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Unseen Strains: The Critical Role of Psychosocial Risks, Mental Health and Violence in Nurses' Musculoskeletal Disorders

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Abstract

Background: Work-related Musculoskeletal disorders (WRMSDs) are highly prevalent among nurses, not only due to the physical demands but also because of significant psychosocial stressors and mental health challenges inherent in healthcare environments. This study investigates the relationship between psychosocial factors, mental health, and workplace violence with the occurrence of WRMSDs in nurses. **Methods:** A total of 266 nurses from various healthcare units participated in this study. Three validated questionnaires were used: the Health and Work Survey (INSAT) to assess psychosocial factors and musculoskeletal disorders; The Violence at Work Scale to measure exposure to violence factors; and the DASS-21 scale to evaluate mental health dimensions, depression, anxiety, and stress. Data analysis was conducted using descriptive and inferential statistics to determine the associations between the investigated factors and WRMSDs. **Results:** This study analyzed the complex relationships that exist between three clusters of characteristics – psychosocial risk factors, mental health, particularly anxiety, and workplace violence – and work-related musculoskeletal diseases (WRMSDs) in Portuguese nurses. In sum, inadequate guidance, low decision latitude, skill-development barriers, anxiety, and violence form the principal drivers of WRMSDs in this workforce. **Conclusions:** This study's results highlight the importance of addressing psychosocial factors, mental health, and workplace violence to reduce the incidence of WRMSDs among nurses. Interventions focused on improving working conditions and promoting mental health may be effective in preventing WRMSDs among nurses.

Keywords: Musculoskeletal disorders; psychosocial factors; mental health; workplace violence; nurses

1. Introduction

The global burden of work-related musculoskeletal disorders WRMSDs remain the leading cause of lost work-days and disability worldwide, with substantial health and economic costs for workers and theirs employers [1]. In the health sector significant challenges impose both physical and emotional strains on workers [2] and nurses, due to the inherent demands of their profession, are particularly susceptible to various health risks, including musculoskeletal disorders WRMSDs [3]. The specific nature of nursing duties, combined with organizational culture and environmental factors within healthcare environments, exacerbates their vulnerability to physical and psychological

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ailments, which in turn have a strong influence on the tasks they perform with a high impact on the quality of care provided. and patient safety [4–6].

Psychosocial risks in the healthcare environment stem from increased workloads, time pressure, emotional demands, and insufficient support from management and colleagues. These factors create a stressful work atmosphere that negatively impacts nurses' physical and mental health, contributing to a higher incidence of WRMSDs [1].

Previous studies have established a strong link between the intense pace of work, exposure to suffering and death, emotional overload, and the development of musculoskeletal disorders among nursing professionals [7–9]. In addition to psychosocial risks, violence in the workplace is another critical issue that healthcare workers frequently encounter [10]. Concurrently, workplace violence has escalated post-pandemic; psychological and vicarious aggression not only elevate anxiety and stress but are also associated with greater musculoskeletal pain [11]. Forms of violence range from verbal abuse and threats to physical assaults, typically from patients or their relatives, but also from colleagues. The repercussions of such violent experiences are severe, affecting both the physical and mental well-being of healthcare workers, reducing job satisfaction, and impairing overall work performance [12,13]. Understanding the factors associated with workplace violence and its prevention is essential to mitigating its impact on healthcare workers [14–16]. Moreover, mental health concerns, including depression, anxiety, and stress, are prevalent among nurses and significantly affect their susceptibility to WRMSDs [17]. High job demands, emotional labor, and the burden of caregiving contribute to psychological distress, which in turn exacerbates physical health problems [18,19]. This research used three distinct questionnaires to evaluate factors related to psychosocial risks at work, violence dimensions and mental health that could be responsible for the occurrence or aggravation of WRMSDs: the INSAT for psychosocial risk factors related to work, the Aggression and Violence at Work Scale [20] for dimensions of workplace violence, and the DASS-21 [21] for mental health dimensions. By comprehensively examining these variables, this study seeks to elucidate the multifaceted influences on the occurrence of WRMSDs in nurses, providing a foundation for targeted interventions and preventive measures to improve the health and well-being of healthcare workers.

2. Materials and Methods

A cross-sectional study was conducted in Portuguese nurses from public and private hospitals, between June 2024 and November 2024 (this study is part of a larger study applied to professionals working in various activity sectors). All participants provided informed consent to participate in this study, and issues associated with confidentiality and anonymity were ensured, keeping in mind the Data Protection Law Regulation (EU) 2016/679 (General Data Protection Regulation). The Ethics Committee of Fernando Pessoa University approved the study, with the reference FCHS/PI 219/21-2. The study promotion and recruitment were done by social platforms (e.g. Instagram, Facebook, WhatsApp), and data collection was conducted online using the Google Forms platform.

