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Determining the Relationship of Situational Awareness, Cognitive Flexibility, and Fatigue with Perceived Stress among Nurses

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Abstract

Background: Fatigue and stress are major occupational health concerns among clinical nurses and may adversely affect well-being and job performance. Cognitive resources such as situational awareness and cognitive flexibility may help nurses adapt to demanding work conditions, but the relationships among these factors remain insufficiently understood.

Objective: This study aimed to examine the associations among situational awareness, cognitive flexibility, fatigue, and perceived stress in clinical nurses.

Methods: In this descriptive-analytical cross-sectional study, 103 nurses were recruited using convenience sampling. Data were collected using standardized self-report instruments assessing situational awareness, cognitive flexibility, fatigue, and perceived stress. Statistical analyses included descriptive statistics, Pearson correlation coefficients, multiple linear regression, and path analysis. Because participant flow was not systematically documented, the number of invited and non-responding individuals could not be reported.

Results: All study measures showed acceptable to excellent internal consistency (Cronbach's alpha range: 0.801–0.915). Situational awareness and cognitive flexibility were significantly and inversely correlated with fatigue ($r=-0.458$ and $r=-0.571$, respectively; both $p<0.001$). Fatigue was positively correlated with perceived stress ($r=0.247$, $p=0.012$). In the regression model, fatigue was the only significant predictor of perceived stress ($\beta=0.325$, $p=0.007$), explaining 9.2% of the variance. Path analysis suggested an indirect relationship pattern in which situational awareness and cognitive flexibility were associated with perceived stress through fatigue; however, the overall model fit was poor (RMSEA=0.260), and these structural findings should therefore be interpreted with caution.

Conclusion: Fatigue appears to be a key correlate of perceived stress in nurses, whereas situational awareness and cognitive flexibility may function as protective resources through their associations with lower fatigue. Given the cross-sectional design, non-probability sampling, and poor structural model fit, causal and mediational interpretations remain tentative. Longitudinal studies with formal mediation testing are needed to clarify these relationships.

Introduction

Perceived stress refers to the degree to which individuals appraise situations in their daily lives as stressful, reflecting not merely the objective nature of events but primarily the cognitive evaluation of environmental demands in relation to available coping resource .(1) From an occupational health perspective, perceived stress emerges from a dynamic interaction between internal factors such as personality traits, beliefs, values, and cognitive appraisal styles and external factors, including workplace conditions, organizational demands, social pressures, and exposure to critical life events(2). Accumulating evidence indicates that elevated levels of perceived stress are associated with a wide range of adverse health outcomes, including anxiety, depression, sleep disturbances, fatigue,

gastrointestinal disorders, and hypertension. Furthermore, high perceived stress has been shown to impair work performance, interpersonal functioning, and overall quality of life. Among various occupational groups, nurses represent a particularly vulnerable population due to the inherently high physical, cognitive, and emotional demands of their work. From an ergonomics and occupational health standpoint, nursing tasks are characterized by sustained workload, time pressure, frequent interruptions, prolonged shifts, patient handling, and continuous exposure to critical and life-threatening situations. Additional factors such as staffing shortages, rotating shift work, and the need for rapid decision-making under uncertainty further exacerbate occupational stress in this group .(3)Prolonged exposure to such stressors not only compromises nurses' physical and psychological health but also adversely affects patient safety and the quality of healthcare delivery. Consequently, identifying cognitive and psychosocial determinants of perceived stress in nursing professionals constitutes a key priority in occupational health research.

One construct that has received increasing attention in human factors and ergonomics research is situational awareness. Situational awareness refers to an individual's ability to perceive relevant elements in the environment, comprehend their meaning, and project their future status. This capability is particularly critical in complex and dynamic work systems, such as clinical settings, where timely and accurate decisions are essential for maintaining safety and performance. In nursing practice, high levels of situational awareness enable early detection of patient condition changes, effective task prioritization, and efficient management of high-risk clinical situations. Empirical studies have demonstrated that enhanced situational awareness is associated with improved decision-making performance and a reduced likelihood of human error in healthcare environments (4, 5). From an ergonomic perspective, situational awareness functions as a cognitive resource that may buffer the negative impact of high workload and environmental stressors on perceived stress. This construct typically encompasses four subcomponents: focus, attention, anticipation, and distraction (4, 5). Another critical cognitive resource relevant to occupational stress is cognitive flexibility, defined as the ability to shift perspectives, adapt to changing task demands, and generate alternative strategies for problem solving(6–8). Within ergonomically complex work environments such as hospitals, cognitive flexibility supports efficient information processing, adaptive decision-making, and resilience in the face of unexpected events. Research in occupational psychology suggests that individuals with higher cognitive flexibility demonstrate superior emotional regulation and coping capacities, which in turn are associated with lower levels of perceived stress (9).Cognitive flexibility is generally conceptualized as comprising two core dimensions: perceived control over challenging situations and the ability to generate alternative solutions (6). In addition to cognitive factors, fatigue represents a central occupational health concern in healthcare systems. Fatigue may manifest in both physical and cognitive forms and is frequently the result of sustained physical exertion, high job demands, extended work hours, shift work, and insufficient recovery time (10). Chronic fatigue has been shown to impair cognitive performance, leading to diminished attention, memory deficits, compromised decision-making, and reduced problem-solving capacity (11). From an ergonomic and safety perspective, these impairments increase the risk of errors, accidents, and perceived inefficacy at work, thereby contributing to elevated levels of perceived stress

