# The Interaction of Ergonomic Risk Factors with Nurses' Psychological Resilience and Caring Behaviors: A Cross-sectional Study

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## Abstract

## Aims

This study investigated how exposure to ergonomic risk factors affects the interaction between psychological resilience and caring behaviors among nurses.

## Design:

This study was conducted with a cross-sectional and descriptive design.

## Method

This study was conducted with 367 nurses working in Adıyaman Training and Research Hospital between April and June 2025. Data were collected face-to-face via the Personal and Occupational Information Form, Questionnaire for Assessing Ergonomic Risks of Nursing Service Providers, Brief Psychological Resilience Scale and Caring Behaviors Inventory-24. Descriptive statistics, t tests, ANOVAs, Pearson correlation analyses and linear regression analyses were used to analyze the data.

## Results

Nurses were exposed to high levels of ergonomic risk, had moderate levels of psychological resilience and high levels of caring behavior. According to regression analysis, ergonomic risk significantly and negatively affects psychological resilience and general caring behaviors. Ergonomic risk also had significant and negative effects on all the subscales of caring behavior; in particular, the effect was stronger for the “respectful” subscale. On the other hand, psychological resilience had a significant positive effect on general caring behaviors and three subscales. However, there was no significant effect on the “commitment” subscale.

## Conclusion

Ergonomic risk negatively affects nurses' psychological resilience and care behaviors, whereas psychological resilience positively affects caring behavior. These findings suggest that improving nurses' ergonomic conditions and supporting their psychological resilience can improve the quality of care. Health managers should develop strategies to reduce nurses' ergonomic exposure and strengthen their psychological resilience.

## Impact:

Controlling and improving ergonomic risk factors in nurses' work environments will have positive effects on psychological resilience and caring behaviors.

## Reporting Method

: STROBE checklist for cross-sectional studies.

## Public Contribution:

This study did not include patient or public involvement in its design, conduct, or reporting.

## 1. Introduction

Nurses face various ergonomic risks in their work environments (1). These risks affect nurses directly or indirectly in physical, biological, psychological and social aspects (2). These effects are reflected in care services (3). The positive development of care environments enables nurses to be resilient in the face of negative or stressful situations, react more effectively, and provide safe and efficient nursing care (4).

## 2. Background

Nurses, who are the most numerous health professionals, spend the most time providing direct patient care and are therefore highly affected by ergonomic risk factors (1). Ergonomic risk factors in the work environment for nurses include physical environmental factors, occupational health and safety, social and economic factors, work design and organization, information presentation, communication and individual factors (5). Nurses face serious work pressures due to the heavy burden of caring for patients, jeopardizing their physical and mental health due to overwork, a high risk of infection and uncertainty (6). Furthermore, when exposed to ergonomic risks, musculoskeletal disorders (7), absenteeism, decreased productivity and performance, decreased quality of care (3), job dissatisfaction, job stress and increased work accidents occur (8). The working environments and conditions of nurses directly affect nursing outcomes (9) and are important in terms of care performance and quality, reducing medical errors and ensuring safe patient outcomes (10).

Psychological resilience is the ability to return to a normal psychological state following adversity or performance pressure (6). Psychological resilience enables nurses to better cope with challenging environments, adapt and reduce fatigue more easily (11), increases the effectiveness of nurses and leads to greater success (6). The existence of strategies to improve the psychological resilience of nurses enables them to provide efficient and safe nursing care to patients (12). Resilience involves two main elements, personal factors and environmental-systemic factors, and the interaction between these two elements enhances resilience (13). Resilience is positively associated with life and job satisfaction, coping self-efficacy, self-esteem and resilience (14).

Human care theory, which combines care and love and shows ways to provide care via a scientific and holistic approach, proposes caring for individuals not only physically but also psychologically, socially, culturally, ethically and spiritually (15). These aspects of care are demonstrated through nurses' caring behaviors. Caring behaviors include caring, being present, being courteous and respectful, giving importance, taking time, listening, being accessible, smiling, showing interest, empathy, sensitivity and compassion and increasing satisfaction with care (16). Adversities in care settings are stressors, and the use of effective cognitive, affective and behavioral self-regulation and responses in stressful situations improves nurses' ability to respond more effectively and provide better quality care (4).

There are various studies in the literature in line with the subject of our research (13, 17–19). In this context, the number of studies on the subject is limited, and no study has directly examined the effect of ergonomic risk on psychological resilience and care behaviors. Considering that the negative factors in the working environments of nurses are stress factors and that ergonomic risk factors affect not only the physical dimension but also the social, economic, organizational, individual and psychological dimensions, the need for this research has revealed that they may affect psychological resilience and care behaviors.

## 3. Study Aims

This study investigated how exposure to ergonomic risk factors affects the interaction between psychological resilience and caring behaviors among nurses.

Figure 1 shows the study model.

The study seeks answers to the following questions:

- What are the personal and professional characteristics of nurses?
- What are the scores of nurses on ergonomic risk factors, psychological resilience and caring behaviors?
- Do the personal and professional characteristics of nurses affect ergonomic risk factors, psychological resilience and care behaviors?
- Do nurses' ergonomic risk factors correlate with their psychological resilience and caring behaviors?
- Does the psychological resilience of nurses correlate with their caring behaviors?

## 4. Methods

## 4.1 Study Design

This study was designed to be descriptive and cross-sectional.

## 4.2 Setting and Sample

This study was conducted between April and June 2025. The population of the study consisted of 1040 nurses working at the training and research hospital. The sample size was determined as 218 via the G Power 3.1.9.7 program on the basis of the effect size of similar findings in the literature (9, 13, 17–19), with an effect size of 0.20, a margin of error of 0.05 and a confidence interval of 85%. Considering the possibility of missing data, data collection forms were distributed to 400 nurses, 367 of whom completed the forms completely and constituted the sample of the study. A random sampling method was used for sample selection.

## 4.3 Inclusion and Exclusion Criteria

Nurses who volunteered to participate in the study, had no verbal-auditory communication problems, had been actively working at the relevant institution for at least 1 year during the research period, and had no diagnosed psychological problems were included. Nurses who did not meet these criteria and who were on leave or reported were excluded from the study.

## 4.4 Instruments

**4.4.1 Personal and Occupational Information Form**: This study was designed by researchers in line with the literature (13, 17, 20–31) and consists of 16 questions. These 16 questions included age, gender, marital status, education level, working unit, voluntary status in the unit of employment, position in the current unit, shift type, satisfaction with the organization, satisfaction with the occupation, thinking of leaving the job, decision making in the unit together with the team, workload status, ergonomics-related training status, and definition of health status for the past year.