The sample consisted of 266 nurses working in hospitals and primary healthcare centers in Portugal, both public (53.4%) and private (46.6%). It was composed of 83.3% females and 16.7% males, aged between 20 and 67 years (M = 36.67; SD = 10.992). Most nurses (61.7%) have been working for less than 16 years. Most of the participants (79.3%) work under permanent contracts.

In this study, three different scales were used: i) INSAT - Health and Work Survey, a self-reported questionnaire that measures working conditions, risk factors, and health problems. Concerning the main goal of the present study, only the psychosocial risk factors and musculoskeletal disorders items were used. The psychosocial risk factors were grouped in categories: work intensity (10 items, $\alpha = .918$); lack of autonomy (4 items, $\alpha = .857$); work relations with coworkers and managers (8 items, $\alpha = .908$); employment relations with the organization (13 items, $\alpha = .929$); working times (8 items, $\alpha = .848$); emotional demands (8 items, $\alpha = .939$) and ethical and value conflicts (4 items, $\alpha = .911$). Psychosocial-risk items originally measured on a 6-point Likert scale (0 = “not exposed”; 1–5 = “exposed” with increasing discomfort) were dichotomized for analysis: 0 = no exposure and

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1 = yes (combining responses 1 through 5). In terms of psychometric properties, the INSAT has good internal consistency obtained by the Rasch Partial Credit Model analysis, with Person Separation Reliability coefficient of 0.8761, and has been used in several health-related studies before [4,7,22]. To measure WRMSDs a four ordered categories item from INSAT was used (0 = no disorder; 1 = disorder not work-related; 2 = disorder present and work aggravates it; 3 = disorder present and work is the primary cause). For this study's purposes, this variable was transformed into a dichotomous outcome: 0 = no work-related disorder (levels 0 and 1) and 1 = work-related disorder (levels 2 and 3). This collapses non-occupational conditions into the reference category and isolates cases in which work exposure either precipitates or exacerbates the disorder, thereby aligning the dependent variable with the study's focus on work-related risk; ii) The Violence at Workplace was assessed through Aggression and Violence at Work Scale [20] that evaluates three dimensions of violence: physical violence (8 items, α = .833), psychological violence (3 items, α = .812), and vicarious violence at work (5 items, α = .916). The physical violence subscale consists of eight items reflecting a variety of physically violent behaviors and threats (e.g., being hit, kicked, or threatened with a weapon). Psychological violence was measured with a three-item subscale representing exposure to psychological aggression at work stemming from three sources: colleagues, supervisors and members of the public (e.g., being yelled at or sworn at). The vicarious violence subscale, with five items, indicates how often they had witnessed or heard about violent events experienced by co-workers, supervisors, friends, or relatives. All three dimensions of violence are covered by a total of 16 items arranged in an ordinal Likert-type scale with four classes that indicate a frequency (ranging from 0 for "never" to 3 for "four or more times"). The measure has been shown to have acceptable construct validity and reliability for the Portuguese version used in this study (Cronbach's Alpha > 0.68 for all subscales) [23]; iii) The Depression, Anxiety and Stress Scale - 21 Items (DASS-21) [21] is a set of three self-report scales designed to measure the emotional states of depression (7 items, α = .914), anxiety (9 items, α = .937) and stress (5 items, α = .910). These categories have different items measured on a 4-point Likert scale ranging from 0 (not applied to me) to 3 (applied to me most of the time).

A descriptive statistical analysis of all variables assessed was performed. Frequency and percentage analyses were performed on the sociodemographic characteristics of the participants. Afterwards, a descriptive analysis of all variables from the three questionnaires was performed using frequency measures, central tendency (mean) and dispersion measures (standard deviation, range, minimum and maximum). Then, a Bivariate analysis was performed using point-biserial correlation to identify the psychosocial risk factors, violence factors and mental health factors that could be related to WRMSDs. Subsequently, a multivariable binary-logistic regression was performed using the ENTER method, entering predictors in three sequential blocks (block 1: psychosocial risk items, block 2: DASS-21 anxiety score, block 3: violence exposure scores) to estimate their adjusted associations with the presence of WRMSDs. The threshold for statistical significance was $p < 0.05$. The regression equations satisfied all assumptions, and the results of the logistic regression analyses were considered reliable. Data were analyzed with the support of the IBM SPSS statistical program for Windows, version 29.0 (SPSS Inc.: Chicago, IL, USA).

3. Results

The study was performed with 266 nurses from public (53.4%) and private (46.6%) sector. Participants' ages ranged between 20 and 67 years (Mean (M) = 36.67 years; Standard Deviation (SD) = 10.992 years). All the sociodemographic characteristics are presented in Table 1.

Table 1. Sociodemographic characteristics of the sample.

