

The Correlation between Psychosocial Risk Factors and Musculoskeletal Disorders among Workers in A Steel Foundry

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Abstract:

This paper aims to display the contribution of psychosocial risk factors(PSRF) to the prediction of musculoskeletal disorders(MSD). among workers in a steel foundry based in Oran. We have adopted the descriptive correlational approach. To collect data was used: Copsoq,(2018) scale, Kuorinka,(1987) scale. It was applied among the sample of the present study (n=122). Stepwise multiple linear regression analysis was used. The resulted showed that: the quantitative demands of the job, workplace, sleep disorders and stress can be considered as contributing factors in the prediction of MSD. To reduce the prevalence of PSRF and MSD, the company should implement a reduction of quantitative demands for the work, and Implementing rest pauses at work according to work tasks.

Key words: Psychosocial risk factors; Quantitative demands; Workplace; Stress; Musculoskeletal disorders.

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Introduction :

Work itself has an important impact on health, which has created new risks and challenges in the field of occupational health and safety. In this regard, the psychosocial aspects of work have increasingly been topics of study and research since the 1950s, and research in this area gained further momentum with the emergence of psychosocial work environment research and occupational psychology in the 1960s, with a shift in focus from an individual perspective to the impact of specific aspects. From work environment to health (Leka & Jain, 2010, p.11).

The new Canadian Standard (CSA Z1003-13) codes injury or illness at work as: “any exposure by a worker to chemical, physical, biological, ergonomic or psychosocial hazards in the workplace.” (Statham, M., 2018, p. 11), the latter is defined as a combination of the individual, collective, and organizational dimensions of the activity carried out by the worker in the

organization ((Technologia, 2013, p. 4). Psychosocial risks also correspond to the work situation where they may be combined or independent of each other, and include: stress - and internal violence committed by employees within the organization - moral or sexual harassment, and the exacerbation of conflicts between individuals or between teams - external violence committed by employees outside the organization such as insults, threats, and assaults... (Inrs, 2017 ,p.1).

These risks arise as a result of several factors known as psychosocial risk factors at work, which refer to interactions within and between the work environment, such as quantitative, cognitive and emotional work demands, and organizational conditions such as regular working hours, overtime, shift work and night work, rest times, and work capabilities. Employees create a margin of independence, the absence of organizational justice, as well as sleep disorders, which through negative experiences and perceptions of individuals may affect work performance, job satisfaction, psychological and physical health, and also includes the way the work is carried out (deadlines, workload, work methods), and the context. In which work occurs including the relationships and interactions between managers, supervisors, colleagues, and customers or customers (Gilbert, M., et al., 2018, p.1).

It is worth noting that these factors are multiple, and there is no agreement between academic researchers and professional specialists about their number due to the complexity of their dimensions and the differences in their concepts, and these two examples present the extent of the difference that exists; The study conducted by the French expert team on monitoring psychosocial risks at work Dares (2014), and the study of the National Institute for Research and Safety (Inrs) limited the factors that individuals suffer from these risks into six categories, including work requirements, margin of independence, and work relationships. As for the Anglo-Saxon trend He expanded his inventory of these factors to more than forty factors, and in the paper we will address twelve factors, including stress at work. In addition to the classification developed by Cox, where he identified the characteristics that cause stress into ten types included in his ILO model (2016).

The World Health Organization acknowledges that psychosocial risk factors go hand in hand with the experience of stress, and the latter may be associated with heart disease, depression, and musculoskeletal disorders. (Leka, Jain, 2010, p. 2). Stress at work is not a positive experience. We feel stressed when we are under excessive pressure and see that we do not have the physical and mental resources to deal with all the demands of our work. These resources can be as simple as having time to do the required work. Preventing stress at work is about preparing An environment for workers in which the appropriate resources are available to handle their daily tasks. (Eu-Osha, 2018, p. 15)

Occupational stress has become common, and it has a high cost in terms of workers' health,

absenteeism and low performance. Although stress is not a disease, it is among the indicators that warn of the presence of a long-term health problem, such as: memory loss (Beckner, V., (2004), peptic ulcers, Levenstein, S., (1998), high blood pressure (Gasperin, D., et al. (2009), Evolution of Cardiovascular Diseases ILO, (2019).