**4.4.2 Questionnaire for Assessing Ergonomic Risks of Nursing Service Providers (ErgoEnf-TR)**: This questionnaire was developed by Coluci and Alexandre (2014) and adapted into Turkish by Ercan et al. (2021) to evaluate the ergonomic risks of individuals providing nursing services (29, 30). The questionnaire consists of 32 questions and 3 subdimensions (biomechanical factors; questions 1–9, environmental factors/workplaces; questions 10–16, organizational and psychosocial factors; and questions 17–32). The questions are answered on a 10-point Likert scale, where 0 = No effect at all and 10 = Very much effect. There is no reverse scoring question in the questionnaire, and each subscale is scored within itself. The score obtained from the subscale is summed and

divided by the highest score that can be obtained from that subscale and multiplied by 100 to calculate the score of that subscale. The total score of the questionnaire is obtained by summing the calculated subscale scores. The higher the score obtained from the questionnaire is, the greater the exposure to ergonomic risks. The lowest score that can be obtained from the questionnaire is 30, and the highest score is 300. There was no cutoff point for scoring the questionnaire. In the Turkish version of the questionnaire, the Cronbach's alpha coefficient was 0.97 (30). In this study, the Cronbach's alpha coefficient of the questionnaire was determined to be 0.95.

**4.4.3 Brief Psychological Resilience Scale**: The scale developed by Smith et al. (2008) and adapted into Turkish by Doğan (2015) to measure individuals' psychological resilience consists of a total of 6 questions (20, 22). After the items on the 5-point Likert-type scale are reverse coded (items 2, 4 and 6), a high score indicates high psychological resilience. The lowest score that can be obtained from the scale is 6, and the highest score is 30. There is no cutoff point in the scoring of the scale. In the Turkish version of the scale, the Cronbach's alpha coefficient was determined to be 0.83. (22). In this study, the Cronbach's α coefficient of the scale was determined to be 0.82.

**4.4.4 Caring Behaviors Inventory-24**: This scale is a tool used to evaluate the nursing care process. It was first developed by Wolf (1994) and includes 75 items in total (32). The scale was later revised by Wu et al. (2006) and organized into 24 items and 4 subscales (31). These subscales are assurance (8 items: 16, 17, 18, 20, 21, 22, 23, 24), knowledge skills (5 items: 9, 10, 11, 12, 15), respectfulness (6 items: 1, 3, 5, 6, 13, 19) and commitment (5 items: 2, 4, 7, 8, 14). Validity and reliability studies of the scale in Turkish were conducted by Kurşun and Kanan (2012) (33). This scale, which is used to measure the level of nurses' perception of quality of care, evaluates responses on a 6-point Likert-type scale. When the total scale score is calculated, the scores of all the items are summed, and this total score is divided by 24 to obtain a value between 1 (never) and 6 (always). Similarly, the scores of the items in the subscales are summed, and the score obtained is divided by the number of items to obtain a subscale score between 1 and 6. The higher the score obtained from the scale is, the greater the degree of caring behavior. The lowest score that can be obtained from the scale is 1, and the highest score is 6. There is no cutoff point in the scoring of the scale. The Cronbach's alpha value of the scale was determined to be 0.96, which is a high reliability indicator (33). In this study, the Cronbach's α coefficient of the scale was determined to be 0.97.

## 4.5 Data collection

At the beginning of the shift, the data collection forms were distributed to the nurses with the necessary explanations (the purpose of the study, its importance, and questions of interest) after they signed the informed consent form and were collected at the end of the shift.

## 4.6 Data analysis

The obtained data were coded and entered into the IBM SPSS Statistics 25 program, descriptive analyses were performed, and the normality distribution was tested. Skewness and kurtosis, histograms and Q–Q plots were evaluated in the examination of normality distributions. In the analyses, $p < .05$ was taken as the significance value. To test the research model, model fit was evaluated, followed by correlation analysis and linear regression analysis.

## 4.7 Ethical Declaration

Study permission was obtained from Adıyaman University noninterventional ethics committee (Meeting decision and date no: 27.03.2025-51). Institutional permission was obtained from the Chief Physician and Directorate of Nursing Services of the Adıyaman Training and Research Hospital for the implementation of the study. Before the data collection phase, the participants were informed about the research, their questions were answered, their verbal consent was obtained, and their written consent was obtained through the informed consent form. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

# 5. Results

## 5.1 Participants' Personal and Occupational Characteristics

The findings regarding the personal and occupational characteristics of the nurses are presented in Table 1. A total of 35.1% of the nurses who participated in our study were between 26 and 30 years old, 77.7% were female, 64.9% were married, and 83.1% had a bachelor's degree. A total of 37.9% of the nurses had occupational durations ranging from 1–5 years, 34.3% were working in other services (Palliative Care, Obstetrics and Gynecology, Pediatrics, Psychiatry and Oncology Services, Burn/Dialysis Unit), 82.0% were working in their current units voluntarily, 92.4% were working as clinical nurses, and 55.9% were working in a night–day rotating shift system. A total of 68.7% of the nurses stated that they were satisfied with the institution where they worked, 65.4% were satisfied with their profession, and 77.7% did not think that they left their jobs. A total of 73.0% of the nurses stated that decisions were made together with the team, and 92.6% stated that they had a high workload. Only 34% of the nurses had received training on ergonomics, and 54% described their health status as "good" for the past year.

Table 1
Personal and Occupational Characteristics of Nurses (N: 367)

| Variables | N | % |
|---|---|---|
| Age | | |
| 20–25 | 64 | 17.4 |
| 26–30 | 129 | 35.1 |
| 31–35 | 61 | 16.6 |
| 36–40 | 65 | 17.7 |
| 41–45 | 40 | 10.9 |
| 46–50 | 8 | 2.17 |
| Gender | | |
| Woman | 285 | 77.7 |
| Man | 82 | 22.3 |
| Marital Status | | |
| Married | 238 | 64.9 |
| Single | 129 | 35.1 |
| Education Level | | |
| High School | 10 | 2.7 |
| Associate Degree | 43 | 11.7 |
| Bachelor's Degree | 305 | 83.1 |
| Post Graduate | 9 | 2.5 |
| Occupational Duration of Employment | | |
| 1–5 years | 139 | 37.9 |
| 6–10 years | 66 | 18.0 |
| 11–15 years | 82 | 22.3 |
| 16–20 years | 57 | 15.5 |
| 21–25 years | 19 | 5.2 |
| 26 years and above | 4 | 1.1 |
| Working Unit | | |
| Internal Services | 30 | 8.2 |
| Surgical Services | 82 | 22.3 |
| Emergency Department | 40 | 10.9 |
| Intensive Care | 30 | 8.2 |
| Operating Room | 59 | 16.1 |
| Other* | 126 | 34.3 |
| **Palliative Care Service, Obstetrics Service, Pediatrics Service, Burn Unit, Dialysis Unit, Psychiatry Service, Oncology Service* | | |
| Working Voluntarily in the Unit of Employment | | |
| Yes | 301 | 82.0 |
| No | 66 | 18.0 |
| Position in the Current Unit | | |
| Clinic Nurse | 339 | 92.4 |
| Staff Nurse | 28 | 7.6 |
| Shift Type | | |
| Night | 28 | 7.6 |

| Variables | N | % |
|---|---|---|
| Day | 134 | 36.5 |
| Night-Day Shift | 205 | 55.9 |
| Satisfaction with the Organization | | |
| Yes | 252 | 68.7 |
| No | 115 | 31.3 |
| Satisfaction with the Occupation | | |
| Yes | 240 | 65.4 |
| No | 127 | 34.6 |
| Thinking of Leaving the Job | | |
| Yes | 82 | 22.3 |
| No | 285 | 77.7 |
| Decision Making in the Unit Together with the Team | | |
| Yes | 268 | 73.0 |
| No | 99 | 27.0 |
| Workload Status | | |
| Low | 27 | 7.4 |
| High | 340 | 92.6 |
| Ergonomics Related Training Status | | |
| Yes | 125 | 34.0 |
| No | 242 | 66.0 |
| Definition of Health Status for the Past Year | | |
| Very Low | 20 | 5.4 |
| Low | 134 | 36.5 |
| Goog | 198 | 54.0 |
| Very Good | 15 | 4.1 |
| *N: Number, %: Percentage* | | |

