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Article

Psychosocial risks and emotional exhaustion among university employees: the mediating role of perceived stress and the moderating role of resilience

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Abstract: Psychosocial risks are an important occupational health concern and may be associated with emotional exhaustion through psychological mechanisms related to employees' appraisal of adverse working conditions. This secondary analysis used a quantitative, cross-sectional design and data from 458 university employees to examine the mediating role of perceived stress and the moderating role of resilience in the association between psychosocial risks and emotional exhaustion. Correlation, mediation, and moderation analyses were performed, with bootstrap estimation based on 10,000 resamples. Greater psychosocial risk was associated with higher perceived stress and emotional exhaustion, whereas resilience was associated with lower perceived stress. Perceived stress partially mediated the association between psychosocial risks and emotional exhaustion, accounting for approximately 32.5% of the total association. The stress–resilience interaction was statistically significant in the unadjusted model, although its incremental contribution was small ($\Delta R^2 = 0.004$); after adjustment for sociodemographic and occupational covariates, the interaction retained a similar direction but did not reach conventional statistical significance ($p = 0.058$). The model accounted for 59.6% of the variance in emotional exhaustion. Given the cross-sectional design, these findings represent statistical associations and do not establish temporal or causal relationships. The results support considering organizational psychosocial conditions, perceived stress, and resilience jointly when examining occupational well-being among university employees.

Keywords: psychosocial risks; emotional exhaustion; perceived stress; resilience; occupational health; university employees

1. Introduction

Contemporary transformations in the world of work have heightened attention to psychosocial risks as important determinants of occupational health. These risks arise from the interaction among work organization, occupational demands, and the resources available to address them, and may be expressed through excessive workload, limited autonomy, insufficient rewards, deteriorating workplace relationships, perceived injustice, or conflicts between individual and organizational values. Their relevance extends beyond situational discomfort because adverse psychosocial working conditions are associated with sustained stress, impaired health, and organizational consequences that require integrated preventive strategies (Fernandes & Pereira, 2016; Forastieri, 2016; Iavicoli & Di Tecco, 2020; Saik et

al., 2024). In this context, evolving work environments call for approaches that move beyond risk identification and examine how psychosocial conditions are statistically related to relevant occupational health outcomes (Di Tecco et al., 2023; do Nascimento Teixeira et al., 2025).

Burnout provides an important conceptual framework for understanding adverse responses to prolonged occupational demands. Within this broader construct, emotional exhaustion represents a central dimension characterized by the depletion of physical and psychological resources associated with sustained job demands (Maslach et al., 2001). The Areas of Worklife model provides a complementary organizational perspective by describing employees' relationship with their work environment through six domains: workload, control, reward, community, fairness, and values (Leiter & Maslach, 1999, 2004). Evidence indicates that mismatches across these areas are differentially associated with burnout and other occupational health indicators (Brom et al., 2015), while workplace resources may be associated with differences in the strength of these relationships (Jimenez & Dunkl, 2017). This multidimensional perspective is particularly relevant in universities, where academic, administrative, and technological demands coexist with multiple responsibilities and heterogeneous working conditions.

The relationship between adverse psychosocial conditions and emotional exhaustion may also involve employees' appraisal of occupational demands. Perceived stress reflects the extent to which experienced situations are appraised as unpredictable, uncontrollable, or exceeding the resources available to cope with them (Cohen et al., 1983). It may therefore represent an important statistical pathway linking psychosocial working conditions with emotional exhaustion. Resilience, in turn, refers to the capacity to adapt to adverse circumstances and constitutes a potentially relevant personal resource when individuals encounter environmental demands (Campbell-Sills & Stein, 2007; Connor & Davidson, 2003). Previous research has documented relationships among perceived stress, resilience, and burnout-related outcomes; however, some of this evidence derives from university students and cannot be directly extrapolated to employees (Takács & Jancso-Farcas, 2025). Among university employees, occupational characteristics such as contract status, job type, and seniority coexist with psychosocial and technological factors that may be differentially associated with health. Recent evidence from employees at a Spanish university has likewise identified perceived stress as an important correlate of emotional symptoms and resilience as a potentially relevant personal resource (Asensio-Martínez & Aguilar-Latorre, 2025).

Despite these advances, less is known about how psychosocial working conditions, perceived stress, and resilience are jointly associated with emotional exhaustion among university employees. In particular, examining whether the association between psychosocial risk and emotional exhaustion is statistically mediated by perceived stress and whether the stress–exhaustion association varies according to resilience may provide a more integrated account of organizational and individual factors. Such an approach is also relevant because the six areas of worklife represent conceptually distinct aspects of the psychosocial environment and may show different relationships with emotional exhaustion. Examining both their dimension-specific associations and a global composite representation of psychosocial risk can therefore provide complementary information about the psychosocial work environment.

The present study constitutes a secondary analysis of an existing dataset and

addresses a research question distinct from that examined in the source study. Rather than reproducing its original analyses, the present investigation focuses specifically on emotional exhaustion, operationalized using the five exhaustion items of the MBI-GS, and evaluates perceived stress as a statistical mediator and resilience as a moderator of the stress–exhaustion association. The six areas of worklife are examined both individually and through a composite psychosocial risk indicator, allowing organizational psychosocial conditions, stress appraisal, and personal resources to be considered within the same analytical framework.

Accordingly, this study aimed to analyse the association between psychosocial risk and emotional exhaustion among university employees, examining the mediating role of perceived stress and the moderating role of resilience. Four hypotheses were formulated: H1, higher psychosocial risk is positively associated with emotional exhaustion; H2, perceived stress statistically mediates the association between psychosocial risk and emotional exhaustion; H3, resilience moderates the association between perceived stress and emotional exhaustion, such that the association is weaker at higher levels of resilience; and H4, the indirect association between psychosocial risk and emotional exhaustion through perceived stress varies according to the level of resilience.

2. Materials and methods

2.1. Study design, data source, and participants

A quantitative, observational, cross-sectional secondary analysis was conducted using open-access data from university employees. The source study was carried out at the University of Zaragoza, Spain, and examined psychosocial, occupational, and health-related factors among university staff (Asensio-Martínez et al., 2026). Data were collected between June 1 and July 31, 2022, through a self-administered online survey administered via Google Forms. Participants were recruited using non-probability convenience sampling through the University of Zaragoza's internal communication channels, including its bulletin board, newsletter, and mailing lists.

Eligible participants were adults employed by the University of Zaragoza as academic and research staff or administrative and service staff. The source study required participants to be older than 18 years, have proficiency in written and spoken Spanish, and provide electronic informed consent. Based on a reference workforce of 6,007 university employees, the original investigators calculated a minimum required sample of 206 participants. The final source sample comprised 458 employees who met the eligibility criteria. The present secondary analysis retained all 458 observations because complete data were available for the core variables included in the analytical model; therefore, no participants were excluded from the source sample for the primary analyses.

The dataset includes information on general health, perceived stress, technostress, burnout, job satisfaction, resilience, social support, work-environment characteristics, and sociodemographic and occupational variables (Asensio-Martínez & Aguilar-Latorre, 2025). For the present study, the dataset was accessed through the Zenodo repository and reused under the terms of the Creative Commons Attribution 4.0 International (CC BY 4.0) licence. The source study received approval from the Aragón Ethics Committee (CEICA; PI22-259) and the Data Protection Unit of the University of Zaragoza (RAT 2022-93). Participation in the original study was voluntary and anonymous and was preceded by electronic informed consent (Asensio-Martínez et al., 2026).

