56.8%)
	Non-permanent	95 (43.2%)
Hospital unit	ICU	48 (21.8%)
	CCU + Post-CCU	18 (8.2%)
	Emergency	46 (20.9%)
	Internal medicine	44 (20.0%)
	Surgical wards	26 (11.8%)
	Other wards*	38 (17.3%)
Night shifts/month	$\leq$ 4 nights	58 (26.4%)
	5–7 nights	89 (40.5%)
	$\geq$ 8 nights	73 (33.2%)

3.2. Psychosocial work-environment characteristics

The seven HSE-derived psychosocial work-environment dimensions showed moderate variation across the sample (Supplementary Table S4). Mean scores were 2.45 (SD 0.66) for Demands, 2.79 (SD 0.64) for Control, 2.45 (SD 0.77) for Manager Support, 3.05 (SD 0.71) for Peer Support, 2.91 (SD 0.64) for Relationships, 3.25 (SD 0.57) for Role, and 2.51 (SD 0.71) for Change. Higher scores indicated more favorable psychosocial work-environment conditions. Role and Peer Support had comparatively higher mean scores, whereas Demands and Manager Support had comparatively lower scores; Control and Change were intermediate.

The seven domain scores showed limited skewness, with values ranging from -0.22 to 0.24 . Cronbach's alpha ranged from 0.55 for Relationships to 0.70 for Demands across the seven HSE-derived dimensions; domain-specific coefficients and corrected item–total correlations are provided in Supplementary Table S4. No blank values were identified in the supplied questionnaire item fields. This multidimensional pattern provided the basis for latent profile analysis, allowing nurses to be characterized according to empirically observed configurations of psychosocial work conditions rather than a single composite score.

3.3. Identification and selection of latent profiles

Latent profile models containing one through five profiles were estimated using the seven HSE-derived psychosocial work-environment dimensions. Model selection considered information criteria, entropy, likelihood-ratio tests, class size, classification quality, convergence and stability across alternative starting values, average posterior probabilities, and substantive interpretability (Table 2).

The one-profile model provided the poorest fit. The two-profile solution substantially improved fit, with entropy of 0.986 , a smallest class of 12 nurses (5.5%), LMR-LRT $p < 0.001$, and BLRT $p = 0.002$. The three-profile solution produced a further improvement according to both

likelihood-ratio tests (LMR-LRT $p < 0.001$; BLRT $p = 0.023$), with entropy of 0.789 and class sizes of 142 (64.5%), 65 (29.5%), and 13 (5.9%). Average posterior probabilities for the three profiles were 0.913, 0.864, and 0.970, respectively.

Although AIC and adjusted BIC continued to decrease with four and five profiles, these solutions produced extremely small classes. The four-profile solution contained only 2 nurses (0.9%), and the five-profile solution contained only 1 nurse (0.5%). Both solutions showed poorer stability across alternative starting values, and bootstrap evidence was weaker for the four- and five-profile comparisons (BLRT $p = 0.083$ and $p = 0.189$, respectively). The three-profile solution was therefore retained on the basis of the joint evidence from model fit, classification quality, class-size adequacy, stability, and interpretability rather than any single fit statistic.

Table 2
Fit statistics for the 1–5 latent profile solutions

Profiles	Log-likelihood	Parameters	AIC	BIC	Adjusted BIC	Entropy	Smallest class, n (%)	LMR-LRT p^*	BLRT $p^\dagger$	High-start stability
1	-1561.48	14	3150.95	3198.46	3154.10	—	220 (100.0)	—	—	Stable
2	-1484.73	22	3013.46	3088.12	3018.40	0.986	12 (5.5)	< 0.001	0.002	Very stable
3	-1470.91	30	3001.82	3103.63	3008.56	0.789	13 (5.9)	< 0.001	0.023	Stable/moderately stable
4	-1455.57	38	2987.14	3116.09	2995.67	0.840	2 (0.9)	< 0.001	0.083	Unstable
5	-1441.72	46	2975.44	3131.55	2985.78	0.861	1 (0.5)	< 0.001	0.189	Unstable

* LMR-LRT is the ad-hoc adjusted Lo–Mendell–Rubin likelihood-ratio calculation based on neighboring models.

† BLRT values are **parametric-bootstrap LRTs calculated independently here**: 500 bootstrap replications for the 2-vs-1 comparison and 300 for subsequent comparisons.