## 5.2 Participants' Levels of Ergonomic Risks, Psychological Resilience and Caring Behaviors

The mean scores, standard deviations and internal consistency coefficients of the scales used in the study are presented in Table 2. The mean score of the nurses on the Ergonomic Risk Assessment Questionnaire for Nursing Service Providers (ErgoEnf-TR) was 190.07 ± 55.56, and considering that the scale was evaluated over a total of 300 points, this value indicates that nurses are exposed to high levels of ergonomic risk. When the mean scores of the ErgoEnf-TR subscales are analyzed, the highest score corresponds to biomechanical factors (69.09 ± 19.66), and the lowest score corresponds to environmental factors (57.52 ± 22.30). In addition, the Cronbach's alpha coefficients of the ErgoEnf-TR questionnaire and its subscales ranged between 0.89 and 0.95, indicating that this measurement tool is highly reliable (34). The mean score obtained from the Psychological Resilience Scale (PRS) was 17.84 ± 4.16, indicating that the psychological resilience of the nurses was moderate. The Cronbach's alpha value of the scale is 0.81. This value indicates an acceptable level of internal consistency in the measurement of the level of psychological resilience (34). The mean score of the Caring Behaviors Inventory-24 (CBI) was 4.94 ± 0.80, and it was determined that the nurses' caring behaviors were high. An analysis of the subscales revealed that the highest mean score was associated with knowledge skills (5.12 ± 0.84), and the lowest mean score was associated with commitment (4.83 ± 0.83). The Cronbach's alpha values for all the subdimensions ranged between 0.89 and 0.95, indicating that the reliability of the subdimensions is quite high (34).

Table 2
Scale Scores and Coefficient of Internal Consistency

| Scale | Mean ± SS | Cronbach Alpha |
|---|---|---|
| ErgoEnf-TR | 190.07 ± 55.56 | 0.95 |
| ErgoEnf-TR Biomechanical Factors Subscale | 69.09 ± 19.66 | 0.91 |
| ErgoEnf-TR Environmental Factors Subscale | 57.52 ± 22.30 | 0.89 |
| ErgoEnf-TR Organizational and Psychosocial Factors Subscale | 63.45 ± 21.59 | 0.94 |
| Psychological Resilience Scale (PRS) | 17.84 ± 4.17 | 0.81 |
| Caring Behaviours Inventory-24 (CBI) | 4.94 ± 0.80 | 0.97 |
| CBI-Assurance Subscale | 4.92 ± 0.85 | 0.94 |
| CBI-Knowledge-Skills Subscale | 5.12 ± 0.84 | 0.90 |
| CBI-Respectfulness Subscale | 4.90 ± 0.84 | 0.93 |
| CBI-Commitment Subscale | 4.83 ± 0.83 | 0.89 |
| *SS: Standart Deviation, ErgoEnf-TR: Turkish Version of the Questionnaire for Assessing Ergonomic Risks of Nursing Service Providers.* | | |

### 5.3 Differences in Ergonomic Risks, Psychological Resilience and Caring Behaviors According to Nurse Personal and Occupational Characteristics

The differences in the ergonomic risk, psychological resilience and caring behavior scores of the nurses according to their personal and occupational characteristics are presented in Table 3. According to the results of the analysis, there was a statistically significant difference between the ErgoEnf-TR score ($F$ = 2.480, $p$ = .032) and its subscales E-1 ($F$ = 3.255, $p$ = .007) and E-2 ($F$ = 2.429, $p$ = .035) scores according to age group. A statistically significant difference was found between the ErgoEnf-TR score ($t$ = -3.186, $p$ = .002) and its subscales E-1 ($t$ = -2.337, $p$ = .020), E-2 ($t$ = -4.401, $p$ = .000) and E-3 ($t$ = -4.691, $p$ = .000) scores in terms of gender. There was a significant difference between marital status and CBI scores ($t$ = 2.260, $p$ = .024). A statistically significant difference was found between the level of education and the E-2 subscale score of the ErgoEnf-TR ($F$ = 2.789, $p$ = .040) and the C-4 subscale score of the CBI ($F$ = 2.917, $p$ = .034). A statistically significant difference was observed between the ErgoEnf-TR score ($F$ = 2.475, $p$ = .032) and its subscale E-3 score ($F$ = 3.335, $p$ = .006) and the C-4 score of the subscale of the CBI ($F$ = 2.476, $p$ = .032). A statistically significant difference was found in the ErgoEnf-TR score ($F$ = 6.041, $p$ = .000) and all subscales E-1 ($F$ = 5.243, $p$ = .000), E-2 ($F$ = 7.269, $p$ = .000), and E-3 ($F$ = 3.433, $p$ = .005) scores in terms of the working unit. Similarly, a statistically significant difference was found in the PRS score ($F$ = 4.647, $p$ = .000), CBI score ($F$ = 2.988, $p$ = .012) and CBI subscales C-1 ($F$ = 2.499, $p$ = .030), C-2 ($F$ = 3.172, $p$ = .008), C-3 ($F$ = 3.168, $p$ = .008) and C-4 ($F$ = 3.936, $p$ = .002). There is a statistically significant difference in the ErgoEnf-TR score ($t$ = -3.538, $p$ = .000) and its subscales E-1 ($t$ = -1.981, $p$ = .048), E-2 ($t$ = -3.285, $p$ = .001) and E-3 ($t$ = -4.302, $p$ = .000) scores according to working voluntarily in the unit of employment. Statistically significant differences were also found in the PRS score ($t$ = 4.405, $p$ = .000), the CBI score ($t$ = 2.632, $p$ = .010) and the CBI subscales C-1 ($t$ = 2.560, $p$ = .012), C-2 ($t$ = 2.822, $p$ = .006), C-3 ($t$ = 2.396, $p$ = .019) and C-4 ($t$ = 2.623, $p$ = .010). There was a statistically significant difference between the scores of the E-1 subscale of the ErgoEnf-TR ($t$ = -2.699, $p$ = .007) and the C-4 subscale of the CBI ($t$ = -2.237, $p$ = .026) according to the status in the current unit. Statistically significant differences were found in the ErgoEnf-TR ($F$ = 7.808, $p$ = .000), E-2 ($F$ = 9.311, $p$ = .000) and E-3 ($F$ = 11.148, $p$ = .000) scores of ErgoEnf-TR and the PRS score ($F$ = 3.620, $p$ = .028) according to the position in the current unit. There were statistically significant differences in the ErgoEnf-TR score ($t$ = -7.669, $p$ = .000) and its subscales E-1 ($t$ = -5.212, $p$ = .000), E-2 ($t$ = 5.082, $p$ = .000) and E-3 ($t$ = -8.775, $p$ = .000) scores and PRS score ($t$ = 2.264, $p$ = .024) according to satisfaction with the organization. In terms of satisfaction with the occupation, there was a statistically significant difference in the ErgoEnf-TR score ($t$ = -4.841, $p$ = .000) and its subscales E-1 ($t$ = -2.426, $p$ = .016), E-2 ($t$ = -3.741, $p$ = .000) and E-3 ($t$ = -6.426, $p$ = .000). A statistically significant difference was found in the ErgoEnf-TR score ($t$ = 2.822, $p$ = .005) and its subscale E-3 score ($t$ = 6.018, $p$ = .000) and PRS score ($t$ = -2.281, $p$ = .024) according to the status of leaving the job. A statistically significant difference was found in the ErgoEnf-TR score ($t$ = -5.561, $p$ = .000) and its subscales E-1 ($t$ = -3.487, $p$ = .001), E-2 ($t$ = -3.741, $p$ = .000) and E-3 ($t$ = -4.551, $p$ = .000) scores according to whether the decisions in the unit were made together with the team. In terms of workload status, the ErgoEnf-TR score ($t$ = -4.669, $p$ = .000) and its subscales E-1 ($t$ = -3.320, $p$ = .001), E-2 ($t$ = -4.069, $p$ = .000) and E-3 ($t$ = -4.718, $p$ =. 000) scores, PRS scores ($t$ = 3.109, $p$ = .002), and C-3 ($t$ = 2.038, $p$ = .042) and C-4 ($t$ = 2.040, $p$ = .042) scores, which are subscales of the CBI. According to the definition of health status for the past year, the ErgoEnf-TR score ($F$ = 10.603, $p$ = .000) and its subscales E-1 ($F$ = 7.975, $p$ = .000), E-2 ($F$ = 3.382, $p$ = .018) and E-3 ($F$ = 17.776, $p$ = .000) scores, PRS score ($F$ = 11. 869, $p$ = .000), CBI score ($F$ = 3.677, $p$ = .012) and C-2 ($F$ = 5.334, $p$ = .001), C-3 ($F$ = 3.835, $p$ = .010) and C-4 ($F$ = 3.410, $p$ = .018) scores, which are subscales of the CBI.