2.2. Variables and instruments

The analytical model was structured around four components: psychosocial risks at work, perceived stress, resilience, and emotional exhaustion

The variables of interest were selected from the measures available in the dataset, whose documentation identifies assessments of perceived stress, emotional exhaustion, resilience, and other psychosocial and occupational factors among university employees. For the present analysis, psychosocial risks at work were represented by six dimensions available in the dataset: workload, control, reward, community, fairness, and values. These dimensions were initially examined independently and were subsequently considered jointly to represent psychosocial exposure in the analytical model.

Perceived stress was operationalized using the 10 items identified in the dataset as components of the PSS score; resilience was operationalized using the 10 items corresponding to the CD-RISC score; and emotional exhaustion was operationalized using the five items corresponding to the exhaustion dimension of the Maslach Burnout Inventory–General Survey (MBI-GS) available in the dataset. Accordingly, the emotional exhaustion outcome analysed in this study specifically reflects the exhaustion component of the broader burnout construct. Because the repository does not provide a variable dictionary or an independent scoring protocol, construction of these variables was empirically verified by comparing scores recalculated from the items with the aggregate variables available in the original file.

To ensure transparency and reproducibility in the operationalization of the study variables, the scoring procedures were verified directly from the item-level data and the aggregate variables available in the source dataset. **Table 1** summarizes the instruments and variables used, the scoring procedures, reverse-coded items, theoretical score ranges, and the direction of interpretation for each construct included in the analytical model.

Table 1. Operationalization and scoring of the study variables.

Construct	Instrument/variables	Scoring procedure	Reverse-coded items	Score direction
Psychosocial work conditions	Six Areas of Worklife Questionnaire–Short Version, 18 items	Six three-item subscales: workload, control, rewards, community, fairness, and values; each subscale calculated as the sum of its corresponding items	AWLS items 1, 2, 3, 9, and 12 were reverse-coded as 6 − response	Higher subscale scores indicate more favourable working conditions
Global psychosocial risk	Six AWLS subscale scores	Psychosocial risk = 90 − (workload + control + rewards + community + fairness + values); theoretical range 0–72	Based on the already direction-corrected AWLS items	Higher scores indicate greater psychosocial risk
Perceived stress	PSS-10	Sum of the 10 items; theoretical range 0–40	Items 4, 5, 7, and 8 were reverse-coded as 4 − response	Higher scores indicate greater perceived stress
Resilience	CD-RISC-10	Sum of the 10 items; theoretical range 0–40	None	Higher scores indicate greater resilience

Continuation Table:

Construct	Instrument/variables	Scoring procedure	Reverse-coded items	Score direction
Emotional exhaustion	MBI-GS exhaustion dimension	Mean of MBI-GS items 1, 2, 3, 4, and 6; theoretical range 0–6	None	Higher scores indicate greater emotional exhaustion

Note: Scoring procedures were verified directly against the aggregate variables available in the source dataset. Reconstructed scores reproduced the corresponding dataset variables exactly for all 458 observations.

Item content and response formats. To provide additional information on item content and response formats, the AWLS items assess perceived workload demands, control over work, recognition and rewards, workplace community and support, fairness, and congruence between personal and organizational values. Responses are provided on a five-point agreement scale ranging from 1 (strongly disagree) to 5 (strongly agree). The PSS-10 assesses the frequency of perceived unpredictability, lack of control, overload, and coping-related experiences during the previous month, using a five-point frequency scale from 0 (never) to 4 (very often). The CD-RISC-10 assesses perceived adaptability, coping capacity, recovery from adversity, persistence, and ability to manage difficult experiences, with responses ranging from 0 (not true at all) to 4 (true nearly all the time). The MBI-GS exhaustion items assess the frequency of work-related physical and emotional depletion and fatigue, using a seven-point frequency scale ranging from 0 (never) to 6 (daily). To respect instrument copyright and licensing conditions, proprietary item wording is not reproduced verbatim; concise descriptions of item content are provided instead.

The global psychosocial risk indicator was derived from the six Areas of Worklife dimensions after orienting all items toward favourable working conditions. Each dimension was represented by three items and had the same theoretical score range (3–15); consequently, summing the six dimension scores gives each worklife area the same numerical contribution to the composite. This equal-weight formulation was adopted as a transparent operational summary of cumulative psychosocial exposure rather than as an empirically derived latent score or an assumption that some worklife areas are intrinsically more important than others. Because the six subscale scores jointly range from 18 to 90, the global risk score was calculated as 90 minus the sum of workload, control, rewards, community, fairness, and values, yielding a theoretical range from 0 to 72, with higher values indicating greater psychosocial risk. Equal weighting nevertheless assumes comparable contribution of the six dimensions and may obscure domain-specific differences; therefore, the composite was complemented by separate analyses of each worklife dimension in relation to emotional exhaustion. The global score should consequently be interpreted as an operational aggregate of psychosocial exposure rather than as a validated unidimensional latent construct.

This strategy made it possible to verify correspondence between the item-level data and the scores used in the analyses, thereby avoiding the introduction of coding procedures not documented by the dataset authors. The internal consistency of each measure was reassessed in the analytical sample using Cronbach's α.

2.3. Data preparation and quality control

Before the statistical analysis, a comprehensive audit of the dataset's structure and quality was conducted. The number of records, presence of duplicate cases, missing values, response ranges, and consistency of the variables used were verified.

In addition, for the core measures, scores reconstructed from the items were compared with the aggregate variables available in the file to confirm their correspondence before inclusion in the analytical model.

The primary analyses were conducted on n = 458, with no imputation required for the variables included in the model. Descriptive statistics were calculated, including the mean, standard deviation, minimum, and maximum, and internal consistency was assessed using Cronbach's α, with 0.70 adopted as the minimum criterion for acceptability.

Given the multidimensional nature of the six psychosocial areas considered, a one-factor confirmatory model was additionally estimated to assess whether the six AWLS dimension scores could be empirically represented as reflective indicators of a single latent factor. The model was estimated using maximum likelihood (ML). Model fit was evaluated using the chi-square statistic (χ^2) and its degrees of freedom, the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) with its 90% confidence interval, and Standardized Root Mean Square Residual (SRMR). Standardized factor loadings were also examined to assess the contribution of each worklife dimension to the hypothesized common factor. This analysis was used to evaluate the empirical support for a unidimensional reflective interpretation of the six dimensions rather than to validate the operational composite score used in the primary regression analyses.

Prior to the main analysis, the dataset was screened for missing data, univariate and multivariate outliers, distributional characteristics, and multicollinearity. No missing values were identified for the variables included in the main analytical models; therefore, all 458 participants were retained without imputation. Univariate screening using standardized scores ($|z| > 3.29$) identified two extreme observations for resilience and none for psychosocial risk, perceived stress, or emotional exhaustion. However, no multivariate outliers were detected using Mahalanobis distance at $p < 0.001$; consequently, no observations were excluded on this basis. Distributional assessment showed absolute skewness values ranging from 0.004 to 0.484 and absolute kurtosis values ranging from 0.051 to 1.097, indicating no severe departures from distributional symmetry. Multicollinearity was also low, with variance inflation factors ranging from 1.34 to 1.57 for the predictors in the main model. Mean-centering was applied to perceived stress and resilience before computing their interaction term, for which the VIF was 1.05.

2.4. Statistical analysis

Descriptive statistics were first calculated for the core variables, and bivariate correlations were estimated among psychosocial risks, perceived stress, resilience, and emotional exhaustion. The associations between each of the six psychosocial dimensions and emotional exhaustion were also examined separately to determine the magnitude and direction of their relationships. The internal consistency of the measures was estimated using Cronbach's α.

A regression-based mediation model was subsequently estimated to examine the relationships between psychosocial risks at work and emotional exhaustion. Perceived stress was specified as a mediating mechanism, such that psychosocial risks could be associated with emotional exhaustion both directly and indirectly through increased stress.