	M	**SD**
Age(years)	M=36.67	SD=10.992
Gender	**N**	**%**
Male	46	17.2

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Female	218	82,0
Other	2	.8
Relationship status		
Married	136	51.1
Divorced	12	4.5
Single	116	43.6
Widow	2	.8
Education level		
Bachelor	188	70,68
Master	74	27,82
PhD	4	1,50
Working situation		
Fixed-term contract	26	9,77
Permanent contract	188	70,68
Temporary contract	42	15,79
Self-employed, own account, without employees	10	3,76

Legend: M – Mean; SD – Standard Deviation.

The descriptive analysis of the musculoskeletal work-related disorders (WRMSDs) item from INSAT showed that 86% of the participants suffered from WRMSDs.

Table 2 summarizes the descriptive analysis of the INSAT Psychosocial Risk Factors Scale, reporting the proportion of nurses who answered "yes" to each workplace stressor. To highlight the most prevalent issues affecting practice, only items endorsed by ≥ 20 % of respondents are shown.

Table 2. Descriptive analysis of psychosocial risk factors.

Category		**Psychosocial risk Factors**	**% Yes**
Work Intensity	WI1	Intense work pace	90.6
	WI2	Depending on colleagues to carry out my work	70.2
	WI3	Depending on direct customer requests	80.0
	WI4	Working to tight deadlines and/or strict standards	80.8
	WI5	Having to constantly adapt to changes in work methods or tools	75.5
	WI6	Lack of clear guidance on my tasks	47.5
	WI7	Have to deal with contradictory instructions	67.2
	WI8	Frequent disturbing interruptions	72.5
	WI9	Constantly changing roles, tasks depending on the needs of the company/organization	49.4
	WI10	Hyper-solicitation	74.7
Working times	WT1	Having to take work home beyond my working hours	56.6
	WT2	Having to work beyond normal working hours	85.3
	WT3	Having to sleep at unusual hours because of work demands	61.1
	WT4	Having to skip or shorten a meal or reduce break times due to work demands	86.0
	WT5	Not knowing my work schedule in advance	52.8
	WT6	Conflict in balancing work and personal life	76.2
	WT7	Having to be permanently available at any time of day	62.6
	WT8	Having to travel frequently for work (resulting in absence or significant distance that disrupts family or social routines)	43.8
Lack of Autonomy and Initiative	AI1	Having to complete the work exactly as defined, with no possibility of making changes	39.2
	AI2	Having to respect strictly defined break periods, with no option to adjust them	27.9

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	AI3	Having to follow a strict work schedule, with no possibility of small adjustments	34.7
	AI4	Having no opportunity to participate in decisions about my work	43.8
Work Relations	WR1	Spending many hours in a workspace where I feel uncomfortable	30.2
	WR2	Frequently needing help from colleagues but not getting it	30.9
	WR3	It's rare to exchange experiences with colleagues to improve the work	21.9
	WR4	My opinion about the functioning of the department/section is disregarded	29.4
	WR6	At work, I am not well recognized by my colleagues	29.4
	WR7	I have no one I can trust	21.1
	WR8	I am not treated fairly and with respect by management	34.7
Employment Relations	ER2	Career progression is almost impossible	69.8
	ER3	My salary does not allow me to maintain a satisfactory standard of living	70.2
	ER4	Lack of resources to carry out my work	60.4
	ER5	There are conditions that undermine my dignity	37.7
	ER6	Lack of opportunities to develop my professional skills	51.3
	ER7	Lack of recognition and/or appreciation	66.4
	ER8	Lacks the feeling of "useful contribution to society"	40.0
	ER9	At work, I feel exploited most of the time	55.1
	ER10	I am afraid of suffering an injury caused by the nature of my job.	60.4
	ER11	My company shows no concern for my well-being	55.8
	ER12	It will be very difficult for me to do my job when I am 60 years old	74.0
Emotional Demands	ED1	Have to deal with direct contact with external public	94.0
	ED3	I have to handle tense situations in relationships with the public	85.3
	ED4	I fear the possibility of verbal aggression from the public	65.7
	ED5	I fear the possibility of physical aggression from the public	61.1
	ED6	I have to deal with other people's difficulties and/or suffering	89.4
	ED7	I have to simulate good mood and/or empathy	70.9
	ED8	I have to hide my emotions at workplace	67.9
Work Values	WV1	I have to do things that I disapprove of	45.3
	WV2	My professional conscience is shaken	37.7
	WV3	The things I do are seen as underrated	43.0
	WV4	Lack of necessary resources to perform a well-done job	50.6