3.4. Characteristics of the final latent profiles

The retained three-profile solution identified distinct configurations across the seven HSE-derived psychosocial work-environment dimensions (Table 3; Fig. 1). Profile 1: Managerial-support constrained comprised 65 nurses (29.5%) and was distinguished particularly by low Manager Support (1.64), while the remaining dimensions were within a moderate range. Profile 2: Balanced/intermediate comprised 142 nurses (64.5%) and represented the largest group. Its scores were relatively clustered across the psychosocial dimensions, with no single domain showing the marked separation observed for Manager Support in Profile 1.

Profile 3: Higher-scoring comprised 13 nurses (5.9%). This profile had higher scores across most dimensions, particularly Demands, Control, Manager Support, Peer Support, and Relationships. Role was similar across profiles, while change showed relatively little differentiation. The three profiles therefore represented different combinations of psychosocial work-environment conditions rather than a simple three-level severity continuum. The most pronounced separation occurred for Manager Support (1.64, 2.71, and 4.02 across Profiles 1–3), whereas Role was nearly unchanged (3.26, 3.25, and 3.28) and Change showed relatively little differentiation (2.38, 2.58, and 2.51).

Table 3
Psychosocial work-environment dimensions across the final latent profiles.

HSE domain	Profile 1: Managerial-support constrained	Profile 2: Balanced/intermediate	Profile 3: Higher-scoring
Demands	2.45	2.33	3.73
Control	2.87	2.65	4.00
Manager support	1.64	2.71	4.02
Peer support	2.92	2.98	4.38
Relationships	2.97	2.82	3.58
Role	3.26	3.25	3.28
Change	2.38	2.58	2.51
n (%)	65 (29.5%)	142 (64.5%)	13 (5.9%)

3.5. Depression, anxiety, and stress across psychosocial profiles

BCH-adjusted distal outcome estimates for depression, anxiety, and stress are presented in Table 4 and Fig. 2, with pairwise comparisons provided in Supplementary Table S1.

BCH-adjusted depression means were 8.30 (SE 0.44), 6.73 (SE 0.60), and 5.29 (SE 2.18) for Profiles 1, 2, and 3, respectively. The omnibus comparison was not statistically significant (Wald $\chi^2=4.81$, $p = 0.090$).

For anxiety, BCH-adjusted means were 6.20 (SE 0.33), 5.10 (SE 0.51), and 4.33 (SE 2.05) for Profiles 1, 2, and 3, respectively. The omnibus comparison was not statistically significant (Wald $\chi^2=3.19$, $p = 0.202$).

Stress showed a different pattern. BCH-adjusted means were 10.67 (SE 0.40), 9.43 (SE 0.58), and 5.14 (SE 2.14) across Profiles 1, 2, and 3, respectively. The omnibus comparison across profiles was statistically significant (Wald $\chi^2=7.98$, $p = 0.019$). An unadjusted pairwise comparison showed a difference between Profiles 1 and 3 (mean difference = 5.52, $p = 0.011$). The Profile 1 versus Profile 2 comparison was not statistically significant ($p = 0.115$), and the Profile 2 versus Profile 3 comparison was also not statistically significant (mean difference = 4.29, $p = 0.052$).

Table 4
BCH-adjusted distal psychological distress outcomes across the three latent psychosocial work-environment profiles

Psychological outcome	Profile 1: Managerial-support constrained, mean (SE)	Profile 2: Balanced/intermediate, mean (SE)	Profile 3: Higher-scoring, mean (SE)	Wald χ^2	p-value
Depression	8.30 (0.44)	6.73 (0.60)	5.29 (2.18)	4.81	0.090
Anxiety	6.20 (0.33)	5.10 (0.51)	4.33 (2.05)	3.19	0.202
Stress	10.67 (0.40)	9.43 (0.58)	5.14 (2.14)	7.98	0.019

Stress was the only DASS-21 outcome showing a statistically significant omnibus difference across profiles in the primary BCH analysis. Depression and anxiety did not show statistically significant omnibus differences. Depression and anxiety analyses included 220 participants; the strict stress analysis included 216 participants.

3.6. Demographic and occupational characteristics associated with profile membership

Multinomial logistic regression was used to examine associations between selected demographic and occupational characteristics and profile membership, with the Managerial-support constrained profile (Profile 1) as the reference category (Supplementary Table S2). Given the small size of Profile 3, the primary model was intentionally parsimonious and included age, sex, monthly night-shift category, and employment type. Hospital unit and marital status were not included in the primary model.