The indirect effect was evaluated using bootstrapping with 10,000 resamples and estimation of 95% confidence intervals. Evidence of mediation was considered present when the confidence interval for the indirect effect did not include zero. Total, direct, and indirect effects were estimated, as was the proportion of the total effect

explained by the mediated pathway.

Resilience was incorporated as a potentially relevant psychological resource. In addition to evaluating its direct association with stress and emotional exhaustion, an interaction term between perceived stress and resilience was introduced to determine whether resilience modified the strength of the relationship between stress and emotional exhaustion.

The variables involved in the interaction were mean-centered before the product term was generated.

All analyses were reproduced in Python using pandas for data management, SciPy for distributional diagnostics, and statsmodels for regression-based estimation. Continuous variables were standardized for the estimation and reporting of standardized regression coefficients. Mediation was evaluated by decomposing the total association between psychosocial risk and emotional exhaustion into direct and indirect components. Moderation was examined by mean-centering perceived stress and resilience before constructing their product term. Conditional effects were examined across predefined levels of resilience. Indirect effects, interaction effects, conditional indirect effects, and the index of moderated mediation were evaluated using nonparametric bootstrap estimation with 10,000 resamples and 95% confidence intervals. Statistical significance was evaluated at $\alpha = 0.05$.

When the interaction was statistically significant, simple-slope analyses were conducted at three levels of resilience: low (-1 standard deviation), mean, and high (+1 standard deviation). Conditional indirect effects of psychosocial risks on emotional exhaustion through perceived stress were also calculated at the same resilience levels, making it possible to assess a process consistent with moderated mediation.

Standardized regression coefficients (β) were reported together with their significance levels and confidence intervals, as applicable. The proportion of variance explained in the endogenous variables was evaluated using the coefficient of determination (R^2).

As a sensitivity analysis, the main associations were additionally estimated after adjustment for age, sex, job position, contract type, and seniority (< 12 vs. ≥ 12 years). These covariates were selected because they represent relevant sociodemographic and occupational characteristics available in the source dataset. Complete coefficient estimates, standard errors, 95% confidence intervals, and significance levels for the core predictors and all covariates are reported in Supplementary Table S3. The adjusted analyses were used to assess the stability of the principal associations rather than to redefine the prespecified analytical model.

The incremental contribution of the interaction term was assessed through the change in explained variance (ΔR^2). The magnitude and confidence interval of the index of moderated mediation were additionally estimated to evaluate whether the indirect association varied systematically across levels of resilience.

2.5. Ethical considerations and reproducibility

The study was conducted through secondary analysis of a dataset that had previously been collected and deposited publicly in Zenodo. There was no contact with participants, and no new information was collected during the present study. The resource is identified by DOI 10.5281/zenodo.17662702 and is distributed under a Creative Commons Attribution 4.0 International license, which permits reuse with appropriate attribution to the source (Asensio-Martínez & Aguilar-Latorre, 2025). Accordingly, the present secondary analysis did not involve participant recruitment, intervention, or primary data collection by the authors.

To facilitate reproducibility of the secondary analysis, all 458 records available for the core variables were retained, and the procedure used to construct and verify the scores was documented. When aggregate variables were available in the original file, they were compared with scores recalculated from the corresponding items. No imputation procedures were applied to the variables included in the analytical model.

3. Results

3.1. Data quality and variable distributions

A total of 458 records from university employees were analyzed. No missing values were identified in the core variables used in the model: psychosocial work dimensions, perceived stress, resilience, and emotional exhaustion. Age ranged from 23 to 70 years, with a mean of 49.56 ± 9.61 years. Six areas of worklife were considered to represent the psychosocial environment: workload, control, reward, community, fairness, and values (**Table 2**).

Table 2. Descriptive statistics for the core variables.

Variable	Mean	SD	Min.	Max.
Workload	8.60	3.22	3	15
Control	9.81	2.32	3	15
Reward	10.21	2.81	3	15
Community	11.10	3.06	3	15
Fairness	8.31	2.50	3	15
Values	8.97	2.83	3	15
Perceived stress	17.66	8.11	0	39
Resilience	28.35	6.81	2	40
Emotional exhaustion	2.50	1.80	0	6

The descriptive scores showed sufficient variability across all core constructs. Among the areas of worklife, community and reward had the highest mean scores, whereas fairness, workload, and values had comparatively lower scores. The substantive interpretation of these differences was based on the specific direction of each dimension.

3.2. Internal consistency of the constructs

The internal consistency of the scales was satisfactory to high. Cronbach's α coefficients exceeded the 0.70 criterion for all core constructs, with particularly high values for emotional exhaustion, resilience, and perceived stress (**Table 3**).

Table 3. Internal consistency of the scales used.

Construct	Number of items	Cronbach's α
Psychosocial areas of worklife	18	0.855
Perceived stress	10	0.901
Resilience	10	0.906
Emotional exhaustion	5	0.945

Scores reconstructed from the items matched the derived variables available in the dataset for perceived stress, resilience, and emotional exhaustion, supporting the integrity of the scores used in subsequent analyses.

3.3. Relationships among psychosocial risks, perceived stress, resilience, and emotional exhaustion

The bivariate associations showed a pattern consistent with the proposed model. Greater psychosocial exposure was associated with higher perceived stress and emotional exhaustion, whereas resilience was inversely related to both indicators. The strongest association was observed between perceived stress and emotional exhaustion ($r = 0.703$; $p < 0.001$) (**Table 4**).

Table 4. Pearson correlations among the core study variables.

Variable	Psychosocial risk	Perceived stress	Resilience	Emotional exhaustion
Psychosocial risk	1			
Perceived stress	0.479	1		
Resilience	−0.373	−0.519	1	
Emotional exhaustion	0.615	0.703	−0.442	1

Note: Values are Pearson's correlation coefficients (r). All off-diagonal correlations were statistically significant at $p < 0.001$.

As a complementary dimension-specific analysis, the six areas of worklife were examined separately in relation to emotional exhaustion to assess whether the global psychosocial risk composite obscured meaningful differences across domains. All six dimensions were significantly associated with emotional exhaustion, although the magnitude of the associations varied. Workload showed the strongest association ($r = −0.558$), followed by reward ($r = −0.444$), control ($r = −0.407$), values ($r = −0.346$), community ($r = −0.325$), and fairness ($r = −0.313$) (**Table 5**). Because higher scores in the areas of worklife represent more favourable working conditions, the negative coefficients indicate that more favourable conditions were associated with lower emotional exhaustion. The variation in effect magnitude across dimensions supports retaining domain-specific information alongside the equal-weight global composite.

Table 5. Pearson correlations between areas of worklife and emotional exhaustion.

Area of worklife	r with emotional exhaustion	p
Workload	−0.558	< 0.001
Reward	−0.444	< 0.001
Control	−0.407	< 0.001
Values	−0.346	< 0.001
Community	−0.325	< 0.001
Fairness	−0.313	< 0.001

Note: Values are Pearson's correlation coefficients (r). Higher scores in the areas of worklife indicate more favourable working conditions; therefore, negative coefficients indicate that more favourable conditions are associated with lower emotional exhaustion.

3.4. Regression model for perceived stress

In the component of the model explaining perceived stress, psychosocial risks and resilience showed significant associations in opposite directions. The model explained 36.1% of the variance in perceived stress ($R^2 = 0.361$). The standardized coefficient for psychosocial risks was positive ($\beta = 0.334$; $p < 0.001$), whereas resilience showed a negative association ($\beta = -0.391$; $p < 0.001$). These findings indicate that greater exposure to adverse psychosocial conditions is associated with higher stress, whereas higher levels of resilience are associated with lower perceived stress.