Within Work Intensity, over 90% of participants reported an intense work pace, and more than 70% indicated dependencies on colleagues or customer demands, strict standards, and frequent interruptions, indicating sustained operational pressure. Working-hours strain is reinforced by unpredictable schedules (53 %) and permanent availability (63 %). Autonomy is limited for roughly four in ten workers, who lack decision latitude or flexible breaks. In contrast, Work Relations show notably lower exposure levels, with fewer than one-third reporting discomfort related to recognition, fairness, or trust among colleagues, suggesting relatively stable interpersonal dynamics. However, Employment Relations highlight substantial concerns, with around 70% citing stagnant career progression, inadequate salary, and lack of recognition, signaling structural dissatisfaction. The Emotional Demands dimension stands out, with nearly all respondents reporting regular public contact (94%) and handling others' suffering (89.4%), underscoring the emotional burden intrinsic to their roles. Finally, Work Values reflect moderate concern, with around 45% expressing dissonance between their actions and values or professional identity. Collectively, these findings point to high emotional strain in the work environment, with key risk zones in work intensity, emotional exposure, and organizational recognition.

The descriptive analysis for the three dimensions of mental health (DASS-21) and of workplace violence (Aggression and Violence at Work Scale), is presented in Table 3.

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Table 3. Descriptive analysis of Mental Health dimensions and Workplace Violence dimensions for the sample (N=266).

	M (SD)	Min.-Max.
Mental Health		
Anxiety	0.58 (.665)	0-3
Depression	0.58 (.722)	0-3
Stress	0.76 (.731)	0-3
Workplace Violence		
Physical	0.38 (.531)	0-3
Psychological	1.06 (0.994)	0-3
Vicarious	0.78 (0,913)	0-3

Complementary continuous measures (Table 2) reinforce this picture. Mental-health scores were moderate: stress averaged 0.76 (SD = 0.73), slightly exceeding anxiety and depression (both M = 0.58). Mean exposure to psychological violence was highest (M = 1.06, SD = 0.99 on a 0–3 scale), followed by vicarious (M = 0.78, SD = 0.91) and physical violence (M = 0.38, SD = 0.53); all variables spanned the full 0–3 range, indicating that a subset of workers experienced maximum violence. The co-occurrence of elevated emotional demands, frequent psychological and vicarious violence, and measurable anxiety–stress symptomatology underscores a multifaceted psychosocial burden likely to influence musculoskeletal health outcomes examined in subsequent analyses.

The results of the point-biserial analysis are presented in Table 3, with the statistically significant correlations observed between psychosocial risk factors, mental health factors, workplace violence factors,, and WRMSDs.

Table 4. Point-Biserial analysis: correlations between psychosocial risk factors, mental health factors, violence factors, and WRMSDs.

Category		Psychosocial risk Factors	*r*	*p*
Working Intensity	WI2	Depending on colleagues to carry out my work	0.131	0.033
	WI6	Lack of clear guidance on my tasks	0.218	<.001
	WI7	Have to deal with contradictory instructions	0.284	<.001
	WI9	Constantly changing roles and tasks depending on the needs of the company/organization	0.166	0.007
	WI10	Hyper-solicitation	0.251	<.001
Working Hours	WH3	Having to sleep at unusual hours because of work demands	0.199	0.001
	WH4	Having to skip or shorten a meal or reduce break times due to work demands	0.141	0.022
	WH5	Not knowing my work schedule in advance	0.2	0.001
	WH6	Conflict in balancing work and personal life	0.151	0.014
	WH8	Having to travel frequently for work	0.132	0.032
Lack of Autonomy	AI1	Having to complete the work exactly as defined, with no possibility of making changes	0.197	0.001
	AI2	Having to respect strictly defined break periods, with no option to adjust them	0.277	<.001
	AI3	Having to follow a strict work schedule, with no possibility of small adjustments	0.265	<.001
	AI4	Having no opportunity to participate in decisions about my work	0.292	<.001
Work Relations	WR1	Spending many hours in a workspace where I feel uncomfortable	0.203	0.001
	WR2	Frequently needing help from colleagues but not getting it	0.282	<.001