among nurses. Moreover, fatigue is closely linked to psychological outcomes such as anxiety, depressive symptoms, and irritability, which may further intensify stress experiences (3). Fatigue is commonly operationalized through two sub dimensions : physical fatigue and cognitive fatigue (12). Despite the growing body of literature on occupational stress in nursing, most existing studies have examined situational awareness, cognitive flexibility, and fatigue in isolation. There remains a notable gap in integrative research that simultaneously investigates the combined and interactive effects of these cognitive-ergonomic and occupational health factors on perceived stress. Addressing this gap is essential for developing a comprehensive understanding of stress mechanisms within healthcare work systems. Accordingly, the primary aim of the present study is to elucidate the structural relationships among the subcomponents of situational awareness, cognitive flexibility, and fatigue (physical and cognitive) in relation to perceived stress among nurses, using path analysis. Both direct and indirect effects of the predictor variables on perceived stress are examined to determine their relative contributions within a unified structural model. The findings of this study are expected to provide empirical evidence to inform ergonomics-based and occupational health interventions aimed at reducing stress and promoting psychological well-being among nursing professionals.

Materials and Methods

Study Design and Setting

This study utilized a descriptive-analytical, cross-sectional design. Data collection was conducted from May to June 2026 across clinical wards within hospitals affiliated with the Mazandaran University of Medical Sciences, Iran. The target population consisted of clinical nurses actively employed in patient care settings.

Participants and Sampling

A convenience sampling strategy was employed to recruit participants from the hospital's nursing staff. Only fully completed questionnaires (n = 103) were included in the final analysis. Information on the total number of eligible nurses approached, those who refused to participate, and the number of incomplete responses excluded was not systematically documented during the data collection process. Consequently, the exact response rate could not be determined.

The inclusion criteria were: (1) a minimum of one year of clinical work experience, (2) active employment in clinical wards, and (3) willingness to participate. Participants who submitted incomplete questionnaires (e.g., missing essential demographic or item data) or reported a history of severe psychiatric disorders were excluded from the analysis.

Ethical Considerations

The study was approved by the Ethics Committee of Mazandaran University of Medical Sciences, Sari, Iran (Ethics code: IR.MAZUMS.REC.1405.027). All participants were informed about the objectives and

procedures of the study, and written informed consent was obtained from all participants before data collection. All methods were performed in accordance with the relevant guidelines and regulations.

Measures

Data were collected using four standardized, self-report instruments:

1. Perceived Stress: Measured using the 10-item Perceived Stress Scale (PSS-10) (Cohen et al.). This instrument assesses the degree to which life situations are appraised as stressful over the past month. Responses are recorded on a 5-point Likert scale (0=never, 4=very often), with higher aggregate scores indicating greater perceived stress (13, 14).

2. Situational Awareness: Assessed via the 20-item Work Situational Awareness Scale. This tool evaluates four domains: concentration, attention, anticipation, and distraction. Responses are provided on a 5-point Likert scale (1=never, 5=very often), where higher scores reflect superior situational awareness (15).

3. Cognitive Flexibility: Measured using the 20-item Cognitive Flexibility Inventory (CFI), consisting of two subscales: control and alternatives. Higher scores on the 5-point Likert scale indicate greater cognitive flexibility (6).

4. Fatigue: A 10-item scale was employed to assess both physical and cognitive fatigue. Respondents rate the frequency of fatigue symptoms on a Likert scale, with higher scores denoting increased fatigue levels (12).

Data Analysis

Statistical analysis was performed using SPSS (version 26) and AMOS (version 26). Descriptive statistics (means and standard deviations) were calculated to summarize participant characteristics, and the internal consistency of all scales was verified using Cronbach's alpha coefficients.