None of the primary characteristics was statistically associated with Profile 2 versus Profile 1 or with Profile 3 versus Profile 1. For Profile 3 versus Profile 1, the estimate for night-shift category was $OR = 0.41$ (95% CI 0.15–1.11; $p = 0.080$) and did not reach conventional statistical significance. The remaining estimates were also non-significant, and confidence intervals for Profile 3 were wide. Because age and work experience were strongly collinear, work experience was examined in a separate sensitivity model replacing age. This model produced a similar pattern, with no statistically significant association between work experience and profile membership.

3.7. Sensitivity analyses

Two secondary analyses examined the robustness of the profile structure and profile–distress findings (Supplementary Table S3). First, repeating the LPA using HSE domain sum scores rather than domain means reproduced the same three-profile structure, class sizes, and profile configuration. Classification agreement with the primary solution was complete (adjusted Rand index = 1.00), and entropy remained 0.789.

Second, profile differences in psychological symptoms were examined after adjustment for key occupational characteristics. Because of substantial collinearity between age and work experience, two parallel models were estimated: one adjusted for age and night-shift category, and the other for work experience and night-shift category. After adjustment for age and night-shift category, omnibus differences were not statistically significant for depression ($F(2,214) = 0.45$, $p = 0.640$), anxiety ($F(2,214) = 0.35$, $p = 0.702$), or stress ($F(2,210) = 1.39$, $p = 0.252$). Replacing age with work experience produced the same pattern, with no statistically significant differences for depression ($F(2,214) = 0.48$, $p = 0.621$), anxiety ($F(2,214) = 0.37$, $p = 0.693$), or stress ($F(2,210) = 1.36$, $p = 0.259$).

Taken together, the sensitivity analyses supported the stability of the three-profile psychosocial work-environment structure, while showing that the profile differences in psychological symptoms observed in the primary BCH analysis were attenuated after adjustment for selected occupational characteristics.

Discussion

This study identified three distinct psychosocial work-environment profiles among hospital nurses, indicating that psychosocial conditions were heterogeneous rather than distributed along a single severity continuum. The largest group showed a relatively balanced/intermediate pattern, whereas one profile was distinguished mainly by low Manager Support and a smaller profile showed generally favorable scores across most HSE dimensions. The primary BCH analysis showed an overall difference across profiles for stress, but not for depression or anxiety. Importantly, the stress difference did not remain statistically significant after adjustment for age and night-shift category, or when work experience replaced age. Thus, the main contribution of the study is not evidence of a single profile associated with psychological distress, but the identification of distinct psychosocial configurations and the demonstration that their relationships with distress were outcome-specific and sensitive to occupational adjustment.

The three-profile solution indicates that nurses did not simply differ in the overall level of psychosocial risk. Instead, they showed different combinations of work conditions across the seven HSE domains. Manager Support was markedly lower in Profile 1, while Role was highly similar across profiles and Change showed relatively little differentiation. This pattern is consistent with recent person-centred research in nursing, which has identified distinct combinations of job demands and resources rather than a single underlying continuum. Portoghese et al. identified five job-demand/resource profiles among 449 nurses, and Nam et al. identified four job-characteristic profiles among 544 shift nurses. More recently, Liu et al. identified three demand/resource profiles among 1,804 hospital nurses, with different profiles showing different patterns of work fatigue. These studies, despite differences in measures and populations, support the value of examining how psychosocial characteristics cluster within individuals rather than assuming that each work characteristic varies independently [6–8].

Manager Support was the clearest dimension separating the profiles. Profile 1 had a Manager Support score of 1.64, compared with 2.71 in Profile 2 and 4.02 in Profile 3, whereas Role showed little separation between groups. This suggests that supervisory support may form a distinct component of psychosocial heterogeneity rather than merely reflecting an overall level of favorable working conditions. The finding is compatible with the JD-R perspective, in which leadership and social support can function as job resources. A 2025 systematic review of 38 nursing studies found consistent associations between leadership characteristics and burnout and work engagement, although most studies were cross-sectional and the leadership constructs varied substantial [14]. Accordingly, the prominent separation of Manager Support in this study identifies supervisory support as a feature that may merit closer organizational assessment, without establishing that it independently determines nurses' psychological symptoms.