3.5. Prediction of emotional exhaustion

The model that simultaneously incorporated psychosocial risk, perceived stress, and resilience explained 59.6% of the variance in emotional exhaustion ($R^2 = 0.596$). Perceived stress showed the strongest direct association ($\beta = 0.509$; $p < 0.001$), followed by psychosocial risk ($\beta = 0.353$; $p < 0.001$). After adjustment for the other variables in the model, the direct association of resilience with emotional exhaustion did not reach statistical significance ($\beta = -0.049$; $p = 0.170$) (**Table 6**).

Table 6. Standardized direct associations with emotional exhaustion.

Path	β	95% CI	p
Perceived stress – emotional exhaustion	0.509	[0.442, 0.575]	< 0.001
Psychosocial risk – emotional exhaustion	0.353	[0.278, 0.428]	< 0.001
Resilience – emotional exhaustion	−0.049	[−0.119, 0.021]	0.170

Note: β represents the standardized regression coefficient. CI = confidence interval. The model explained 59.6% of the variance in emotional exhaustion ($R^2 = 0.596$).

Although resilience was negatively correlated with emotional exhaustion ($r = -0.442$), its direct association was no longer statistically significant when perceived stress and psychosocial risk were considered simultaneously. This finding indicates that resilience should not be interpreted as having an independent direct association with emotional exhaustion within the multivariable model.

3.6. Mediating role of perceived stress

The mediation analysis indicated that psychosocial risk was associated with emotional exhaustion both directly and indirectly through perceived stress. The total association was $\beta = 0.523$, of which $\beta = 0.353$ corresponded to the direct component and $\beta = 0.170$ to the indirect component through perceived stress. The bootstrap confidence interval for the indirect effect did not include zero, supporting a statistically significant indirect association. Approximately 32.5% of the total association was accounted for by the pathway involving perceived stress (**Table 7**).

Table 7. Total, direct, and indirect associations between psychosocial risk and emotional exhaustion through perceived stress.

Effect	β	SE	95% CI
Total effect	0.523	0.037	[0.448, 0.594]

Continuation Table:

Effect	β	SE	95% CI
Direct effect	0.353	0.038	[0.279, 0.427]
Indirect effect	0.170	0.023	[0.126, 0.217]

Note: β represents the standardized effect. The indirect effect was estimated using nonparametric bootstrapping with 10,000 resamples. The indirect association accounted for approximately 32.5% of the total association between psychosocial risk and emotional exhaustion.

3.7. Moderating role of resilience

The moderating role of resilience in the association between perceived stress and emotional exhaustion was subsequently examined. The perceived stress × resilience interaction was statistically significant in the unadjusted model (β = −0.059, p = 0.007; 95% bootstrap CI [−0.103, −0.016]). The inclusion of the interaction term increased the explained variance from $R^2 = 0.596$ to $R^2 = 0.600$ ($\Delta R^2 = 0.004$), indicating that its incremental contribution to explained variance was small. Simple-slope analyses were therefore conducted to characterize the interaction across different levels of resilience (**Table 8**).

Table 8. Conditional association between perceived stress and emotional exhaustion at different levels of resilience.

Resilience level	β (stress - emotional exhaustion)	95% bootstrap CI
Low (−1 SD)	0.577	[0.486, 0.666]
Mean	0.517	[0.442, 0.590]
High (+1 SD)	0.458	[0.375, 0.536]

Note: β represents the standardized conditional association between perceived stress and emotional exhaustion. Confidence intervals were estimated using 10,000 bootstrap resamples.

In the covariate-adjusted sensitivity analysis, the main associations remained broadly consistent with the primary model. The adjusted main-effects model explained 60.5% of the variance in emotional exhaustion ($R^2 = 0.605$; adjusted $R^2 = 0.598$). After inclusion of the perceived stress × resilience interaction, the explained variance increased to $R^2 = 0.608$ (adjusted $R^2 = 0.600$; $\Delta R^2 = 0.003$). The adjusted interaction retained the same negative direction as in the primary analysis but did not reach conventional statistical significance (β = −0.052, SE = 0.028, 95% CI [−0.106, 0.002], p = 0.058). Complete estimates for the core predictors and all sociodemographic and occupational covariates are reported in Supplementary Table S3.

Perceived stress remained positively associated with emotional exhaustion at all three levels of resilience, although the magnitude of the association decreased progressively as resilience increased. The confidence intervals excluded zero at each level examined. However, consistent with the small incremental variance explained by the interaction ($\Delta R^2 = 0.004$), the differences among the conditional slopes should be interpreted as modest rather than as evidence of a strong protective influence of resilience.

3.8. Indirect effects conditional on resilience

The magnitude of the indirect psychosocial risks–perceived stress–emotional exhaustion pathway also varied according to resilience level. The indirect effect was

greatest when resilience was low and decreased progressively at mean and high levels (**Table 9**).

Table 9. Conditional indirect associations of psychosocial risk with emotional exhaustion through perceived stress.

Resilience level	Indirect effect (β)	95% bootstrap CI
Low (−1 SD)	0.192	[0.141, 0.248]
Mean	0.173	[0.128, 0.220]
High (+1 SD)	0.153	[0.112, 0.198]

Note: Conditional indirect associations were estimated using 10,000 bootstrap resamples. The index of moderated mediation was −0.020 (SE = 0.008; 95% bootstrap CI [−0.036, −0.005]).

The conditional indirect association decreased progressively as resilience increased, from β = 0.192 at low resilience to β = 0.153 at high resilience, with bootstrap confidence intervals excluding zero at all three levels. The index of moderated mediation was −0.020 (SE = 0.008; 95% bootstrap CI [−0.036, −0.005]), indicating that the indirect association through perceived stress varied statistically across levels of resilience. However, the magnitude of this variation was small and should therefore be interpreted cautiously.

3.9. Sensitivity analysis

Sensitivity analyses were conducted to examine the stability of the main associations after adjustment for age, sex, job position, contract type, and seniority. In the covariate-adjusted main-effects model, psychosocial risk (β = 0.339, 95% CI [0.270, 0.408], $p < 0.001$) and perceived stress (β = 0.505, 95% CI [0.430, 0.579], $p < 0.001$) remained significantly associated with emotional exhaustion, whereas the direct association of resilience remained non-significant (β = −0.047, 95% CI [−0.118, 0.023], p = 0.189). This model explained 60.5% of the variance in emotional exhaustion ($R^2 = 0.605$; adjusted $R^2 = 0.598$). After inclusion of the perceived stress × resilience interaction, the model explained 60.8% of the variance ($R^2 = 0.608$; adjusted $R^2 = 0.600$; $\Delta R^2 = 0.003$). The adjusted interaction retained the same negative direction observed in the primary analysis but did not reach conventional statistical significance (β = −0.052, SE = 0.028, 95% CI [−0.106, 0.002], p = 0.058). These findings indicate that the principal associations were stable after covariate adjustment, whereas the moderation result was comparatively sensitive to the inclusion of sociodemographic and occupational covariates. Complete estimates for all predictors and covariates are reported in Supplementary Table S3.

3.10. Global representation of psychosocial risks

A one-factor confirmatory model was estimated using maximum likelihood (ML) to assess whether the six areas of worklife could be represented as reflective indicators of a single latent psychosocial factor. Model fit showed mixed evidence for unidimensionality: $\chi^2(9) = 40.186$, CFI = 0.947, TLI = 0.912, RMSEA = 0.087 (90% CI [0.061, 0.115]), and SRMR = 0.039. Standardized factor loadings were 0.245 for workload, 0.636 for control, 0.731 for reward, 0.523 for community, 0.655 for fairness, and 0.663 for values. Although some fit indices were comparatively favorable, the RMSEA, TLI, and substantially lower loading for workload indicated limited support for interpreting the six dimensions as interchangeable manifestations

of a strongly unidimensional latent construct. This pattern is consistent with treating the Areas of Worklife framework as multidimensional.