To examine the interrelationships between study variables, Pearson correlation analysis was conducted. Subsequently, predictors of perceived stress were identified via multiple regression analysis. Finally, path analysis within a Structural Equation Modeling (SEM) framework was employed to delineate the direct and indirect pathways among the variables. The model was estimated using the Maximum Likelihood (ML) method, and the overall model fit was evaluated using standard goodness-of-fit indices (GFI, CFI, TLI, and RMSEA).

Results

Demographic and Occupational Characteristics

A total of 103 clinical nurses participated in this study. Due to the study's documentation process, the numbers of invited, non-responding, and excluded individuals were not systematically recorded; thus, a formal participant flow and response rate are not reported. The demographic and occupational characteristics of the participants are summarized in Table 1.

The sample was predominantly female (n = 76, 73.8%) and married (n = 82, 79.6%). In terms of educational attainment, the vast majority held a Bachelor's degree (n = 82, 79.6%), while others possessed Master's (n = 12, 11.7%), Associate (n = 8, 7.8%), or PhD (n = 1, 1.0%) degrees.

Regarding employment status, most participants held formal (permanent) positions (n = 82, 79.6%), followed by company-based (n = 10, 9.7%), Peymani (contract-to-permanent) (n = 10, 9.7%), and contractual (n = 1, 1.0%) statuses. The participants were distributed across various hospital departments, with the highest representation from the Emergency unit (n = 23, 22.3%), followed by Surgery (n = 15, 14.6%), ICU (n = 11, 10.7%), Internal Medicine (n = 9, 8.7%), and CCU (n = 5, 4.9%); the remaining 38.8% (n = 40) worked in other specialized wards. Finally, the majority of nurses worked rotating shifts (n = 81, 78.6%), while 21.4% (n = 22) followed a fixed shift schedule.

Table 1
Demographic and Occupational Characteristics of Participants (N = 103)

Variable		N	%
Gender	Female	76	8.73
	Male	27	2.26
Marital status	Single	18	.517
	Married	82	.679
	Divorced	3	2.9
Education level	Associate degree	8	7.8
	Bachelor’s degree	82	79.6
	Master’s degree	12	11.7
	PhD	1	1
Employment status	Company-based	10	9.7
	Contractual	1	1
	Peymani (contract-to-permanent)	10	9.7
	Formal (permanent)	82	79.6
Work department	Emergency	23	22.3
	Internal medicine	9	8.7
	Surgery	15	14.6
	ICU	11	10.7
	CCU	5	4.9
	Other departments	40	38.8
Shift work status	Fixed shift	22	21.4
	Rotating shift	81	78.6

Note. Values are frequencies (n) and percentages (%). Percentages may not sum to 100 due to rounding.

Descriptive Statistics, Reliability, and Inter-correlations

Table 2 presents the descriptive statistics, internal consistency coefficients, and Pearson correlation coefficients for the study variables. All scales showed acceptable to excellent internal consistency, with Cronbach’s alpha values ranging from .801 for perceived stress to .915 for situational awareness. The

mean scores were 3.49 ± 0.63 for situational awareness, 3.70 ± 0.68 for cognitive flexibility, 2.61 ± 0.67 for fatigue, and 14.30 ± 4.83 for perceived stress.

Pearson correlation analysis showed that situational awareness was positively correlated with cognitive flexibility and negatively correlated with fatigue. Cognitive flexibility was also negatively correlated with fatigue. In addition, fatigue was positively correlated with perceived stress. However, perceived stress was not significantly correlated with situational awareness or cognitive flexibility at the bivariate level.

Table 2
Descriptive Statistics, Reliability, and Inter-correlations Among Study Variables (n = 103)

Variable	Number of Items	Cronbach's Alpha	Mean	SD	SA	CF	FAT	PS
Situational Awareness (SA)	20	.915	3.49	0.63	1	-	-	-
Cognitive Flexibility (CF)	20	.912	3.70	0.68	.340***	1	-	-
Fatigue (FAT)	10	.878	2.61	0.67	−.458***	−.571***	1	-
Perceived Stress (PS)	10	.801	14.30	4.83	−.114	−.026	.247*	1

Note. Values are Pearson correlation coefficients. p < .05, p < .01, p < .001 (two-tailed).