Table 3
Differences in ErgoEnf-TR, Psychological Resilience and Caring Behaviors Scores According to Personal and Occupational Cha

| Variables | Mean Scores from Scales and Subscales and Statistical Tests | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ErgoEnf-TR | | E-1 | | E-2 | | E-3 | | PRS | | CBI | | C-1 | |
| | M± SD | t/F (p) | M± SD | t/F (p) | M± SD | t/F (p) | M± SD | t/F (p) | M ± SD | t/F (p) | M ± SD | t/F (p) | M ± SD | t/F (p) |
| Age | | | | | | | | | | | | | | |
| 20–25 | 207.39 ± 50.80 | 2.480 **(.032)** | 76.18 ± 15.83 | 3.255 **(.007)** | 64.41 ± 24.36 | 2.429 **(.035)** | 66.79 ± 18.65 | 1.852 (.102) | 2.96 ± 0.67 | 1.536 (.178) | 4.91 ± 0.87 | .396 (.852) | 4.88 ± 0.93 | .413 (.839) |
| 26–30 | 188.77 ± 64.43 | | 68.34 ± 22.40 | | 57.50 ± 24.99 | | 62.92 ± 23.40 | | 3.06 ± 0.73 | | 4.92 ± 0.72 | | 4.91 ± 0.75 | |
| 31–35 | 181.82 ± 53.12 | | 68.87 ± 20.23 | | 52.50 ± 18.94 | | 60.45 ± 24.52 | | 2.86 ± 0.72 | | 4.85 ± 0.95 | | 4.81 ± 0.99 | |
| 36–40 | 184.99 ± 45.12 | | 66.54 ± 18.34 | | 53.82 ± 19.29 | | 64.62 ± 17.73 | | 2.84 ± 0.73 | | 5.01 ± 0.76 | | 4.97 ± 0.82 | |
| 41–45 | 194.91 ± 45.77 | | 68.05 ± 14.28 | | 60.71 ± 16.34 | | 66.14 ± 20.40 | | 3.00 ± 0.22 | | 4.99 ± 0.78 | | 5.04 ± 0.89 | |
| 46–50 | 152.41 ± 49.36 | | 51.94 ± 13.83 | | 55.00 ± 20.84 | | 45.46 ± 16.16 | | 3.29 ± 1.05 | | 5.12 ± 0.49 | | 5.00 ± 0.68 | |
| Gender | | | | | | | | | | | | | | |
| Woman | 185.7 ± 52.55 | -3.186 **(.002)** | 67.81 ± 18.47 | -2.337 **(.020)** | 54.84 ± 20.91 | -4.401 **(.000)** | 62.52 ± 21.52 | -1.549 (.122) | 2.87 ± 0.63 | -4.691 **(.000)** | 4.96 ± 0.69 | .943 (.348) | 4.93 ± 0.76 | .413 (.681) |
| Man | 207.09 ± 62.36 | | 73.53 ± 22.91 | | 66.84 ± 24.50 | | 66.70 ± 21.62 | | 3.32 ± 0.79 | | 4.84 ± 1.09 | | 4.87 ± 1.11 | |
| Marital Status | | | | | | | | | | | | | | |
| Married | 188.04 ± 52.73 | − .914 (.362) | 68.30 ± 19.36 | -1.047 (.296) | 56.63 ± 21.09 | -1.033 (.302) | 63.10 ± 20.99 | − .427 (.670) | 3,00 ± 0.71 | 1.294 (.197) | 5.00 ± 0.73 | 1.946 (.052) | 4.99 ± 0.79 | 2.260 **(.024)** |
| Single | 193.82 ± 60.46 | | 70.55 ± 20.20 | | 59.15 ± 24.38 | | 64.11 ± 22.72 | | 2,91 ± 0.64 | | 4.83 ± 0.90 | | 4.78 ± 0.93 | |
| Education Level | | | | | | | | | | | | | | |
| High School | 194.87 ± 65.48 | 1.041 (.374) | 68.66 ± 17.18 | .120 (.948) | 38.00 ± 22.22 | 2.789 **(.040)** | 53.50 ± 22.30 | .853 (.465) | 3.06 ± 0.74 | .223 (.880) | 5.47 ± 0.55 | 1.753 (.156) | 5.52 ± 0.47 | 2.069 (.104) |
| Associate Degree | 188.11 ± 54.42 | | 69.74 ± 18.02 | | 56.24 ± 21.47 | | 65.47 ± 18.35 | | 2.96 ± 0.70 | | 4.87 ± 0.72 | | 4.78 ± 0.78 | |
| Bachelor's Degree | 188.24 ± 42.72 | | 68.91 ± 19.58 | | 58.27 ± 21.98 | | 63.44 ± 21.3 | | 2.97 ± 0.69 | | 4.92 ± 0.81 | | 4.91 ± 0.86 | |
| Post Graduate | 197.64 ± 84.21 | | 72.59 ± 32.67 | | 59.84 ± 29.94 | | 65.20 ± 30.08 | | 2.81 ± 0.70 | | 5.11 ± 0.74 | | 4.97 ± 0.91 | |
| Occupational Duration of Employment | | | | | | | | | | | | | | |
| 1–5 years | 194.87 ± 65.48 | 2.475 **(.032)** | 70.81 ± 21.26 | 2.086 (.067) | 60.34 ± 26.18 | 2.019 (.075) | 63.71 ± 23.40 | 3.335 **(.006)** | 3.06 ± 0.72 | 1,401 (.223) | 4.99 ± 0.77 | .984 (.427) | 4.96 ± 0.82 | 1.157 (.330) |
| 6–10 years | 188.11 ± 54.42 | | 68.24 ± 21.37 | | 57.16 ± 20.54 | | 62.69 ± 22.62 | | 2.93 ± 0.90 | | 4.82 ± 0.75 | | 4.81 ± 0.75 | |
| 11–15 years | 188.24 ± 42.72 | | 69.18 ± 18.14 | | 52.92 ± 19.03 | | 66.12 ± 17.79 | | 2.87 ± 0.61 | | 4.83 ± 0.94 | | 4.83 ± 1.00 | |