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	WR3	It's rare to exchange experiences with colleagues to improve the work	0.194	0.001
	WR4	My opinion about the functioning of the department/section is disregarded	0.262	<.001
	WR6	At work, I am not well recognized by my colleagues	0.262	<.001
	WR7	I have no one I can trust	0.222	<.001
	WR8	I am not treated fairly and with respect by management	0.182	0.003
Employment Relations	ER2	Career progression is almost impossible	0.177	0.004
	ER3	My salary does not allow me to maintain a satisfactory standard of living	0.27	<.001
	ER4	Lack of resources to carry out my work	0.236	<.001
	ER5	There are conditions that undermine my dignity	0.143	0.02
	ER6	Lack of opportunities to develop my professional skills	0.289	<.001
	ER7	Lack of recognition and/or appreciation	0.203	0.001
	ER8	Lacks the feeling of "useful contribution to society"	0.142	0.02
	ER9	At work, I feel exploited most of the time	0.186	0.002
	ER10	I am afraid of suffering an injury caused by the nature of my job.	0.365	<.001
	ER11	My company shows no concern for my well-being	0.23	<.001
	ER12	It will be very difficult for me to do my job when I am 60 years old	0.236	<.001
Emotional Demands	ED1	I have to handle tense situations in relationships with the public	0.167	0.016
	ED3	Have to deal with direct contact with external public	0.148	0.006
	ED4	I fear the possibility of verbal aggression from the public	0.357	<.001
	ED5	I fear the possibility of physical aggression from the public	0.345	<.001
	ED6	I have to deal with other people's difficulties and/or suffering	0.162	0.008
	ED7	I have to simulate good mood and/or empathy	0.197	0.001
	ED8	I have to hide my emotions at workplace (e.g. fear, frustration, anger, sadness, disappointment)	0.246	<.001
Work Values	WV1	I have to do things that I disapprove of	0.202	0.001
	WV2	My professional conscience is shaken	0.143	0.02
	WV3	The things I do are seen as underrated	0.185	0.002
	WV4	Lack of necessary resources to perform a well-done job	0.214	<.001
Mental Health		Anxiety	0.336	<.001
		Depression	0.28	<.001
		Stress	0.337	<.001
Workplace Violence		Physical	0.232	<.001
		Psychological	0.213	<.001
		Vicarious	0.26	<.001

Point-biserial correlations show a positive and statistically robust link between musculoskeletal disorders and a set of psychosocial stressors. The strongest associations ($r \approx .34 – .37$, $p < .001$) appear for specific employment and emotional-threat items: afraid of suffering an injury ($r = .365$), and fear of verbal aggression from the public ($r = .357$). Moderate correlations ($r \approx .25 – .30$) cluster around lack of autonomy with "Having no opportunity to participate in decisions" ($r = .292$), "deal with contradictory instructions"/"hyper-solicitation" ($r = .284–.251$), and employment relations (e.g., low salary, $r = .270$). Although somewhat smaller, consistently significant ($r \approx .13 – .22$) links emerge for work-intensity factors (e.g., "Depending on colleagues", "Lack of clear guidance") and work values ("things I do are seen as underrated" or "professional conscience is shaken"). Collectively, these coefficients—ranging from small to moderate—indicate that musculoskeletal complaints are most

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closely tied to perceived threat and insecurity at work, but they are also sensitively modulated by autonomy, workload clarity, and overall psychosocial climate.

Focusing specifically on DASS-21 mental-health scores and violence exposure, the point-biserial analysis confirms a psychological pathway to WRMSDs. Anxiety and stress are the mental health dimensions with the highest correlations (respectively, r =.336 and r =.337), while depression (r =.280). All dimensions contribute significantly (all p <.001). The three workplace violence's dimensions (Vicarious violence; r =.260; physical violence, r =.232; and psychological violence, r =.213) had moderately favorable relationships with WRMSDs, indicating that exposure to violence also plays an important role. These results highlight the need for integrated interventions that address emotional well-being and violence prevention, as they imply that both direct and indirect experiences of workplace aggression—as well as elevated affective distress—are independently and cumulatively related to higher odds of WRMSDs.

After this multivariable binary-logistic regression was performed using the ENTER method only with the items considered statistically significant from the previous analysis (Table 5). The method option was Enter because a model only with significant predictors was the main objective for this work. Before this, the assumptions to use this statistical tool were verified and validated. Due to de possibility of multicollinearity between all independent variables, the Variance Inflation Factor (VIF) was calculated and all VIF > 10.0 were removed from the model to ensure the reliability of the logistic regression model. [24].

Table 5. Logistic regression analysis to identify psychosocial risk factors, violence factors and Mental Health factors that are predictors of WRMSDs.

Items	*p*	OR (95% C.I.)
Psychosocial risk factors		
WI2 Depending on colleagues to carry out my work	.038	.228 (.057 - 0.922)
WI6 Lack of clear guidance on my tasks	.028	4.808 (1.189 - 19.444)
WH6Conflict in balancing work and personal life	.014	.109 (.019 - .635)
AI4 Having no opportunity to participate in decisions about my work	.009	8.940 (1.717 - 46.562)
WR2 Frequently needing help from colleagues but not getting it	.003	11.753 (2.305 - 59.939)
ER5 There are conditions that undermine my dignity	.006	2.073 (1.711 - 2.770)
ER6 Lack of opportunities to develop my professional skills	<.001	33.532 (6.346 - 177.178)
ER9 At work, I feel exploited most of the time	.016	2.068 (1.610 - 2.623)
WV8I have to hide my emotions at workplace	.045	5.958 (0.962 - 36.912)
Mental Health		
Anxiety	.005	19.075 (2.434 - 149.468)
Violence		
Psychological	.007	4.215 (1.476 - 12.045)
Vicarious	.005	4.022 (1.436 - 11.037)