Studies (Cail & Aptel., 2005; Zakerian, et al., 2009; Vinstrup et al., 2018) show a contributing relationship between workers' complaints of musculoskeletal disorders and their exposure to occupational stress resulting from a negative sense of psychosocial risk factors. In the same context, ILO (2019) states that exposure of a worker to continuous stress may cause acute and chronic changes that can cause long-term damage to systems and organs, especially if the body does not have time to rest and recover, including musculoskeletal disorders. So occupational stress in this sense acts as a mediating variable between psychosocial risk factors and osteomuscular disorders, which Niosh (2018) defines as soft tissue injuries resulting from sudden or continuous exposure to repetitive movements, vibrations, and uncomfortable positions. Inrs (2016) indicates that they are multifactorial disorders of occupational origin, linked to organizational constraints, biomechanical psychosocial pressures, as well as some individual factors such as aging or medical antecedents that contribute to the occurrence of these disorders.

Exposure to psychosocial risk factors and musculoskeletal disorders in work contexts is one of the biggest challenges facing occupational safety and health, which has given impetus to academic studies and interventions by professionals at work sites such as (Dares, 2008; 2009; 2014), and the International Labor Office, 2019) (ILO, 2008; 2009; 2014). , the Institutes of Occupational Health and Safety (Inrs, 2016; Eupae, Tuned, 2017; Eu-Osha, 2018; Etui, 2018) and the World Health Organization (Who, 2010).

However, there has been some controversy surrounding the acceptance of psychosocial variables as risk factors for musculoskeletal disorders due to the difficulty of conceptualizing a causal mechanism. Recently, studies have begun to explore the mechanisms that may explain the relationship between these variables. Models have been proposed for the pathways by which psychosocial factors may influence work-related musculoskeletal disorders. Here we refer to the study by Devereux, et al., (1999). Which shows that psychosocial risk factors may influence physical exposure, for example: the adoption of poor work postures, repetition of tasks, and heavy lifting may increase due to the worker's awareness of the high quantitative demands and pace of work.

After extensively investigating the literature (Bongers et al., 2006; Haukka. 2011 DGAFP, 2015; INRS, 2016; HSE, 2017 Roquelaure, 2018) concerned with the underlying causes of workers' complaints of work-related musculoskeletal pain, it became clear that adding In addition to individual factors and biomechanical factors, we also find psychosocial factors.

We note that several scientific conferences have been held to discuss the causal relationship between psychosocial risk factors and osteomuscular disorders, for example the nineteenth conference of the International Ergonomics Association (IEA), (2015), where many scientific papers were presented, including the paper by Bergsten, et. al., (2015), through which the research team confirmed that occupational psychosocial factors contribute to the incidence of musculoskeletal disorders in the back and shoulder regions among baggage porters at six Swedish airports.

Many field studies have also agreed that psychosocial risk factors can lead to the occurrence of musculoskeletal disorders, which would constitute a danger to workers that threatens their health and psychological comfort in all fields of work. For example, we mention in the field of health care studies: (Magnago, et al. al., 2010; Eatough et al., 2012; Carugno.et al.,2012; Chanchai, et al, 2016), and in the construction sector, (Eatough, et al., 2012; Argoub, 2013; Sobeih, et al. , 2014) and in the field of computer work (Aptel, 2005; Zakerian, et al., 2009 Cail,), while in the plumbing sector we find (Ghaffari, et al., 2008; Eatough, et al., 2012; Coggon, et al. (2012; Neupane, et al., 2013; Chaman, et al., 2015; Da silva, De Almeida, Fernandes, 2017.)