| Variables | Mean Scores from Scales and Subscales and Statistical Tests | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16–20 years | 194.74 ± 50.07 | | 69.74 ± 17.96 | | 59.37 ± 19.77 | | 65.62 ± 20.17 | | 2.88 ± 0.40 | | 5.06 ± 0.79 | | 5.00 ± 0.83 | |
| 21–25 years | 172.90 ± 32.97 | | 62.45 ± 5.66 | | 56.99 ± 14.14 | | 53.45 ± 17.57 | | 3.17 ± 0.69 | | 5.00 ± 0.45 | | 5.21 ± 0.69 | |
| 26 years and above | 108.11 ± 10.85 | | 43.33 ± 6.41 | | 35.71 ± 8.24 | | 29.06 ± 9.02 | | 2.91 ± 0.09 | | 5.08 ± 0.67 | | 4.50 ± 0.57 | |
| Working Unit | | | | | | | | | | | | | | |
| Internal Services | 154.75 ± 45.04 | 6.041 **(.000)** | 57.25 ± 19.99 | 5.243 **(.000)** | 43.33 ± 13.47 | 7.269 **(.000)** | 54.16 ± 18.80 | 3.433 **(.005)** | 3.12 ± 0.77 | 4.647 **(.000)** | 5.07 ± 0.63 | 2.988 **(.012)** | 5.05 ± 0.64 | 2.499 **(.030)** |
| Surgical Services | 190.21 ± 53.71 | | 72.03 ± 18.29 | | 55.67 ± 22.72 | | 62.50 ± 22.70 | | 2.87 ± 0.66 | | 5.05 ± 0.72 | | 4.99 ± 0.84 | |
| Emergency Department | 223.16 ± 55.75 | | 77.33 ± 19.91 | | 73.14 ± 19.95 | | 72.68 ± 20.02 | | 3.38 ± 0.78 | | 5.02 ± 0.63 | | 5.05 ± 0.76 | |
| Intensive Care | 198.24 ± 32.03 | | 71.40 ± 9.57 | | 56.71 17.15 | | 70.12 ± 9.83 | | 3.06 ± 0.28 | | 5.20 ± 0.44 | | 5.18 ± 0.42 | |
| Operating Room | 192.69 ± 58.69 | | 71.50 ± 20.78 | | 59.92 ± 25.60 | | 61.26 ± 21.38 | | 3.00 ± 0.73 | | 4.95 ± 0.92 | | 4.96 ± 1.02 | |
| Other* | 184.71 ± 56.52 | | 65.69 ± 20.01 | | 56.21 ± 21.21 | | 62.80 ± 22.95 | | 2.84 ± 0.66 | | 4.73 ± 0.89 | | 4.72 ± 0.88 | |
| **Palliative Care Service, Obstetrics Service, Pediatrics Service, Burn Unit, Dialysis Unit, Psychiatry Service, Oncology Service* | | | | | | | | | | | | | | |
| Working Voluntarily in the Unit of Employment | | | | | | | | | | | | | | |
| Yes | 185.34 ± 55.86 | -3.538 **(.000)** | 68.14 ± 19.75 | -1.981 **(.048)** | 55.75 ± 21.43 | -3.285 **(.001)** | 61.44 ± 21.71 | -4.302 **(.000)** | 3.04 ± 0.68 | 4.405 **(.000)** | 5.01 ± 0.68 | 2.632 **(.010)** | 4.98 ± 0.76 | 2.560 **(.012)** |
| No | 211.65 ± 49.00 | | 73.41 ± 18.79 | | 65.58 ± 24.49 | | 72.65 ± 18.56 | | 2.64 ± 0.64 | | 4.62 ± 1.14 | | 4.61 ± 1.12 | |
| Position in the Current Unit | | | | | | | | | | | | | | |
| Clinic Nurse | 188.54 ± 55.69 | -1.836 (0.67) | 68.30 ± 19.75 | -2.699 **(.007)** | 57.17 ± 22.40 | -1.052 (.293) | 63.07 ± 21.62 | -1,185 (.237) | 2.98 ± 0.70 | .882 (.378) | 4.92 ± 0.80 | -1.306 (.192) | 4.90 ± 0.85 | -1.257 (.210) |
| Staff Nurse | 208.53 ± 51.28 | | 78.65± 15.91 | | 61.78 ± 20.92 | | 68.10 ± 20.99 | | 2.86 ± 0.50 | | 5.13 ± 0.76 | | 5.11 ± 0.76 | |
| Shift Type | | | | | | | | | | | | | | |
| Night | 194.99 ± 45.72 | 7.808 **(.000)** | 67.93 ± 17.08 | .770 (.464) | 61.12 ± 20.57 | 9.311 **(.000)** | 65.93 ± 18.81 | 11.148**(.000)** | 2.94 ± 0.70 | 3.620 **(.028)** | 5.01 ± 0.63 | .390 (.677) | 5.08 ± 0.77 | .781 (.459) |
| Day | 175.29 ± 54.65 | | 67.60 ± 18.91 | | 51.04 ± 21.85 | | 56.65 ± 22.32 | | 2.85 ± 0.67 | | 4.89 ± 0.76 | | 4.86 ± 0.74 | |
| Night-Day Shift | 199.06 ± 55.55 | | 70.22 ± 20.47 | | 61.26 ± 21.94 | | 67.57 ± 20.40 | | 3.05 ± 0.69 | | 4.95 ± 0.84 | | 4.93 ± 0.92 | |
| Satisfaction with the Organisation | | | | | | | | | | | | | | |
| Yes | 177.03 ± 55.24 | -7.669 **(.000)** | 65.59 ± 19.41 | -5.212 **(.000)** | 53.65 ± 21.47 | -5.082 **(.000)** | 57.78 ± 21.12 | -8.775 **(.000)** | 3.02 ± 0.68 | 2.264 **(.024)** | 4.92 ± 0.71 | − .466 (.642) | 4.90 ± 0.77 | − .463 (.644) |
| No | 218.64 ± 44.63 | | 76.74 ± 18.03 | | 66.00 ± 21.83 | | 75.90 ± 16.93 | | 2.85 ± 0.69 | | 4.97 ± 0.97 | | 4.95 ± 1.00 | |
| Satisfaction with the Occupation | | | | | | | | | | | | | | |