The multivariable logistic-regression results show that both work-related stressors and emotional burdens independently shape the odds of reporting WRMSDs. The analysis of psychosocial risk factors shows that four items markedly raise risk: "There are conditions that undermine my dignity" (ER5, OR = 2.073), "feel exploited most of the time " (ER9, OR = 2.068), "Lack of clear guidance" (WI6, OR = 4.808), "no opportunity to participate in decisions " (AI4, OR = 8.940), "needing help from colleagues.." (WR2, OR = 11.753), and "Lack of opportunities to develop professional skills" (ER6, OR = 33.532). Conversely, several conditions appear protective: "Depending on colleagues" (WI2, OR = 0.228) and "Conflict in balancing work and personal life" (WH6, OR=.109) show ORs significantly below 1, suggesting lower WRMSDs odds when these issues are present. The anxiety dimension from mental health is a dominant predictor: each one-unit increase in anxiety multiplies WRMSDs odds nearly twenty-fold (OR = 19.08). Finally, workplace violence is a risk amplifier: exposure to psychological violence (OR = 4.22) and vicarious violence (OR = 4.02) each

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quadruples the likelihood of WRMSDs, independent of other factors. Figure 1 presents an explanatory model structure to visualize the relationship between predictors and WRMSDs.

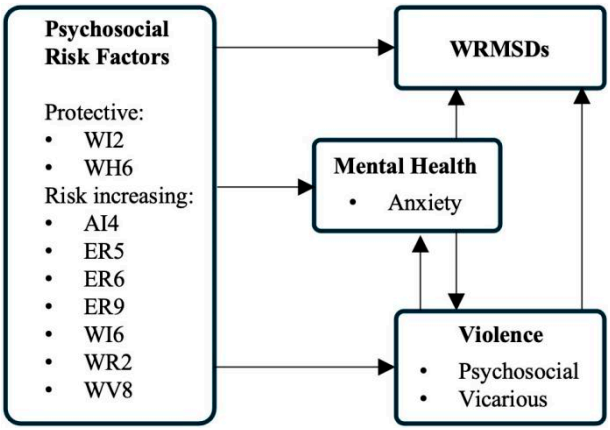

Figure 1. Explanatory Model Diagram.

To resume, inadequate guidance, low decision latitude, skill-development barriers, anxiety, and violence form the principal drivers of WRMSDs in this workforce. In contrast, several seemingly adverse conditions display inverse associations that warrant further qualitative exploration. This model shows that both psychosocial risks, violence at work, and mental health dimensions impact the presence of WRMSDs. The direction and magnitude of these effects provide insights into which factors most strongly influence WRMSDs.

4. Discussion

This study analyzed the complex relationships that exist between psychosocial risk factors, mental health, particularly anxiety, and workplace violence – and WRMSDs in Portuguese nurses. This discussion summarizes the findings in the context of previous research, focusing on three main relationships: 1) between psychosocial risk factors and WRMSDs; 2) between WRMSDs and mental health, especially anxiety; and 3) and between WRMSDs and workplace violence. Finally, a suggested model is presented in Figure 1 to explain the interrelations among psychosocial risk factors, mental health, and violence.

4.1. WRMSDs and Psychosocial Risk Factors

The bivariate and multivariable analyses identified multiple psychosocial risk factors as significant correlates—or predictors—of WRMSDs. Notably, fear of job-related injury (ER10; $r = .365$, $p < .001$) and fear of verbal aggression (ED4; $r = .357$, $p < .001$) exhibited the strongest point-biserial correlations with WRMSDs, suggesting that perceived threat and insecurity at work substantially heighten musculoskeletal complaints. This finding aligns with literature which indicates that exposure to threatening work environments amplifies physical tension and muscular strain, thereby exacerbating WRMSDs [1,7,25].

Beyond threat perception, lack of autonomy emerged as a robust predictor. Participants reporting "no opportunity to participate in decisions about my work" (AI4) had higher odds of WRMSDs (OR = 8.94, 95% CI = 1.717–46.562; $p = .009$), and "following a strict work schedule with no adjustments" (AI3; $r = .265$, $p < .001$) correlated positively with WRMSDs. Such associations mirror prior evidence that limited decision latitude fosters muscle tension and reduces opportunities for micro-breaks, both of which are known risk factors for musculoskeletal injury [7,18,26].