Multiple Regression Analysis

A multiple linear regression analysis was conducted to examine whether situational awareness, cognitive flexibility, and fatigue predicted perceived stress. The overall model was statistically significant, $F(3,99) = 3.34$, $p=.022$, and explained 9.2% of the variance in perceived stress ($R^2=.092$; adjusted $R^2=.064$). Among the predictors, fatigue was the only statistically significant positive predictor of perceived stress ($\beta = .325$, $t = 2.76$, $p=.007$). Situational awareness ($\beta=-.110$, $t = -1.11$, $p=.270$) and cognitive flexibility ($\beta = .182$, $t = 1.55$, $p=.124$) were not significant predictors in the multivariable model. Given the overlap among predictors, these coefficients should be interpreted cautiously because of possible multi collinearity. Confidence intervals for the regression coefficients were not reported in the available output in Table 3.

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Table 3
Multiple Regression Model Predicting Perceived Stress (N = 103)

Predictor	B	SE	β	t	p
Situational Awareness	− .105	.094	− .110	-1.11	.270
Cognitive Flexibility	.068	.044	.182	1.55	.124
Fatigue	.119	.043	.325	2.76	.007
Model Summary	**R^2=.092, Adjusted R^2=.064, F(3,99) = 3.34, p=.022**				
Note. B = unstandardized coefficient; SE = standard error; β = standardized coefficient.					

Path Analysis

Path analysis indicated that cognitive flexibility was negatively associated with fatigue (β=−.476, p<.001), and situational awareness was also negatively associated with fatigue (β=−.378, p<.001). In turn, fatigue was positively associated with perceived stress (β = .554, p<.001). These findings are consistent with an indirect pattern in which higher cognitive flexibility and situational awareness may relate to lower perceived stress through reduced fatigue. However, indirect effects were not formally estimated, and no bootstrap confidence intervals were reported; therefore, the mediation-like interpretation should be considered tentative in Table 4.

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Table 4
Standardized Path Coefficients for the Proposed Structural Model

Path	Estimate) β(	S.E.	C.R.	p
Cognitive Flexibility → Fatigue	− .476	.082	-5.780	p<.001
Situational Awareness → Fatigue	− .378	.103	-3.677	p<.001
Fatigue → Perceived Stress	.554	.068	8.110	p<.001
Note. β = standardized estimate; SE = standard error; CR = critical ratio.				

Model Fit Assessment

The overall structural model showed poor fit to the data. Although the GFI suggested acceptable fit (GFI=.933), the remaining indices indicated inadequate model fit (CFI=.890, IFI=.894, TLI=.671, RMSEA=.260, χ2 = 15.799, p<.001). In particular, the RMSEA value was far above acceptable thresholds, indicating substantial misfit. Accordingly, the structural model should be interpreted cautiously, and the findings are best considered exploratory rather than confirmatory in Table 5.

Table 5
Goodness-of-Fit Indices for the Structural Model

Index	Recommended Value	Obtained Value
χ2 (Chi-square)	p> .05	15.799 (p=.000)
Degrees of Freedom (df)	-	2
χ2/ df	< 3.0	7.899
GFI	> .90	.933
CFI	> .95	.890
TLI	> .95	.671
IFI	> .95	.894
RMSEA	< .08	.260
Note. Fit indices are reported as provided by AMOS.		

Discussion

The present study examined the relationships among situational awareness, cognitive flexibility, fatigue, and perceived stress in nurses. The findings indicated that situational awareness and cognitive flexibility were negatively associated with fatigue, whereas fatigue was positively associated with perceived stress. In the multiple regression model, fatigue remained the only significant predictor of perceived stress when all predictors were considered simultaneously. This pattern suggests that fatigue may be a more proximal correlate of perceived stress than either situational awareness or cognitive flexibility.

The inverse association between situational awareness and fatigue is consistent with the view that nurses with better situational awareness may be more capable of processing clinical information efficiently and maintaining attentional focus under demanding conditions. Prior nursing research has similarly suggested that situational awareness is associated with lower occupational stress and better adaptation to demanding work environments. In a study of nurses in Ahvaz, situational awareness was significantly and inversely correlated with occupational stress, and it contributed to the prediction of stress alongside resilience (16). Although that study focused on occupational stress rather than perceived stress, it supports the broader idea that situational awareness may function as a protective cognitive resource in nursing settings(17, 18).

The negative association between cognitive flexibility and fatigue is also plausible in light of prior evidence showing that cognitive flexibility is an adaptive resource in nurses (4). reported that cognitive flexibility predicted flexible coping in nurses and was related to perceived stress and coping-related functioning (19). In the context of the present study, nurses with greater cognitive flexibility may be better able to reinterpret stressful situations, shift mental sets, and adapt to changing clinical demands,

which may reduce the accumulation of fatigue(20). This interpretation is also consistent with broader evidence that cognitive flexibility supports adaptive coping and psychological adjustment.