Accordingly, the global psychosocial risk score used in the main analyses was interpreted as an operational composite summarizing adverse conditions across the six worklife areas rather than as a reflective latent factor. The confirmatory analysis does not, by itself, establish the validity of equal weighting across dimensions; rather, it indicates that the composite should be interpreted as an aggregate representation of psychosocial exposure while preserving the conceptual distinctiveness of its components. The dimension-specific associations with emotional exhaustion reported in **Table 5** therefore provide complementary information on the contribution of the individual areas of worklife.

Figure 1 illustrates the conditional association between perceived stress and emotional exhaustion across levels of resilience. Emotional exhaustion increased as perceived stress increased at all three levels of resilience, although the slope was slightly weaker at higher resilience. This pattern is consistent with the statistically significant but modest stress × resilience interaction observed in the unadjusted model.

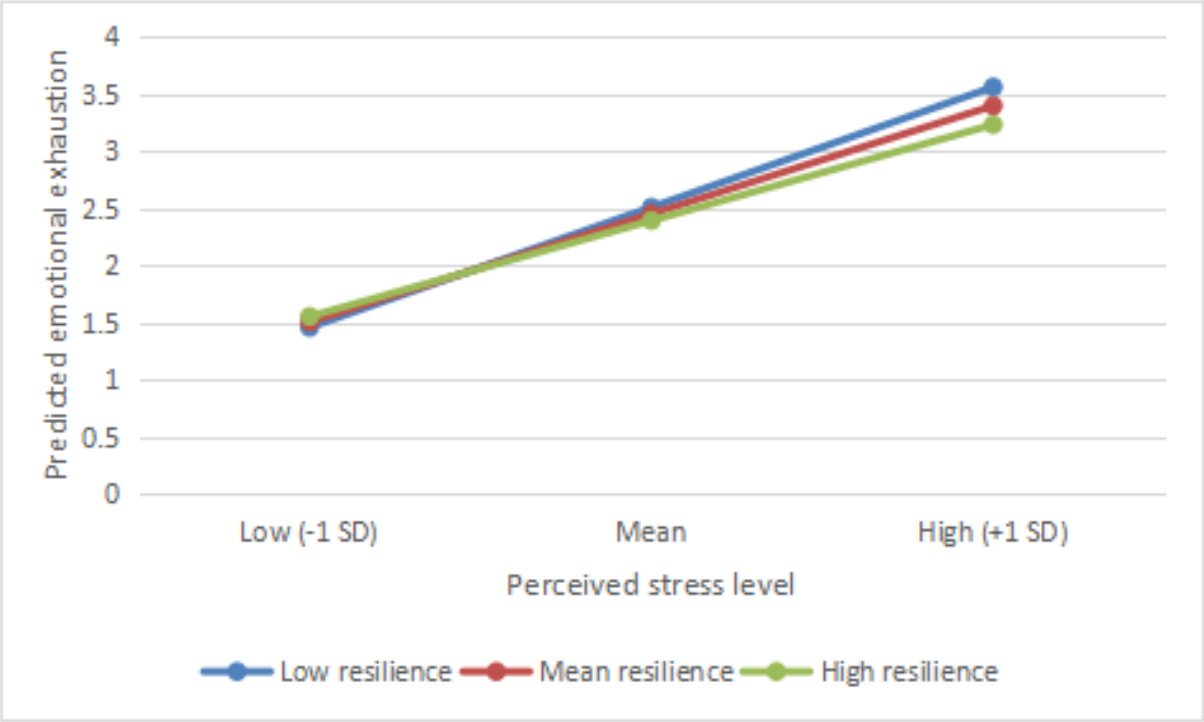


Figure 1. Conditional association between perceived stress and emotional exhaustion at different levels of resilience.

Note: Low and high resilience represent one standard deviation below and above the mean, respectively. The plotted lines represent predicted emotional exhaustion across levels of perceived stress.

Figure 2 provides a graphical representation of the associations between the six areas of worklife and emotional exhaustion. All associations were negative, indicating that more favourable working conditions were associated with lower emotional exhaustion. Workload showed the strongest association, followed by reward and control, whereas fairness showed the weakest association among the six dimensions.

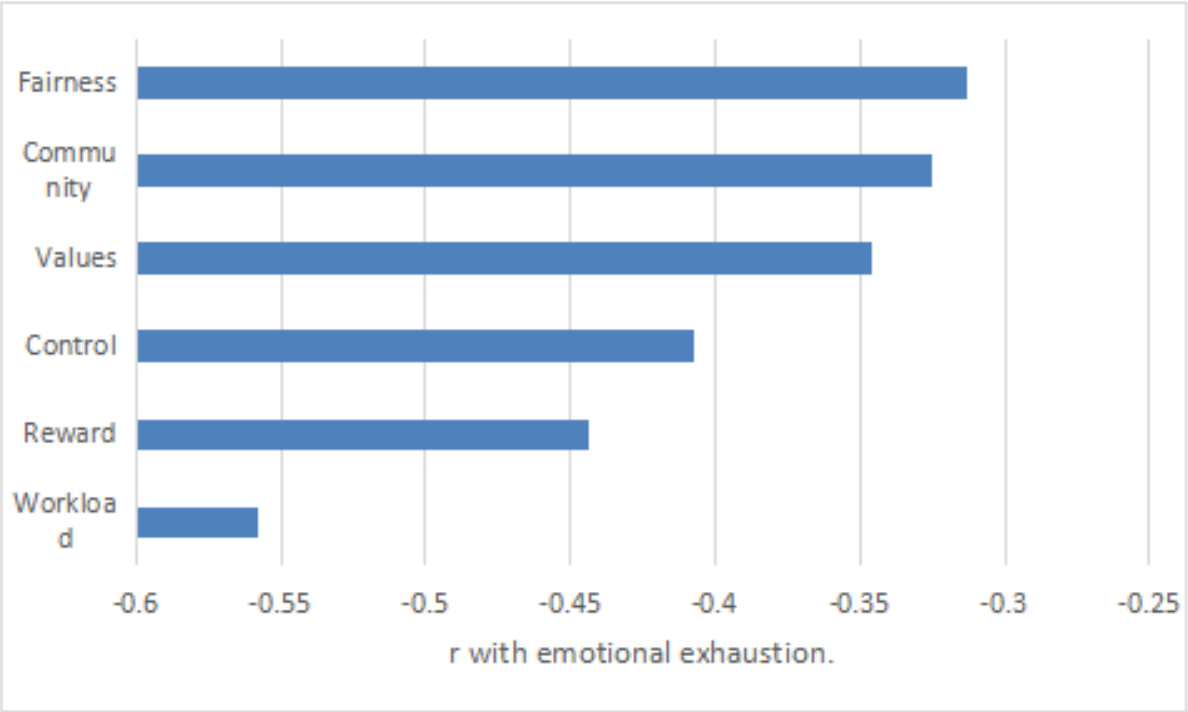


Figure 2. Associations between areas of worklife and emotional exhaustion.

Note: Values represent Pearson's correlation coefficients (r). Higher scores in the Areas of Worklife Scale indicate more favourable working conditions; therefore, negative coefficients indicate associations between more favourable worklife conditions and lower emotional exhaustion.