Profile 3 was small, comprising only 13 nurses, but its pattern was distinct. Higher scores occurred simultaneously across Demands, Control, Manager Support, Peer Support, and Relationships, while Role and Change did not show the same elevation. This is important from a person-centred perspective because the profile represents a combination of psychosocial conditions rather than an increase in one

isolated resource. Recent LPA studies similarly show that resource-rich and demand-rich characteristics can coexist in different combinations within nursing populations and may relate differently to occupational well-being [6, 8].

However, the small size of Profile 3 produced wide uncertainty around its outcome estimates, so its pattern should be regarded as informative but provisional. The profile may represent a relatively resource-rich psychosocial configuration that warrants replication in larger and more diverse nursing samples.

The outcome findings also suggest that associations between psychosocial configurations and psychological symptoms may not be uniform across outcomes. BCH-adjusted mean scores differed numerically across profiles for depression, anxiety, and stress, but only stress showed a statistically significant omnibus comparison, with the significant pairwise difference occurring between Profiles 1 and 3. One possible explanation is that the DASS-21 stress dimension captures experiences such as difficulty relaxing, nervous tension, irritability, agitation, and over-reaction, which may be more closely aligned with current perceived strain than some aspects of depressive or anxiety symptoms [15]. This should be viewed only as a plausible interpretation. Nurses' depression, anxiety, and stress are all influenced by multiple occupational and non-occupational factors, including work demands, social support, shift work, lifestyle, and individual characteristics. A prospective cohort study of 516 nurses, for example, found that night-shift work, longer working hours, frontline exposure, and individual factors were associated with all three outcomes [11], while a broader scoping review identified job demands, job resources, social support, shift work, workplace violence, and lifestyle factors across the nursing mental-health literature [1]. Thus, the present finding is better interpreted as possible outcome-specific patterning than as evidence that psychosocial work conditions are related to stress but not to depression or anxiety.

The strongest qualification to this interpretation is the attenuation after adjustment. After adjustment for age and night-shift category, none of the three DASS-21 outcomes differed significantly across profiles; the same pattern was observed when work experience replaced age. This suggests that the profile-associated differences observed in the primary BCH analysis may partly reflect differences in the occupational composition of nurses across profiles rather than an association attributable solely to profile membership. Age, shift work, working hours, and other characteristics may coexist with psychosocial work conditions and psychological symptoms, making adjustment important when interpreting cross-sectional associations. The prospective evidence from Hu et al. is consistent with this broader view, because several occupational characteristics were associated with anxiety, depression, and stress simultaneously [11]. Therefore, the primary stress finding should be regarded as an adjusted-sensitive association rather than as evidence of an independent relationship between psychosocial profile and stress.

The largely null multinomial results provide a second important observation. Age, sex, night-shift category, and employment type were not statistically associated with profile membership, and replacing age with work experience produced a similar pattern. This does not mean that demographic or occupational characteristics are unimportant. Rather, the available variables provided limited evidence for explaining the specific psychosocial configurations observed in this sample. Recent nursing LPA studies have reported associations of profile membership with different characteristics, including age, employment type, professional position, department, income, and turnover intention, but the correlates vary across populations and profile constructs [6, 16, 17]. This variability supports interpreting profile membership as context-dependent and suggests that psychosocial configurations may cut across conventional demographic categories. The wide confidence intervals involving Profile 3 nevertheless require particular caution.

The profile structure can also be interpreted through the Job Demands–Resources framework, but it should not be presented as a formal test of JD-R theory. The HSE domains include the demand-related dimension of Demands together with several resource-related conditions, including Control, Manager Support, Peer Support, Relationships, Role, and Change. These dimensions do not correspond perfectly to the formal JD-R categories, but their joint pattern is compatible with the proposition that demands and resources coexist in different configurations. Recent nurse studies using person-centred JD-R approaches similarly identified multiple demand/resource profiles rather than a single continuum [6–8]. More broadly, contemporary JD-R theory explicitly recognizes person–situation and multilevel perspectives, supporting attention to combinations of work characteristics rather than isolated exposures [10]. In the present study, therefore, the LPA provides person-centred evidence consistent with a JD-R interpretation, while the cross-sectional design does not permit testing of JD-R pathways or causal processes.