Referring to the plumbing health and safety guide, foundries are high-risk environments that pose serious risks to the health and safety of employees. In addition to the obvious risks associated with pouring molten metal, such as: eye injuries due to metal splinters, and burns resulting from the explosion of molten metal, foundry workers are also exposed to For a range of less obvious risks such as developing musculoskeletal disorders, because foundry work is physically demanding and often carried out in difficult conditions. (WorkSafe, V., 2017, pp.3-4

In Algeria, the issue of the relationship between psychosocial risk factors, stress at work, and musculoskeletal disorders is still being addressed modestly in some sectors: we mention studies (Benhassine, 2011; Kherbache, H., et al., 2018) in the field of nursing; Aqaqaniyya study (2012) in the field of dentistry. However, the study of this phenomenon is almost non-existent in the plumbing sector - to the extent of our knowledge - which sparked our attention to study it in this sector.

We will begin to uncover this relationship by investigating the associations of thirteen psychosocial risk factors with musculoskeletal disorders among National Plumbing Corporation workers, based on the following question:

- To what extent do psychosocial risk factors contribute (high quantitative work demands, high cognitive work demands, low control over work time, role ambiguity, role conflict, lack of social support from the supervisor, lack of social support from colleagues, lack of job uncertainty, and lack of security in Working conditions, lack of organizational justice, sleep disorders, work pace, and stress) in the occurrence of musculoskeletal disorders among workers in the National

Plumbing Corporation?

Study hypothesis:

To answer this question, we proposed the following hypothesis:

The contribution of psychosocial risk factors varies (quantitative requirements - pace of work - cognitive requirements - control of work time - role clarity - role conflict - social support from the supervisor - social support from colleagues - job insecurity - insecurity about working conditions - organizational justice - Sleep disorders) in the occurrence of musculoskeletal disorders among workers of the National Plumbing Corporation.

2- Method and methods of dealing with the subject:

1.2. Characteristics of the study sample:

We used self-generated data to assess the following sociodemographic variables: gender, age, professional seniority, and occupational category.

Before data collection, all sample members were informed of the objectives of the study and confidentiality of the data. In total, 122 workers from the Algerian Plumbing Foundation voluntarily completed the relevant scales in the survey, meeting the criterion of working for at least five weeks without missing work; this condition is included in the items of the Occupational Stress Scale. The number of males = 113 and females = 9, with a mean (1.07), standard deviation (0.262), average age (34.00), and standard deviation (9.256). The average seniority of the sample was (12.08), and the standard deviation was (7.165), and the professional category had arithmetic mean (1.30), with a standard deviation of (0.667).

2.2. Tools:

Psychosocial risk factors were assessed using the Copenhagen psychosocial questionnaire, third edition, and it contained 36 items distributed into subscales (quantitative requirements 4 items, cognitive requirements 4 items, control of work time 5 items, and clarity Role has 3 items, role conflict has 2 items, social support from the supervisor has 3 items, social support from colleagues has 3 items, lack of job uncertainty has 3 items, lack of security in working conditions has 5 items, and organizational justice has 4 items), while work-related stress consists of 11 items. Distributed into 3 subscales (stress 3 items, physical stress 4 items, and cognitive stress 4 items). The item gives a response to these paragraphs based on his condition in the past five weeks. All scale items were scored on a 5-point Likert scale ranging from 5 (=always) to 1 (=never). The reliability values of the alpha coefficients obtained by the scale creator ranged from 0.50 to 0.89.

We used the Kuorinka (1987) scale, which includes a set of closed, multiple-alternative questions that measure the degree of suffering from musculoskeletal disorders for each limb of the body

during the last 12 months and during the last 7 days at the level of the entire limbs of the body, in addition to questions related to the causes leading to For these disorders, studies using the Quarinca scale have demonstrated high levels of reliability. (Kuorinka, 1987, pp. 235-236)

2.3. Psychometric properties of study tools

The goal in this step was to prove the reliability of the two study tools. Table 1 displays the reliability coefficients of the subscales, which ranged between -0.167 as a minimum and 0.95 as a maximum. The stratified alpha coefficient showed good reliability according to Nunnally & Bernstein (1994), who adopted 0.70. As a minimum reliability level, it reached 0.88 for the total items of the scale. The same can be said about the results of Table 02, where the reliability coefficients of the subscales ranged between 0.60 as a minimum and 0.63 as a maximum. As for the class alpha coefficient, it showed good reliability with a value of 0.80 (see Table 01 and 02).