4. Discussion

The findings indicate that emotional exhaustion among university employees is associated with the interplay between psychosocial working conditions, perceived stress, and personal adaptive resources. The substantial explanatory capacity of the model supports an integrated interpretation in which organizational and individual factors are considered jointly. This perspective is consistent with the broader conceptualization of burnout as a response associated with prolonged exposure to job demands and deterioration in the relationship between employees and their occupational context (Maslach et al., 2001), while recognizing that the outcome examined in the present study specifically represents its exhaustion dimension. It also aligns with the strategic approach to psychosocial risk management proposed by Langenhan et al. (2013), which emphasizes addressing psychosocial factors as structural components of the organization rather than solely as individual adaptation difficulties.

Among the six areas of worklife, workload showed the strongest association with emotional exhaustion ($r = -0.558$), followed by reward ($r = -0.444$) and control ($r = -0.407$). This pattern is relevant in light of the Areas of Worklife model, which proposes that mismatches between individuals and their work environment may occur across distinct domains and contribute differently to occupational well-being (Leiter & Maslach, 1999, 2004). The findings partially correspond with those of Brom et al. (2015), who identified differential relationships between areas of worklife and occupational health, and with Jimenez and Dunkl (2017), who emphasized the relevance of workload and reward in relation to burnout. In the present sample, the comparatively strong association observed for control also suggests that employees'

capacity to influence working conditions and decisions may be particularly relevant within the university context.

The heterogeneous associations observed across the six areas are also consistent with the mixed evidence for unidimensionality obtained when they were specified as reflective indicators of a single global latent factor. Although some fit indices were comparatively favorable ($\chi^2(9) = 40.186$, CFI = 0.947, SRMR = 0.039), the TLI (0.912), RMSEA (0.087; 90% CI [0.061, 0.115]), and substantially lower standardized loading for workload (0.245) provided limited support for a strongly unidimensional interpretation. This finding does not validate or invalidate the equal-weight composite used in the primary analyses; rather, it reinforces the need to interpret that score as an operational aggregate of psychosocial exposure while retaining the conceptual distinctiveness of workload, control, reward, community, fairness, and values. The dimension-specific analyses further showed variation in the magnitude of associations with emotional exhaustion, supporting examination of the individual worklife areas alongside the global composite. This interpretation is consistent with evidence emphasizing the diversity of organizational conditions involved in psychosocial risk management (Iavicoli & Di Tecco, 2020; Di Tecco et al., 2023; do Nascimento Teixeira et al., 2025). From an applied perspective, it also suggests that interventions focused on a single worklife dimension may be insufficient when adverse conditions extend simultaneously across autonomy, recognition, fairness, interpersonal relationships, or value congruence.

Perceived stress occupied a central position in the observed associations. It showed the strongest correlation with emotional exhaustion ($r = 0.703$) and the largest standardized association in the multivariable model ($\beta = 0.509$; $p < 0.001$). This finding is conceptually consistent with perceived stress as an appraisal of experienced situations in terms of unpredictability, lack of control, and demands exceeding available resources (Cohen et al., 1983). The mediation analysis further showed that psychosocial risk was associated with emotional exhaustion both directly and indirectly through perceived stress. The indirect association ($\beta = 0.170$; 95% CI [0.126, 0.217]) represented approximately 32.5% of the total association, whereas the direct association remained statistically significant ($\beta = 0.353$). These findings are consistent with partial statistical mediation, although the cross-sectional design does not establish a temporal or causal sequence among psychosocial conditions, perceived stress, and emotional exhaustion.

The persistence of the direct association between psychosocial risk and emotional exhaustion after perceived stress was included in the model is also relevant. Perceived stress accounted for an important proportion of the statistical relationship, but did not account for it completely. Consequently, emotional exhaustion should not be interpreted exclusively in terms of employees' subjective stress appraisal. Organizational conditions retained an independent association with the outcome, supporting approaches to psychosocial risk management that combine attention to individual psychological processes with organizational prevention (Di Tecco et al., 2023; do Nascimento Teixeira et al., 2025; Saik et al., 2024). Interventions designed to strengthen individual coping resources may therefore complement, but should not replace, measures addressing adverse conditions within the workplace.

Resilience showed a different pattern. It was negatively correlated with perceived stress ($r = -0.519$) and emotional exhaustion ($r = -0.442$) and was independently associated with lower perceived stress ($\beta = -0.391$; $p < 0.001$). These results are consistent with the conceptualization of resilience as the capacity to adapt

to adverse experiences (Campbell-Sills & Stein, 2007; Connor & Davidson, 2003) and with evidence linking resilience to lower stress and burnout-related outcomes in university settings (Takács & Jancso-Farcas, 2025). However, its direct association with emotional exhaustion was no longer statistically significant when psychosocial risk and perceived stress were considered simultaneously ($\beta = -0.049$; $p = 0.170$). Resilience should therefore not be interpreted as having an independent direct protective association with emotional exhaustion within the multivariable model.

The stress × resilience interaction provided additional, but comparatively modest, evidence regarding the conditional nature of these associations. In the unadjusted model, the association between perceived stress and emotional exhaustion decreased from $\beta = 0.577$ at low resilience to $\beta = 0.517$ at the mean and $\beta = 0.458$ at high resilience. Although the interaction was statistically significant, its incremental contribution to explained variance was small ($\Delta R^2 = 0.004$). Moreover, after adjustment for age, sex, job position, contract type, and seniority, the interaction retained a similar direction and magnitude but no longer reached the conventional threshold for statistical significance ($\beta = -0.052$; $p = 0.058$). The moderation finding should therefore be interpreted cautiously and as secondary to the more robust main associations observed for psychosocial risk and perceived stress.

A similar qualification applies to the conditional indirect associations. The indirect association between psychosocial risk and emotional exhaustion through perceived stress decreased from $\beta = 0.192$ at low resilience to $\beta = 0.153$ at high resilience, and the index of moderated mediation was statistically different from zero (-0.020; 95% bootstrap CI [-0.036, -0.005]). Nevertheless, the magnitude of this variation was small. The results therefore suggest that resilience may be associated with modest differences in the strength of the stress–exhaustion relationship rather than functioning as a mechanism capable of neutralizing adverse psychosocial conditions. This interpretation is compatible with previous evidence concerning personal and workplace resources in relation to burnout (Jimenez & Dunkl, 2017) and with studies documenting relationships among stress, resilience, and burnout-related outcomes in university populations (Takács & Jancso-Farcas, 2025; Asensio-Martínez & Aguilar-Latorre, 2025).

From an applied perspective, the findings support a two-tiered prevention strategy. The primary tier should focus on organizational conditions, particularly workload, reward, and control, which showed the strongest associations with emotional exhaustion. Human resource management and university leadership may use psychosocial risk assessment to identify units or occupational groups experiencing excessive workload, limited decision latitude, insufficient recognition, or other adverse worklife conditions, and subsequently prioritize organizational measures such as workload review, clearer allocation of responsibilities, increased participation in work-related decisions, and transparent recognition practices. A secondary tier may complement these actions through resources that support stress management and adaptive coping. However, given the small magnitude and sensitivity of the resilience interaction, resilience-building initiatives should be regarded as complementary measures rather than substitutes for organizational risk reduction. This distinction helps avoid transferring responsibility for structurally adverse working conditions from institutions to individual employees.

The findings should be interpreted in light of several limitations. First, the cross-sectional design precludes establishing temporality or causality; consequently, the mediation and moderated mediation models represent statistical decompositions

of observed associations rather than demonstrated causal processes. Second, the analysis was based on employees from a single Spanish university, which limits generalizability to other institutions, university systems, occupational contexts, and countries. Third, the use of self-report measures may increase susceptibility to common-method variance. Fourth, although the scoring procedures were reconstructed and verified against the aggregate variables available in the source dataset, the secondary nature of the analysis limits control over the original data-collection procedures and measurement decisions. Finally, the multidimensional structure of the areas of worklife and the sensitivity of the interaction effect to covariate adjustment warrant replication in independent samples. Longitudinal and multisite studies would be particularly valuable for determining whether changes in psychosocial working conditions precede changes in perceived stress and emotional exhaustion and for assessing the stability of the observed conditional associations over time.