| Variables | Mean Scores from Scales and Subscales and Statistical Tests | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yes | 180.16 ± 55.64 | -4.841 **(.000)** | 67.29 ± 19.22 | -2.426 **(.016)** | 54.41 ± 21.76 | -3.741 **(.000)** | 58.45 ± 21.30 | -6.426 **(.000)** | 3.02 ± 0.69 | 1.811 (.071) | 4.96 ± 0.69 | .761 (.448) | 4.96 ± 0.75 | 1.109 (.269) |
| No | 208.81 ± 50.53 | | 72.49 ± 20.10 | | 63.40 ± 22.20 | | 72.90 ± 18.84 | | 2.88 ± 0.68 | | 4.89 ± 0.98 | | 4.84 ± 1.01 | |
| Thinking of Leaving the Job | | | | | | | | | | | | | | |
| Yes | 203.97 ± 48.66 | 2.822 **(.000)** | 70.62 ± 20.13 | .800 (.424) | 59.23 ± 21.20 | .787 (.432) | 74.11 ± 17.01 | 6.018 **(.000)** | 2.79 ± 0.82 | -2.281 **(.024)** | 5.04 ± 0.95 | 1.346 (.179) | 5.02 ± 0.97 | 1.239 (.216) |
| No | 186.07 ± 56.84 | | 68.65 ± 19.54 | | 57.03 ± 22.62 | | 60.39 ± 21.81 | | 3.02 ± 0.64 | | 4.91 ± 0.75 | | 4.89 ± 0.81 | |
| Decision Making in the Unit Together with the Team | | | | | | | | | | | | | | |
| Yes | 180.64 ± 55.36 | -5.561 **(.000)** | 66.94 ± 20.24 | -3.487 **(.001)** | 54.38 ± 22.49 | -4.551 **(.000)** | 59.31 ± 21.52 | -7.011 **(.000)** | 2.99 ± 0.67 | .701 (.484) | 4.94 ± 0.75 | .141 (.888) | 4.92 ± 0.81 | .034 (.973) |
| No | 215.58 ± 47.74 | | 74.89 ± 16.76 | | 66.01 ± 19.48 | | 74.67 ± 17.44 | | 2.93 ± 0.76 | | 4.93 ± 0.91 | | 4.91 ± 0.95 | |
| Workload Status | | | | | | | | | | | | | | |
| Low | 143.33 ± 52.94 | -4.669 **(.000)** | 57.16 ± 23.36 | -3.320 **(.001)** | 41.05 ± 18.09 | -4.069 **(.000)** | 45.11 ± 21.70 | -4.718 **(.000)** | 3.37 ± 0.91 | 3.109 **(.002)** | 5.19 ± 0.67 | 1.700 (0.90) | 5.13 ± 0.80 | 1.348 (.178) |
| High | 193.78 ± 54.13 | | 70.03 ± 19.06 | | 58.83 ± 22.10 | | 64.91 ± 20.93 | | 2.94 ± 0.66 | | 4.92 ± 0.80 | | 4.90 ± 0.85 | |
| Ergonomics Related Training Status | | | | | | | | | | | | | | |
| Yes | 182.43 ± 55.60 | -1.765 (.078) | 67.13 ± 19.51 | -1.386 (.167) | 54.53 ± 20.92 | -1.773 (.077) | 60.76 ± 22.80 | -1.506 (.133) | 3.09 ± 0.70 | 2.572 (.101) | 4.95 ± 0.74 | .147 (.883) | 4.93 ± 0.79 | .179 (.858) |
| No | 193.47 ± 56.62 | | 70.20 ± 20.13 | | 58.84 ± 23.45 | | 64.42 ± 21.35 | | 2.89 ± 0.69 | | 4.93 ± 0.85 | | 4.91 ± 0.90 | |
| Definition of Health Status for the Past Year | | | | | | | | | | | | | | |
| Very Low | 194.91 ± 64.62 | 10.603 **(.000)** | 65.44 ± 19.97 | 7.975 **(.000)** | 57.28 ± 21.88 | 3.382 **(.018)** | 72.18 ± 27.04 | 17.776**(.000)** | 2.40 ± 0.67 | 11.869 **(.000)** | 4.39 ± 1.51 | 3.677 **(.012)** | 4.47 ± 1.50 | 2.080 (.103) |
| Low | 209.49 ± 49.24 | | 75.53 ± 17.09 | | 61.96 ± 22.93 | | 72.00 ± 17.65 | | 2.80 ± 0.60 | | 5.00 ± 0.72 | | 4.97 ± 0.80 | |
| Goog | 175.96 ± 56.49 | | 65.35 ± 20.73 | | 54.26 ± 22.23 | | 56.34 ± 21.67 | | 3.12 ± 0.71 | | 4.96 ± 0.75 | | 4.93 ± 0.81 | |
| Very Good | 196.43 ± 24.22 | | 65.77 ± 10.94 | | 61.23 ± 7.24 | | 69.41 ± 8.05 | | 3.18 ± 0.35 | | 4.80 ± 0.42 | | 4.86 ± 0.36 | |

*ErgoEnf-TR:Turkish Version of the Ergonomic Risk Assessment Questionnaire for Nursing Service Providers, E-1:ErgoEnf-TR Biomechanical Factors Subsca E-3:ErgoEnf-TR Organizational and Psychosocial Factors Subscale, PRS:Psychological Resilience Scale, CBI:Caring Behaviors Inventory-24, C-1:Caring Beha Behaviors Inventory-24 Knowledge-Skills Subscale, C-3:Caring Behaviors Inventory-24 Respectfulness Subscale, C-4:Caring Behaviors Inventory-24 Commitr*

## 5.4. Correlation Analysis of Eronomic Risks, Psychological Resilience and Caring Behavior

In Table 4, the relationships between nurses' ergonomic risk levels and their psychological resilience and caring behavior scale scores were examined via Pearson correlation analysis. According to the results of the analysis, a low, negative and statistically significant correlation was found between the ErgoEnf-TR and PRS scores ($r = -.138$, $p < .01$). Similarly, there is a weak negative and statistically significant correlation between the E-1 ($r = -.137$, $p < .01$) and E-3 ($r = -.216$, $p < .01$) subscale scores and PRS scores. A weak, negative and statistically significant relationship was found between the ErgoEnf-TR and CBI scores ($r = -.172$; $p < 0.01$). Low, negative and statistically significant correlations were also found between the subscales C-1 ($r = -.140$, $p < 0.01$), C-2 ($r = -.148$, $p < 0.01$), C-3 ($r = -.211$, $p < 0.01$) and C-4 ($r = -.157$, $p < 0.01$) and ErgoEnf-TR scores. There was a low, positive and statistically significant correlation between the PRS and the CBI scores ($r = .118$, $p < 0.05$). In addition, the PRS had a low level of positive correlation with the C-1, C-2 and C-3 subscales of the CBI ($p < 0.05$).