On the other hand, some factors showed inverse associations. "Depending on colleagues to carry out my work" (WI2) was associated with lower odds of WRMSDs (OR = 0.228, 95% CI = .057–.922; $p = .038$). The idea that interdependence promotes social support and shared workload, which might reduce physical strain, is one tenable explanation [18,27]. However, where help from colleagues was

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absent (WR2), the likelihood of WRMSDs significantly rose (OR = 11.753, 95% CI = 2.305–59.939; p = .003), highlighting the importance of perceived (or real) social support as a modifier: its presence reduces the risk of WRMSDs, whereas its absence increases it.

Structural concerns regarding career progression (ER2; r = .177, p = .004), remuneration (ER3; r = .270, p < .001), and skill development (ER6) also predicted WRMSDs. In particular, "lack of opportunities to develop my professional skills" (ER6) conferred dramatically increased odds (OR = 33.532, 95% CI = 6.346–177.178; p < .001). These findings suggest that organizational dissatisfaction—manifested as perceived stagnation or under-utilization—leads to psychological strain that may manifest somatically as muscle tension or other musculoskeletal symptoms [7,18,28].

Taken together, our results corroborate and extend earlier literature: high work intensity, limited autonomy, poor work relations, and structural frustrations each contribute to WRMSDs via psychological and behavioral pathways [1,7]. From an intervention standpoint, these psychosocial domains (e.g., autonomy, social support, resource adequacy) should be prioritized in efforts to reduce WRMSD incidence among nurses [18,29,30].

4.2. WRMSDs and Mental Health (Anxiety Focus)

Mental health dimensions—particularly anxiety and stress—were strongly correlated with WRMSDs and remained significant predictors in multivariable models. The point-biserial correlation between anxiety and WRMSDs (r = .336, p < .001) was nearly identical to that for stress (r = .337, p < .001), while depression also showed a more moderate association (r = .280, p < .001). However, when analyzed the logistic regression only anxiety continued as an independent predictor (OR = 19.075, 95% CI = 2.434–149.468; p = .005): This indicates that anxiety may be the primary "mental health" driver of musculoskeletal complaints. This observation is consistent with some studies where were found that hospital nurses with comorbid WRMSDs and depression more frequently reported elevated anxiety levels, suggesting that anxiety both co-occurs and exacerbates musculoskeletal pain [17,31]. Another study documented that psychosocial risks at work (e.g., emotional demands, pressure) heighten anxiety, which in turn exacerbates physical discomfort [18,19]. Also, evidence shows that, physiologically, anxiety provokes increased muscle tension, altered posture, and hypervigilance—factors that directly increase the mechanical load on musculoskeletal structures [4,32].

Musculoskeletal pain may also feed back into anxiety, creating a bidirectional cycle: persistent pain creates anxiety by reducing functional capacity, promotes dramatization, and increases worry about job performance, fostering anxiety [18]. Clinically, these data emphasize the importance of integrated interventions—combining cognitive-behavioral strategies to reduce anxiety with ergonomic adjustments—to break this cycle and mitigate WRMSDs [17,33–35].

Moderate and significant correlations were obtained between WRMSDs and both direct (physical, psychological) and indirect (vicarious) workplace violence (physical violence: r = .232, p < .001; psychological violence: r = .213, p < .001; vicarious violence: r = .260, p < .001). In the regression model WRMSDs were independently predicted by exposure to psychological violence (OR = 4.215, 95% CI = 1.476–12.045; p = .007) and vicarious violence (OR = 4.022, 95% CI = 1.436–11.037; p = .005). These findings are consistent with several authors who reported that nurses experiencing psychological or vicarious violence have higher levels of musculoskeletal pain. This is probably because of increased stress reactions, hyperarousal, and muscular defense [15],

Furthermore, long-term exposure to workplace violence predisposes healthcare professionals to physical symptoms such as back and neck discomfort [12]. Automatically, continuous sympathetic activation brought on by psychological violence (such as verbal abuse or bullying) and watching violence can result in muscle tension, decreased circulatory perfusion, and delayed recovery of tissue [12,15]. The results from this study are aligned with other studies that demonstrated that both experienced and vicarious violence contribute to emotional exhaustion and physical symptoms among nurses [14].

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Importantly, the absence of physical violence as an independent predictor in our multivariable model suggests that psychological and vicarious forms may exert a more pervasive, insidious effect on WRMSDs than outright physical assaults. This aligns with some studies, suggesting that psychological aggression often goes unrecognized and unaddressed, leading to chronic stress states that predispose individuals to musculoskeletal strain [20]

Collectively, these data underline the critical need for violence prevention programs—addressing not only overt physical assaults but also psychological and vicarious exposures—to reduce WRMSD risk and improve overall well-being in healthcare settings [12,14].