5. Conclusion

Psychosocial risk was consistently associated with emotional exhaustion among university employees, both directly and indirectly through perceived stress. The analytical model accounted for 36.1% of the variance in perceived stress and 59.6% of the variance in emotional exhaustion, highlighting the relevance of considering organizational working conditions and psychological processes jointly when examining occupational well-being in university settings. Perceived stress showed the strongest association with emotional exhaustion and statistically mediated approximately 32.5% of the total association between psychosocial risk and emotional exhaustion.

Resilience was associated with lower perceived stress and emotional exhaustion at the bivariate level, but its direct association with emotional exhaustion was not statistically significant after psychosocial risk and perceived stress were considered simultaneously. Although resilience moderated the stress–exhaustion association in the unadjusted model, the incremental variance explained by the interaction was small, and the interaction no longer reached the conventional threshold for statistical significance after adjustment for sociodemographic and occupational covariates. Resilience should therefore be interpreted as a potentially complementary personal resource rather than as a mechanism capable of compensating for adverse psychosocial working conditions.

The findings also support a multidimensional interpretation of psychosocial working conditions. Workload, reward, control, values, community, and fairness showed associations of different magnitudes with emotional exhaustion, while the one-factor confirmatory model provided mixed evidence for unidimensionality. Although some fit indices were comparatively favorable, other indices and the substantially lower loading for workload provided limited support for treating the six dimensions as interchangeable manifestations of a strongly unidimensional latent construct. Accordingly, the global psychosocial risk score is more appropriately interpreted as an equal-weight operational composite of adverse working conditions that complements, rather than replaces, examination of the individual worklife dimensions.

From a preventive perspective, the findings support a two-tiered approach in university settings: organizational interventions should constitute the primary level by addressing adverse psychosocial conditions, particularly those related to workload,

reward, and control, while individual resources for stress management and adaptive coping may provide a complementary level of support. Because the study was cross-sectional, the observed mediation and moderation patterns represent statistical associations and do not establish temporal or causal relationships. Longitudinal and multisite research is needed to determine the temporal ordering of these relationships and assess their stability across different university contexts.

Author contributions: Conceptualization, FSC and JCL; methodology, JHH; software, FSC; validation, JCL, FCB and RAS; formal analysis, FSC; investigation, LET; resources, FSC and JCL; data curation, JHH; writing—original draft preparation, NRH; writing—review and editing, RAS; visualization, FCB; supervision, FSC; project administration, JCL; funding acquisition, LET. All authors have read and agreed to the final version of the manuscript.

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Ethical approval: Not applicable.

Informed consent statement: Informed consent was obtained from all subjects involved in the study.

Data availability statement: The dataset used in this secondary analysis was originally deposited by Asensio-Martínez and Aguilar-Latorre (2025) in the Zenodo repository and is publicly available under the Creative Commons Attribution 4.0 International (CC BY 4.0) license at DOI: 10.5281/zenodo.17662702. The data were reused for the present study, and the variables included in the analyses were reconstructed and verified from the item-level data as described in the Methods and Supplementary Material S1.

The reproducible Python software developed specifically for the present secondary analysis by the authors of this study has been independently archived in Zenodo (version 1.0.0) at DOI: 10.5281/zenodo.22762019. The archived package includes the analysis script, README documentation, and software requirements necessary to reproduce the analytical workflow reported in this study.

Conflict of interest: The authors declare no conflict of interest.

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Supplementary Material S1.

Analytical Contribution, Variable Reconstruction, and Reproducibility

S1.1. Analytical contribution of the secondary analysis

The present study uses an existing dataset as the empirical basis for a secondary analysis with a different analytical purpose from that of the source study (Asensio-Martínez et al., 2026). The contribution does not derive from generating a new sample, but from reorganizing the available information around a specific outcome and testing relationships that were not evaluated jointly in the original analytical framework. Emotional exhaustion was isolated as the outcome of interest using the five exhaustion items of the MBI-GS, while psychosocial working conditions, perceived stress, and resilience were integrated within a mediation and moderation framework.

This analytical strategy provides several complementary contributions. First, the six Areas of Worklife dimensions were examined individually to determine their differential associations with emotional exhaustion. Second, these dimensions were combined into a global psychosocial risk composite while preserving their conceptual multidimensionality. Third, perceived stress was evaluated as a statistical mediator of the association between psychosocial risk and emotional exhaustion. Fourth, resilience was examined as a moderator of the stress–exhaustion association, including conditional indirect associations and an index of moderated mediation. Finally, the stability of the principal associations was evaluated after adjustment for relevant sociodemographic and occupational characteristics. These analyses extend the analytical use of the source data without altering their original observations or implying that the secondary analysis constitutes an independent data collection.

S1.2. Reconstruction of psychosocial work conditions

Psychosocial working conditions were reconstructed from the 18 items of the Areas of Worklife Scale (AWLS). Each item was scored from 1 to 5. Items 1, 2, 3, 9, and 12 were reverse-coded using the transformation:

$$\textit{R}\text{eversed score} = 6\text{- original item score} \quad (1)$$

The six worklife dimensions were calculated as follows:

$$\text{Workload} = AWLS_{1R}+AWLS_{2R}+AWLS_{3R} \quad (2)$$

$$\text{Control} = AWLS_{4}+AWLS_{5}+AWLS_{6} \quad (3)$$

$$\text{Reward} = AWLS_{7}+AWLS_{8}+AWLS_{9R} \quad (4)$$

$$\text{Community} = AWLS_{10}+AWLS_{11}+AWLS_{12R} \quad (5)$$

$$\text{Fairness} = AWLS_{13}+AWLS_{14}+AWLS_{15} \quad (6)$$

$$\text{Values} = AWLS_{16}+AWLS_{17}+AWLS_{18} \quad (7)$$

where $AWLS_i$ denotes the score of item *i*of the Areas of Worklife Scale, with i = 1,…,18, and the subscript Ridentifies reverse-coded items. Thus, $AWLS_{1R}$, $AWLS_{2R}$, $AWLS_{3R}$, $AWLS_{9R}$, and $AWLS_{12R}$ represent the corresponding item scores after reverse coding. Each dimension was calculated as the sum of three items and therefore had a theoretical range of 3–15, with higher values indicating more favourable working conditions.

S1.3. Construction of the global psychosocial risk composite

After orienting the AWLS dimensions toward favourable working conditions, the six dimension scores had a combined theoretical range of 18–90. To obtain a

composite indicator in which higher scores represented greater psychosocial risk, the global score was calculated as:

$$PR = 90 - W + C + R + Co + F + V \tag{8}$$

where PRrepresents the global psychosocial risk composite; Wrepresents workload; C, control; R, reward; Co, community; F, fairness; and V, values. Each component corresponds to the dimension scores calculated according to Eqs. (2)–(7).

The resulting psychosocial risk composite had a theoretical range of 0–72, with higher scores indicating greater psychosocial risk. This variable was interpreted as a composite representation of adverse psychosocial working conditions rather than as a reflective latent factor. This distinction is consistent with the mixed evidence for unidimensionality obtained when the six dimensions were specified as reflective indicators of a single latent construct.