Table 4
Relationship between Ergonomic Risk, Psychological Resilience and Caring Behaviors

| | | ErgoEnf-TR | E-1 | E-2 | E-3 | PRS | CBI | C-1 | C-2 | C-3 | C-4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ErgoEnf-TR | r | 1 | ,852** | ,900** | ,867** | -,138** | -,172** | -,140** | -,148** | -,211** | -,157** |
| | p | | ,000 | ,000 | ,000 | ,008 | ,001 | ,007 | ,005 | ,000 | ,003 |
| E-1 | r | | 1 | ,672** | ,589** | -,137** | -,102* | -,089 | -,075 | -,132* | -,089 |
| | p | | | ,000 | ,000 | ,009 | ,050 | ,087 | ,150 | ,012 | ,087 |
| E-2 | r | | | 1 | ,672** | -,014 | -,275** | -,235** | -,238** | -,309** | -,265** |
| | p | | | | ,000 | ,783 | ,000 | ,000 | ,000 | ,000 | ,000 |
| E-3 | r | | | | 1 | -,216** | -,065 | -,037 | -,066 | -,104* | -,048 |
| | p | | | | | ,000 | ,211 | ,484 | ,207 | ,047 | ,356 |
| PRS | r | | | | | 1 | ,118* | ,124* | ,128* | ,124* | ,062 |
| | p | | | | | | ,023 | ,017 | ,014 | ,018 | ,236 |
| CBI | r | | | | | | 1 | ,959** | ,918** | ,965** | ,936** |
| | p | | | | | | | ,000 | ,000 | ,000 | ,000 |
| C-1 | r | | | | | | | 1 | ,840** | ,895** | ,845** |
| | p | | | | | | | | ,000 | ,000 | ,000 |
| C-2 | r | | | | | | | | 1 | ,845** | ,816** |
| | p | | | | | | | | | ,000 | ,000 |
| C-3 | r | | | | | | | | | 1 | ,909** |
| | p | | | | | | | | | | ,000 |
| C-4 | r | | | | | | | | | | 1 |
| | p | | | | | | | | | | |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

*ErgoEnf-TR:Turkish Version of the Ergonomic Risk Assessment Questionnaire for Nursing Service Providers, E-1:ErgoEnf-TR Biomechanical Factors Subscale, E-2:ErgoEnf-TR Environmental Factors Subscale, E-3:ErgoEnf-TR Organizational and Psychosocial Factors Subscale, PRS:Psychological Resilience Scale, CBI:Caring Behaviors Inventory-24, C-1:Caring Behaviors Inventory-24 Assurance Subscale, C-2:Carng Behaviors Inventory-24 Knowledge-Skills Subscale, C-3:Caring Behaviors Inventory-24 Respectfulness Subscale, C-4:Caring Behaviors Inventory-24 Commitment Subscale.*

## 5.5 Impact of Nurses' Ergonomic Risks on Psychological Resilience and Caring Behaviors

Table 5 shows the regression analysis of the extent to which ergonomic risk in nurses' work environments affects their psychological resilience and caring behaviors. According to the regression analysis results, ergonomic risk significantly affects psychological resilience ($\beta$ = − .138, $p$ = .008) and general caring behavior ($\beta$ = − .172, $p$ = .001). When the subscales of caring behaviors were examined, ergonomic risk was also found to significantly and negatively affect the subscales of caring behaviors ($p$ < .05). When the levels of psychological resilience affecting caring behaviors and their subscales were examined, it was determined that psychological resilience significantly and positively affected general caring behaviors ($\beta$ = .118, $p$ = .023). Psychological resilience also significantly and positively affected subscales C-1, C-2 and C-3 ($p$ < .05).

Table 5
Regression Analysis of the Impact of Ergonomic Risks on Psychological Resilience and Caring Behaviors

| Independent Variable | Dependent Variable | B | SE | (β) | t | P | R | $R^2$ | F | p |
|---|---|---|---|---|---|---|---|---|---|---|
| Ergonomic Risks | **Psychological Resilience** | 3.303 | .128 | − .138 | 25.711 | **.008** | .138 | .019 | 7.080 | **.000** |
| | **Caring Behaviours (CB)** | 5.413 | .147 | − .172 | 36.701 | **.001** | .172 | .030 | 11.124 | **.000** |
| | CB-Assurance Subscale | 5.330 | .157 | − .140 | 33.863 | **.007** | .140 | .020 | 7.320 | **.000** |
| | CB-Knowledge-Skills Subscale | 5.553 | .157 | − .148 | 35.414 | **.005** | .148 | .022 | 8.138 | **.000** |
| | CB-Respectfulness Subscale | 5.515 | .154 | − .211 | 35.749 | **.000** | .211 | .045 | 17.022 | **.000** |
| | CB-Commitment Subscale | 5.283 | .154 | − .157 | 34.206 | **.003** | .157 | .025 | 9.210 | **.000** |
| Psychological Resilience | **Caring Behaviours (CB)** | 4.534 | .183 | .118 | 24.740 | **.023** | .118 | .014 | 5.192 | **.000** |
| | CB-Assurance Subscale | 4.469 | .194 | .124 | 22.981 | **.017** | .124 | .015 | 5.709 | **.000** |
| | CB-Knowledge-Skills Subscale | 4.656 | .194 | .128 | 24.024 | **.014** | .128 | .017 | 6.125 | **.000** |
| | CB-Respectfulness Subscale | 1.089 | .193 | .124 | 23.076 | **.018** | .124 | .015 | 5.695 | **.000** |
| | CB-Commitment Subscale | 4.610 | .192 | .062 | 23.961 | .236 | .062 | .004 | 1.411 | .000 |

*$p < 0.05$, B: Unstandardized coefficient B, SE: Standard error, (β): Standardized beta, t: Significance test value of regression coefficients, P: Significance value of the model, R: Correlation value, $R^2$: Regression value, F: Test value p: Significance value .*

## 6. Discussion

Our findings revealed important results regarding the relationships between nurses' ergonomic risk perceptions and their psychological resilience and caring behaviors and the factors affecting these variables. In our study, the ErgoEnf-TR score of the nurses was high, and the highest score was obtained from the “biomechanical factors” subscale. These findings are consistent with recent studies reporting that work-related musculoskeletal problems are common in nurses (17, 35–38). The psychological resilience of the nurses who participated in our study was moderate; this finding was reported in a study conducted in Turkey on healthcare workers during the pandemic period (12). However, our findings differ from the results of some studies in the literature (14, 39). This difference is thought to occur because psychological resilience is affected by both individual and environmental-systemic factors. According to the findings of our study, nurses' caring behaviors are high. This finding is in line with similar studies in the literature (14, 40). A high level of caring behavior is an indication that nurses reflect not only their technical knowledge and skills but also the principles of empathy, respect and caring for people in clinical practice (15).