4.3. Interrelations Between Psychosocial Risks, Mental Health, and Violence

Figure 1 depicts an explanatory model in which psychosocial risk factors, mental health (specifically anxiety), and workplace violence interact to influence WRMSDs. The model positions psychosocial risk factors (e.g., lack of autonomy, resource deficits, work-life conflict) as antecedent conditions that both directly increase WRMSD risk and indirectly exacerbate anxiety and exposure to violence. In turn, elevated anxiety and violence further amplify WRMSD risk.

Psychosocial Risk Factors → Anxiety: High emotional demands (e.g., handling others' suffering, fear of aggression) and low decision latitude (AI4) precipitate anxiety [18,36]. For instance, nurses lacking clear guidance (WI6) reported significantly higher anxiety levels, consistent with other studies that found that unpredictability and conflicting instructions provoke worry and hypervigilance [7,37].

Psychosocial Risk Factors → Violence Exposure: Work-related stressors—such as high work intensity and insufficient resources—can foster interpersonal tensions that escalate into psychological violence [23]. Some studies highlighted that environments lacking social support and clear communication bear higher incidences of bullying and aggressive behaviors [4].

Anxiety → Violence: Being exposed to violence can cause anxiety as well as cause violence. Anxious workers may be more sensitive or hypervigilant, which can worsen interpersonal miscommunications and perceived threats and raise the risk of psychological aggression [15]. On the other hand, psychological or vicarious violence exposure exacerbates anxiety through trauma-related pathways [12,38].

Mental Health and Violence → WRMSDs: This study's findings indicate that psychological aggression (OR = 4.215) and anxiety (OR = 19.075) are both independent predictors of WRMSDs. This supports the idea of a psychosomatic pathway where exposure to violence causes chronic stress reactions that accelerate the degradation of the musculoskeletal system, while ongoing anxiety leads to muscle tension and abnormal postures [15,17,38–40].

Psychosocial Risk Factors → WRMSDs: Even after controlling for anxiety and violence, several psychosocial factors (such as a lack of professional advancement opportunities (ER6) and a lack of support from colleagues (WR2)) continued to have a strong correlation with WRMSDs. This suggests that these risks also have a direct impact on musculoskeletal health, most likely through behavioral pathways (such as fewer micro-breaks or poor ergonomics) and increased muscle tension [7,18,27,28,41].

In summary, Figure 1 encapsulates a multifactorial framework: psychosocial factors not only elevate WRMSD risk directly (e.g., by fostering muscle tension and poor work behaviors) but also indirectly via increased anxiety and violence exposure. A self-reinforcing cycle is also created when violence and anxiety worsen WRMSDs. This concept is in line with some authors who promoted integrated strategies that successfully reduce WRMSDs by addressing both psychological and physical risk factors [2,42,43].

4.4. Implications for Practice and Future Research

Our findings support that ergonomic interventions alone are insufficient to minimize or/and control WRMSD prevalence; comprehensive strategies must include psychosocial risk management, mental health support, and violence prevention. Specifically:

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Psychosocial Interventions: Promoting decision autonomy (flexible scheduling, participatory decision-making) can reduce muscle tension and perceived stress [7,44]. Instituting regular team-based debriefings and peer-support programs may bolster social support, attenuating the detrimental effects of workload intensity [45–47].

Anxiety Management: Onsite encouraging services, resilience training, mentoring programs, and mindfulness-based stress reduction programs can decrease anxiety, thereby disrupting the anxiety–WRMSD cycle [48–50].

Future studies should evaluate the efficacy of such interventions in reducing both anxiety and WRMSD incidence longitudinally.

Violence Prevention: Implementing policies for zero–tolerance to psychological aggression and establishing reporting systems are critical. Training workers to recognize and de-escalate potentially violent confronts may reduce both direct and indirect violence exposure [10,12,15,51,52].

Integrated Ergonomic-Psychosocial Programs: The underlying drivers of WRMSDs can be holistically addressed by customized interventions that integrate ergonomic assessments (e.g., safe patient-handling training) with psychosocial risk audits [53–55].

5. Conclusions

This study clarifies a complex network of factors that contribute to WRMSDs in nurses: psychosocial risk factors (such as a lack of autonomy and inadequate resources) raise musculoskeletal complaints directly while also increasing anxiety and vulnerability to workplace violence, both of which raise the risk of WRMSDs on their own. Figure 1 effectively integrates these pathways, illustrating that interventions must target psychosocial, mental health, and violence prevention dimensions concurrently to reduce WRMSD burden in healthcare settings. Due to the cross-sectional design, causal inferences are limited. Future studies should be supported by Longitudinal research to examine temporal dynamics among psychosocial risks, anxiety, violence exposure, and WRMSDs. Furthermore, qualitative research examining nurses' perceptions of the relationship between physical discomfort and professional pressures may clarify complex pathways that are not represented by quantitative measures.

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Abbreviations

The following abbreviations are used in this manuscript:

WRMSD	Work-related musculoskeletal diseases

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