The practical implication is that psychosocial assessment may benefit from moving beyond average scores to identifying which dimensions are jointly unfavorable within subgroups of nurses. For example, a subgroup characterized mainly by limited managerial support may warrant a different form of organizational assessment from a subgroup in which several demands and resources are unfavorable. This does not mean that LPA profiles can be translated directly into intervention packages; rather, they may help identify where more detailed assessment of workload, control, supervisory support, teamwork, or work organization is needed. This approach is consistent with recent intervention evidence. A systematic review of 54 organization-directed interventions among healthcare

professionals found effects that varied substantially across outcomes and rated the overall certainty of evidence as very low, emphasizing the importance of needs assessment and local context before intervention selection [18]. A nursing-specific systematic review similarly found heterogeneous intervention approaches and concluded that the available evidence did not establish one universally effective intervention [19]. The present profiles may therefore support subgroup-sensitive monitoring and organizational inquiry rather than prescriptive intervention decisions.

Several methodological strengths increase the value of these findings. The study used a person-centred approach to examine the joint pattern of seven psychosocial dimensions, evaluated one- through five-profile solutions rather than imposing a predetermined class structure, and selected the final solution using multiple statistical and substantive criteria. The use of BCH for continuous distal outcomes accounted for uncertainty in profile assignment, an established approach for classify–analyze problems in LPA [20]. In addition, the same three-profile configuration was recovered when HSE domain sums replaced means, with an adjusted Rand index of 1.00, supporting robustness to the scoring parameterization. These strengths should be considered alongside, rather than used to offset, the limitations of the sample and design.

Our study has some limitations. First, the cross-sectional design prevents determination of temporal ordering and does not support causal inference. This is particularly important because the primary stress difference was attenuated after adjustment. second, Profile 3 contained only 13 nurses, resulting in imprecise BCH estimates and wide confidence intervals for multinomial associations. Third, both psychosocial conditions and psychological symptoms were self-reported, so reporting and common-method processes cannot be excluded. Finally, the available covariate set did not capture the full range of potential non-work influences on psychological symptoms. Future studies should therefore use larger multicentre longitudinal samples, repeated assessments of psychosocial conditions and distress, and objective or multilevel measures of organizational context. Most importantly, longitudinal research should test whether psychosocial configurations predict subsequent changes in psychological distress rather than merely co-occur with them.

This study provided evidence that hospital nurses can occupy distinct psychosocial work-environment configurations that are not adequately represented by a single severity continuum or by domain-by-domain descriptions alone. The prominence of a managerial-support-constrained profile and the outcome-specific, adjustment-sensitive pattern of distress show why person-centred assessment can provide information that aggregate scores may obscure. Although the primary analysis identified a stress difference across profiles, that association was not strong to adjustment for age and night-shift category or work experience and night-shift category. These findings therefore support multidimensional, subgroup-sensitive assessment of nurses' psychosocial work environments while providing a basis for longitudinal research examining whether these configurations predict subsequent psychological health.

Abbreviations

AIC

Akaike information criterion

aBIC

Sample–size–adjusted Bayesian information criterion

BCH

Bolck Croon Hageaars

BIC

Bayesian information criterion

BLRT

Bootstrap likelihood–ratio test

CCU

Cardiac care unit

CI

Confidence interval

DASS

21–Depression Anxiety Stress Scales, 21–item version

EMS

Emergency medical services

HSE

Health and Safety Executive

ICU

Intensive care unit

IQR
Interquartile range
JD
R—Job Demands—Resources
LMR
LRT—Lo Mendell Rubin likelihood—ratio test
LPA
Latent profile analysis
OR
Odds ratio
SD
Standard deviation
SE
Standard error
STROBE
Strengthening the Reporting of Observational Studies in Epidemiology

Declarations

Acknowledgements

The authors would like to thank the Research Center for Public Health Sciences and Technologies at Semnan University of Medical Sciences for their institutional support.

Authors' contributions

MBK: Project administration, Conceptualization, Methodology, Investigation, Validation, Writing – original draft, Writing – review & editing. JAF: Conceptualization, Methodology, Data collection. MM: Conceptualization, Formal analysis, Writing – review & editing. AD: Supervision, Funding acquisition, Project administration, Resources, Conceptualization, Methodology, Data Curation.

Funding

The researcher(s) received no financial support for the research, authorship and/or publication of this article.

Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of Semnan University of Medical Sciences (Ethics Approval No. IR.SEMUMS.REC.1404.182). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and relevant institutional and national regulations. Participation was voluntary, and all eligible nurses were provided with adequate information about the study objectives and procedures before providing written informed consent. Participants were informed that they could decline participation or withdraw from the study at any time without any adverse consequences. The questionnaires were completed anonymously, and the confidentiality of participants' information was strictly maintained throughout data collection, data management, analysis, and reporting.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

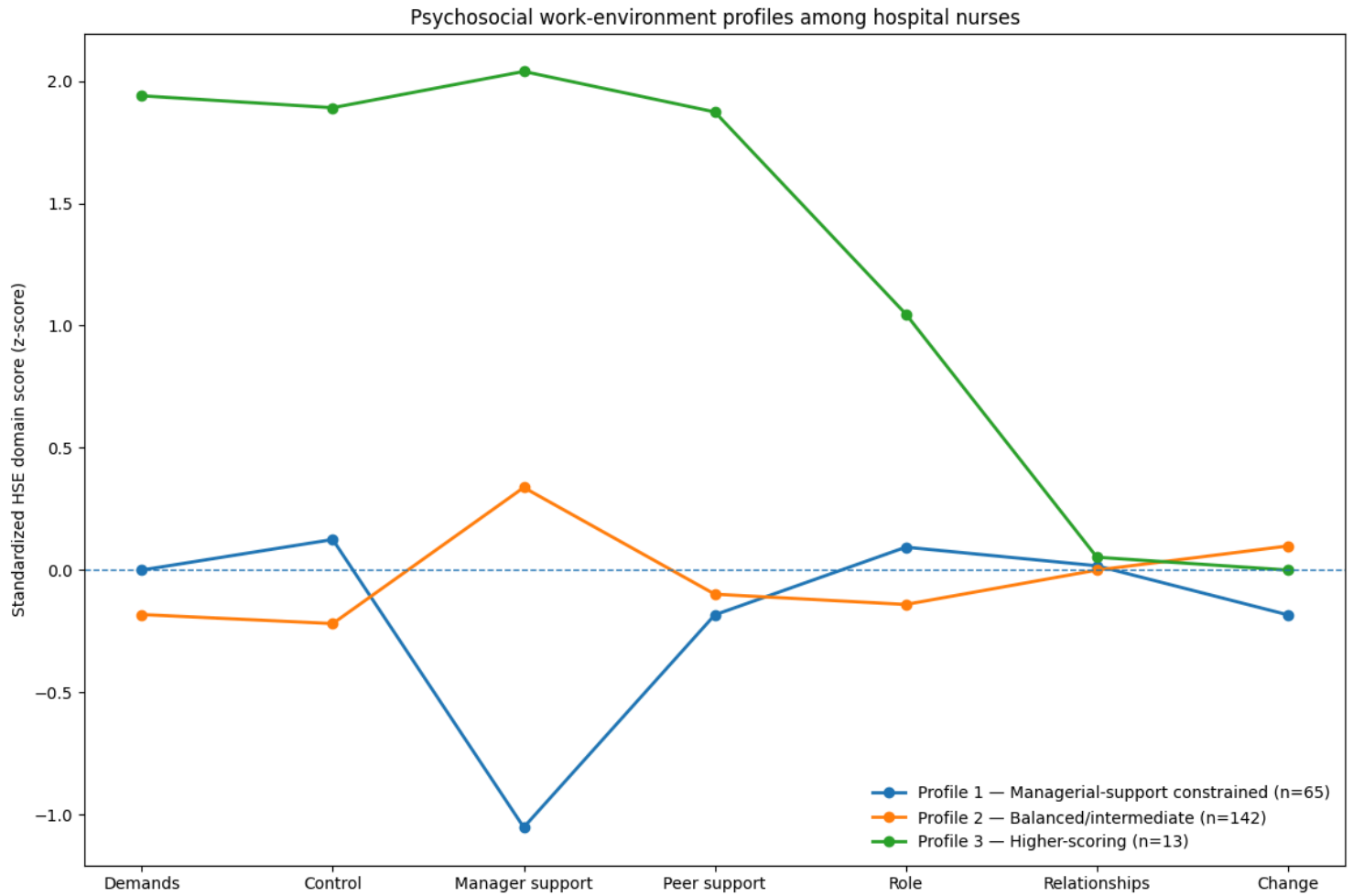


Figure 1

Latent psychosocial work-environment profiles among hospital nurses. Profile means are presented as standardized HSE scores for visualization, with 0 representing the sample mean for each dimension. The latent profile model was estimated using the original, unstandardized HSE domain mean scores.