S1.4. Reconstruction of perceived stress

Perceived stress was reconstructed from the 10 items of the Perceived Stress Scale (PSS-10). Items 4, 5, 7, and 8 were reverse-coded according to:

$$PSS_{iR} = 4 - PSS_{i,\,i} \in 4578 \tag{9}$$

The total perceived stress score was subsequently calculated as:

$$PSS_{\text{Total}} = PSS_1 + PSS_2 + PSS_3 + PSS_{4R} + PSS_{5R} + PSS_6 + PSS_{7R} + PSS_{8R} + PSS_9 + PSS_{10} \tag{10}$$

where PSS_idenotes the original score of item $i$of the PSS-10 and PSS_{iR}denotes the corresponding reverse-coded score for items 4, 5, 7, and 8. The resulting total score had a theoretical range of 0–40, with higher values indicating greater perceived stress. The reconstructed total reproduced the corresponding aggregate variable available in the source dataset.

S1.5. Reconstruction of resilience

Resilience was reconstructed using the 10 items of the Connor–Davidson Resilience Scale (CD-RISC-10). No items required reverse coding. Item scores were summed to obtain a total score ranging from 0 to 40, with higher values indicating greater resilience. The reconstructed score reproduced the corresponding aggregate variable in the source dataset.

S1.6. Reconstruction of emotional exhaustion

Emotional exhaustion was operationalized using items 1, 2, 3, 4, and 6 of the MBI-GS available in the source dataset. The score was calculated as the arithmetic mean of the five exhaustion items:

$$EE = \frac{MBI\text{-}GS_1 + MBI\text{-}GS_2 + MBI\text{-}GS_3 + MBI\text{-}GS_4 + MBI\text{-}GS_6}{5} \tag{11}$$

where EErepresents the emotional exhaustion score and $MBI\text{-}GS_i$denotes the score of item $i$of the MBI-General Survey included in the exhaustion dimension. Items were scored from 0 to 6, and no reverse coding was required. The resulting score therefore had a theoretical range of 0–6, with higher values indicating greater emotional exhaustion.

This operationalization corresponds specifically to the exhaustion dimension of the MBI-GS and should not be interpreted as a score for the complete multidimensional burnout construct. The reconstructed emotional exhaustion score reproduced the corresponding exhaustion aggregate variable available in the source dataset.

S1.7. Verification of reconstructed variables

All scoring algorithms were applied to the item-level observations in the source

dataset. Reconstructed AWLS dimensions, perceived stress, resilience, and emotional exhaustion scores were compared with the corresponding aggregate variables supplied in the dataset. The reconstructed scores reproduced the available aggregate variables for all 458 observations. This verification was conducted before construction of the global psychosocial risk composite and before estimation of the analytical models.

S1.8. Data screening and analytical reproducibility

The analytical dataset contained complete information for the variables included in the principal models; therefore, no imputation was performed and all 458 observations were retained. Univariate outliers were screened using standardized scores with $|z| > 3.29$, and multivariate outliers were evaluated using Mahalanobis distance at $p < 0.001$. Distributional characteristics were examined through skewness and kurtosis, and multicollinearity was assessed using variance inflation factors.

Continuous variables were standardized for estimation and reporting of standardized regression coefficients. Perceived stress and resilience were mean-centered before calculation of their interaction term. Mediation analysis decomposed the total association between psychosocial risk and emotional exhaustion into direct and indirect components. Moderation was evaluated through the perceived stress × resilience interaction, change in explained variance (ΔR^2), and conditional associations across predefined resilience levels. Conditional indirect associations and the index of moderated mediation were additionally estimated. Nonparametric bootstrap estimation with 10,000 resamples and 95% confidence intervals was used for indirect, interaction, and conditional effects.

As a sensitivity analysis, the principal associations were re-estimated after adjustment for age, sex, job position, contract type, and seniority. All analyses were reproduced in Python using pandas for data management, SciPy for distributional diagnostics, and statsmodels for regression-based estimation. The reconstruction rules and analytical specifications reported above provide the information required to reproduce the derivation of the study variables and the principal statistical models from the source dataset.

Supplementary Material S2.

Analysis Code and Reproducible Statistical Workflow

The analytical code used to reproduce the main statistical procedures of the study is provided as a separate supplementary file (Supplementary File S2). The script documents the reconstruction and verification of the study variables, calculation of the composite psychosocial risk indicator, descriptive and correlational analyses, mediation and moderation models, conditional effects, and covariate-adjusted sensitivity analyses.

The workflow reproduces the scoring procedures described in the Methods and Supplementary Material S1, including reverse-coding of the Areas of Worklife Scale and Perceived Stress Scale items, construction of the six Areas of Worklife dimensions, calculation of the global psychosocial risk indicator, reconstruction of the CD-RISC-10 resilience score, and calculation of emotional exhaustion from the five corresponding MBI-GS exhaustion items. Variable reconstruction was verified against the aggregate variables available in the source dataset.

Statistical analyses were conducted in Python using pandas, SciPy, and statsmodels. The reproducible workflow includes data screening, descriptive statistics, Pearson correlations, standardized regression models, mediation analysis, the

perceived stress × resilience interaction, simple-slope estimation, conditional indirect associations, the index of moderated mediation, and sensitivity analyses adjusted for age, sex, job position, contract type, and seniority. Bootstrap confidence intervals were estimated using 10,000 resamples where applicable.

The supplementary code is intended to provide a transparent record of the analytical workflow and should be interpreted together with the variable definitions and scoring procedures reported in Supplementary Material S1.

Supplementary Material S3. Covariate-Adjusted Sensitivity Analysis

Supplementary Table S3 reports the complete covariate-adjusted sensitivity analyses for emotional exhaustion, including the core predictors and the sociodemographic and occupational covariates included in the adjusted models.

Supplementary Table S3. Covariate-adjusted regression models for emotional exhaustion

Predictor	β	SE	95% CI	p
Model 1: Covariate-adjusted main-effects model				
Psychosocial risk	0.339	0.035	[0.270, 0.408]	< 0.001
Perceived stress	0.505	0.038	[0.430, 0.579]	< 0.001
Resilience	−0.047	0.036	[−0.118, 0.023]	0.189
Age	−0.057	0.038	[−0.132, 0.018]	0.136
Sex	0.001	0.030	[−0.058, 0.061]	0.961
Job position	−0.077	0.033	[−0.141, −0.013]	0.019
Contract type	0.012	0.038	[−0.062, 0.087]	0.744
Seniority (< 12 vs. ≥ 12 years)	0.063	0.042	[−0.021, 0.146]	0.140
Model 2: Covariate-adjusted interaction model				
Psychosocial risk	0.342	0.035	[0.273, 0.411]	< 0.001
Perceived stress	0.512	0.038	[0.437, 0.588]	< 0.001
Resilience	−0.032	0.037	[−0.105, 0.040]	0.378
Age	−0.055	0.038	[−0.130, 0.020]	0.149
Sex	0.001	0.030	[−0.059, 0.060]	0.983
Job position	−0.071	0.033	[−0.136, −0.007]	0.029
Contract type	0.004	0.038	[−0.071, 0.079]	0.919
Seniority (< 12 vs. ≥ 12 years)	0.054	0.043	[−0.029, 0.138]	0.202
Perceived stress × resilience	−0.052	0.028	[−0.106, 0.002]	0.058

Note: β represents the standardized regression coefficient; SE = standard error; CI = confidence interval. Model 1: $R^2 = 0.605$, adjusted $R^2 = 0.598$. Model 2: $R^2 = 0.608$, adjusted $R^2 = 0.600$. Addition of the perceived stress × resilience interaction resulted in $\Delta R^2 = 0.003$. Continuous variables were standardized before estimation. Seniority was represented using the dichotomized variable available in the source dataset (< 12 vs. ≥ 12 years).