Fatigue was positively associated with perceived stress and emerged as the only significant predictor in the regression model. This finding is consistent with previous work showing that fatigue is a central occupational health concern in nursing and is linked to impaired functioning and adverse well-being outcomes. Systematic review evidence indicates that nurse fatigue is associated with reduced safety, poorer organizational outcomes, and mental health problems (21). Similarly, more recent studies have emphasized that occupational fatigue in nurses is a major outcome related to workload, shift patterns, and psychological strain (22). Together, these findings support the interpretation that fatigue may be a key pathway through which work-related demands are translated into perceived stress (21).

The path analysis suggested that situational awareness and cognitive flexibility were indirectly related to perceived stress through fatigue. However, because the structural model showed poor overall fit, especially given the very high RMSEA, this indirect interpretation should be considered exploratory rather than confirmatory. The model fit indices indicate that the hypothesized structural pattern did not adequately reproduce the observed covariance structure(23). Therefore, although the estimated paths are theoretically meaningful, stronger evidence is needed before concluding that fatigue mediates the relationship between situational awareness, cognitive flexibility, and perceived stress(24).

These findings should be interpreted in light of the broader literature on nursing stress and cognitive adaptation. Nursing work is inherently demanding, and the combination of cognitive load, emotional labor, and shift-related strain can reduce attentional capacity and increase fatigue(25). Prior studies have suggested that both situational awareness and cognitive flexibility may help nurses cope more effectively with these demands, but the current results imply that their influence on perceived stress may operate indirectly through fatigue rather than through direct effects. This interpretation is also consistent with research on stress, fatigue, and cognitive flexibility in other populations, which has shown that cognitive flexibility may function as a psychological resource linking stress-related experiences with well-being outcomes (26).

A further important issue is the lack of formal mediation testing in the present study. Because indirect effects were not evaluated using bootstrap confidence intervals, the mediation-like interpretation remains tentative(27). Future studies should therefore test these pathways with longitudinal designs and bootstrap-based mediation analyses to clarify temporal ordering and confirm whether fatigue truly mediates the effects of situational awareness and cognitive flexibility on perceived stress (28).

Overall, the present findings suggest that fatigue plays a central role in the stress experience of nurses, while situational awareness and cognitive flexibility may serve as protective cognitive resources that reduce fatigue and thereby indirectly relate to stress. From an occupational health perspective, interventions aimed at reducing fatigue and strengthening cognitive adaptability may be valuable for supporting nurses' mental well-being and work functioning.

Conclusion

In this cross-sectional study of nurses, fatigue was the strongest correlate of perceived stress, while situational awareness and cognitive flexibility were inversely related to fatigue. Although the path model suggested possible indirect relationships, the poor model fit and absence of formal bootstrap mediation testing mean that these findings should be interpreted cautiously. Overall, the results highlight fatigue as a key target for interventions and suggest that enhancing situational awareness and cognitive flexibility may be beneficial for reducing fatigue-related stress in nurses.

Strengths and Limitations

Strengths

This study has several strengths. First, it examined situational awareness, cognitive flexibility, fatigue, and perceived stress simultaneously, providing an integrated view of psychosocial and cognitive factors in nurses. Second, the study used standardized instruments with acceptable internal consistency. Third, the analysis combined correlational, regression, and path-based approaches, allowing a more comprehensive examination of the proposed relationships.

Limitations

Several limitations should be considered. First, the cross-sectional design precludes causal inference and limits the ability to establish temporal relationships among the variables. Second, convenience sampling may limit generalizability to other nursing populations. Third, the number of invited nurses and non-responders was not systematically recorded, which restricts assessment of response bias. Fourth, all variables were self-reported, increasing the possibility of common method bias. Fifth, the structural model showed poor fit, particularly due to the very high RMSEA, which weakens confidence in the path interpretation. Finally, indirect effects were not formally tested with bootstrap confidence intervals, so the mediation-like interpretation remains exploratory.

Declarations

Ethics approval and consent to participate: This study was approved by the Ethics Committee of Mazandaran University of Medical Sciences, Sari, Iran (Ethics code: IR.MAZUMS.REC.1405.027(. All participants were informed about the objectives of the study and written informed consent was obtained from all participants before data collection.

Consent for publication: Not applicable.

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Authors' contributions:

PH: Conceptualization, Methodology, Data collection, Writing – original draft.

MB: Data collection, Investigation, Writing – review and editing.

MMK: Formal analysis, Statistical analysis, Methodology, Writing – review and editing.

MSH: Conceptualization, Study supervision, Methodology, Writing – review and editing, Corresponding author. All authors read and approved the final manuscript.

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