Differences in the scores obtained from the scales and subscales according to the personal and occupational characteristics of the nurses participating in our study were examined. The ErgoEnf-TR score differences by sex are partially in line with a study indicating that ergonomic experience in healthcare professionals may differ by sex (38); however, in the literature, the findings are heterogeneous, and factors such as task distribution, physical capacity and equipment compatibility are decisive (41). The ErgoEnf-TR score and some subscale scores were significantly higher for night and night-night shift workers. Recent studies have also shown that shift work disrupts the circadian rhythm and increases both physical complaints and the psychological burden; the disruption of sleep patterns, fatigue and anxiety increase during night shifts, and the prevalence of work-related accidents/injuries and pain increases (42–44). The difference in the ErgoEnf-TR score according to satisfaction with the organization and occupation suggests that the quality of the working environment reflects occupational health. Indeed, work environment quality and psychological safety have been shown to reduce burnout, whereas good relationships and supportive leadership have been shown to enhance both job satisfaction and well-being (45, 46). This finding is consistent with our results for both the psychological resilience and caring behavior subscale scores of working voluntarily in the unit of employment. Making decisions together with the team is associated with lower scores on all subscales of the ErgoEnf-TR. Team-based shared decision-making practices have been shown to improve the quality of care plans and reduce the risk of erroneous/inappropriate decisions (47). Greater organizational involvement can alleviate psychological burden through both self-efficacy and job satisfaction (48). The increase in ergonomic risk scores and some caring behavior subscales at high workloads is consistent with models showing that quality of care is affected through the implicit withholding of care, emotional exhaustion and job satisfaction. Increased workload and stress have been associated with turnover intention, burnout and deterioration in safety-quality indicators. In our study, the increase in ergonomic risk level and “organizational and psychosocial factors” subscale scores in those who thought of quitting their jobs supports this pattern. (49–51). Lower levels of ergonomic risk and higher psychological resilience and caring behavior scores among those who described their health as “good” in the past year support the bidirectional relationship shown in the occupational health literature (better health → higher endurance and performance; worse health → more pain/fatigue and lower performance) (42). The cycle of insomnia-fatigue in shift work may reinforce this relationship (44).

The relationships between nurses' ergonomic risk levels and psychological resilience and caring behaviors were examined in this study; the ergonomic risk level was found to have a weak but significant negative relationship with psychological resilience and caring behaviors. The literature reveals that nurses are

exposed to high levels of work-related musculoskeletal problems due to patient lifting/carry, repetitive motion and inappropriate postures, which not only lead to pain and absenteeism but also to decreased patient safety and quality of care (37, 52). A systematic review of the negative effects of the ergonomic risk level on psychological resilience emphasized that ergonomic conditions and workload are important variables among the work environment factors affecting the psychological resilience of nurses (53). The negative relationship between the ergonomic risk level and psychological resilience is consistent with the literature. In multicenter studies, it has been shown that psychological resilience both directly strengthens the intention to stay at work and creates indirect effects through the perception of organizational support (54, 55). Decreasing ergonomic and organizational stressors in the work environment may also indirectly affect the quality of care by contributing to the protection and strengthening of psychological resilience. In our study, the negative relationships observed between the level of ergonomic risk and caring behaviors and the assurance, knowledge-skill, respectfulness and commitment subscales of caring behaviors indicate that ergonomic strain affects the multidimensional quality of care at the same time. Naoum et al. (2022) reported that nurses' musculoskeletal disorders negatively affect their caring behaviors (17). This finding suggests that a systematic reduction in ergonomic risk in the work environment is also important for clinical care outcomes. Ergonomics programs, particularly those involving engineering and workflow adjustments to reduce risks associated with patient lifting, have been shown to reduce injuries, workforce loss and compensation costs, with positive consequences for continuity of care and functional efficiency (52, 56). Similarly, long-term exposure of nurses to ergonomic risks leads to both physical and psychological burnout, which negatively affects the quality of patient care (51).

Our findings revealed a positive relationship between psychological resilience and caring behavior, which is consistent with current evidence on the psychosocial determinants of caring behavior. A recent study has shown that psychological resilience directly increases nurses' caring behaviors and that a positive organizational climate partially mediates this relationship (57). In this context, not only investing in ergonomic arrangements but also strengthening the working climate through resilience programs, rational workload arrangements and supportive leadership practices have the potential to increase caring behaviors. Our study also revealed that psychological resilience had a significant positive effect on all subdimensions except the general caring behavior and commitment subdimensions. As Hart et al. (2014) reported, nurses with high psychological resilience can effectively maintain their professional roles even under stressful conditions and thus improve the quality of patient care (53).

## 6.1 Limitations

An important limitation of our study is the relatively low proportion of variance explained in the dependent variables. This finding shows that ergonomic risk and psychological resilience explain only a small portion of the variation in caring behaviors and psychological resilience. Therefore, in addition to these variables, other important factors, such as workload, social support, motivation, educational level, individual experiences, organizational climate and leadership styles, may play a role in influencing care behaviors and psychological resilience. Moreover, since our study has a cross-sectional design, the ability to make precise inferences about the causal relationships between variables is limited.

## 7. Conclusion

This study revealed that ergonomic risk has negative effects on employees' psychological resilience and caring behaviors, whereas psychological resilience has a positive effect on caring behavior. In particular, caring behaviors related to respectfulness were the area most affected by ergonomic risk. Our findings suggest that making ergonomic improvements in the workplace and implementing programs that support employees' psychological resilience (e.g., stress management training, resilience building programs) have the potential to improve the overall quality of care. In this context, it is important for organizations to both improve the physical work environment and develop strategies to enhance psychological resilience to support employee health and well-being. These multifaceted approaches positively affect not only employee well-being but also service quality and organizational productivity. Future research could provide a more comprehensive understanding by examining mediating or moderating variables in these relationships. Furthermore, examining more in-depth relationships between specific types of ergonomic risk (e.g., physical ergonomics, cognitive ergonomics) and specific dimensions of psychological resilience and caring behaviors would enrich the body of knowledge in this field.

## Declarations

# Conflicts of interest

The authors declare that they have no conflicts of interest.

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There was no financial or moral support from any institution or organization during the study process.

# Author Contribution

YA: Writing – original draft, investigation, data curation, visualization, software, resources, supervision, formal analysis, conceptualization. SED: Writing—original draft, investigation, data curation, visualization, software, resources, supervision, formal analysis, conceptualization.

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## Data Availability

The data are available upon request from the corresponding author.

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## Figures

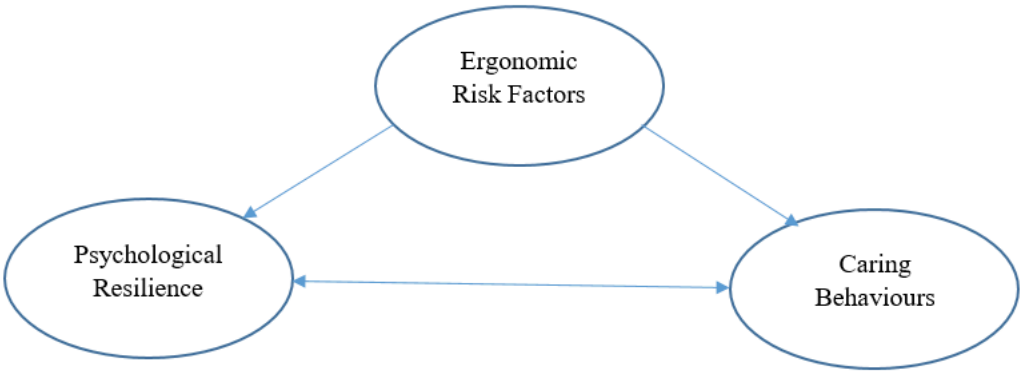


**Figure 1**

Study Model