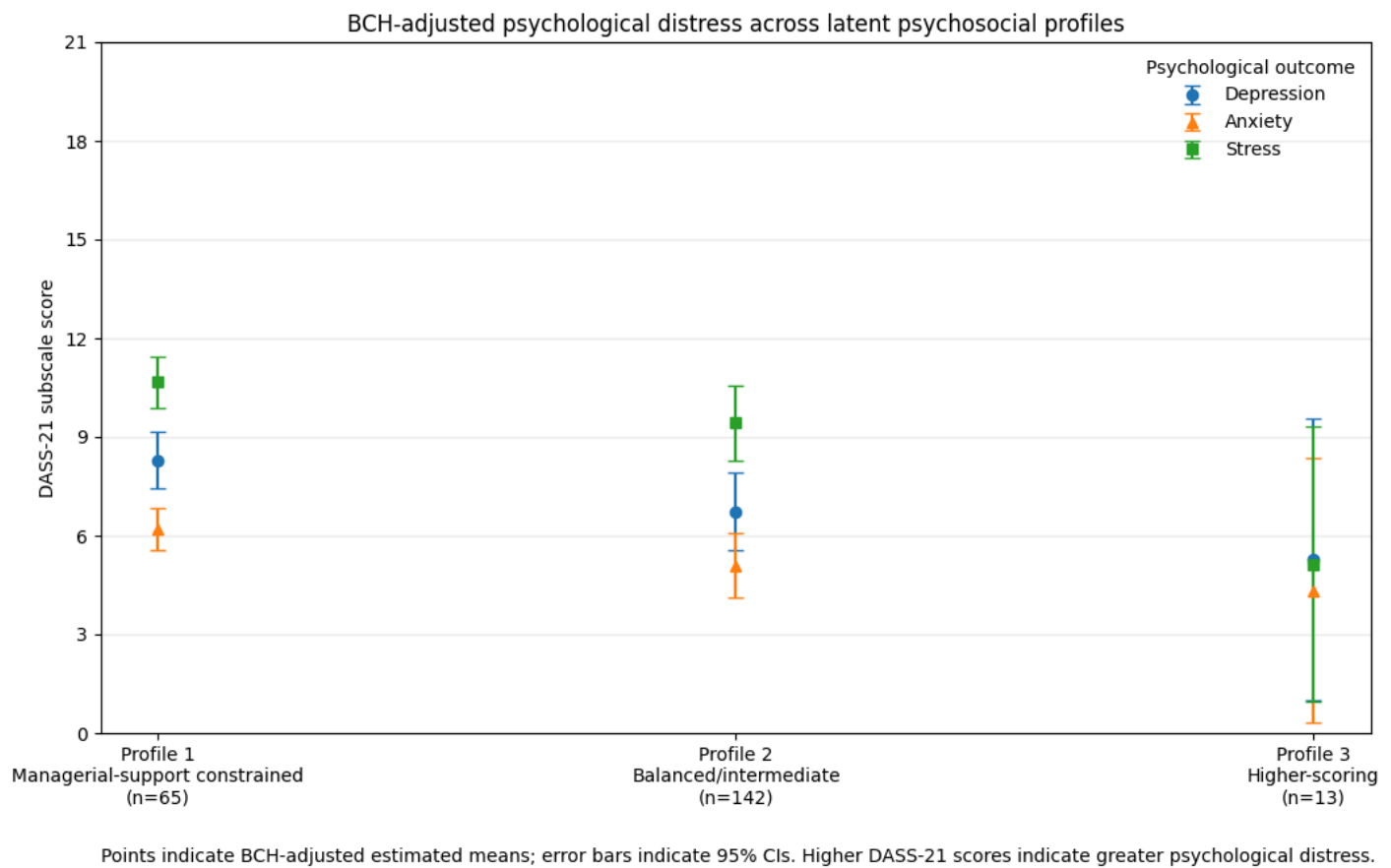


Figure 2

BCH-adjusted psychological distress with 95% CIs

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