Table 01. Summary statistics for the psychosocial risk factors scale, and the stratified alpha coefficient.

	variance	Alpha Coefficient Value (α)	The value of the stratified Alpha Coefficient
High Quantity Work Requirements	15.538	0.659	
High cognitive work requirements	14.278	0.851	
Low control over work time	3.611	-0.167	
Role ambiguity	5.351	0.638	
Role conflict	3.016	0.762	
Lack of social support from the supervisor	5.451	0.576	
Lack of social support from colleagues	6.314	0.443	
Lack of job uncertainty	14.150	0.910	

Insecurity in working conditions	14.231	0.429	
Lack of organizational justice	7.438	0.506	
High pace of work	16.676	0.959	
Sleep disorders	28.898	0.953	
Stress	54.732	0.953	
Psychosocial risk factors scale	431.569	0.820	0.882

Table 02. Summary statistics for bone-musculature scale, and stratified alpha coefficient

	Variance	Alpha Coefficient Value (α)	The value of the stratified Alpha Coefficient
The degree of suffering during the last 12 months	14.577	0.630	
The degree of suffering during the last week	14.058	0.600	
Musculoskeletal Disorders Scale	56.756	0.818	0.806

3- Results:

To test the study hypothesis, we used the Pearson correlation coefficient to verify the existence of a relationship or not, before calculating the contribution of each factor in predicting musculoskeletal disorders. The results were as follows:

Table 03. Correlation coefficient value between psychosocial risk factors and osteomuscular disorders

	correlation coefficient	probability value	(R ²) Coefficient of determination
Association between psychosocial risk factors and osteomuscular disorders	**0.331	0.000	0.109%

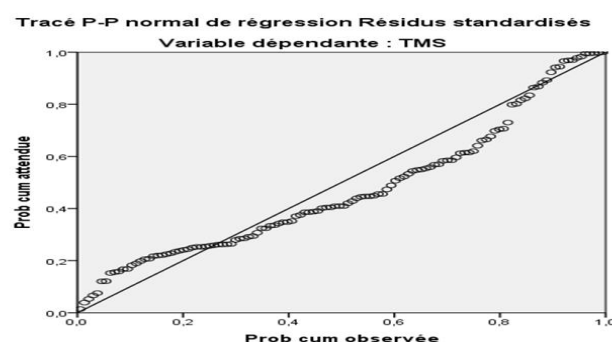
** Function at 0.01

We notice from the previous table that there is a correlation between psychosocial risk factors and musculoskeletal disorders with a coefficient of 0.331 at a significance value of 0.000, where the percentage of explained variance was estimated at 11%. This means that the change that occurs in the dependent variable is partly attributable to the psychosocial risk factors variable. Therefore, we can calculate the amount of contribution of the predictive factors to the study hypothesis. To test the hypothesis, we used stepwise multiple regression analysis to identify the predictor variables contributing to the prediction of musculoskeletal disorders. However, before conducting the multiple regression analysis, it was confirmed that the conditions for its use were met through:

- Examining the normality of the probability distribution of the residuals (OLS) Normality test. The following is the form of the normality of the distribution:

Figure 01. Normalized distribution of the standardized residuals for the musculoskeletal disorders variable

The results resulted in the following:



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Table No. 04. Results of the multiple regression analysis model

model	Correlation coefficient R	the coefficient of determination R ²	Corrected coefficient of determination R ²	Estimation error
1	0.688	0.473	0.455	0.560

The table shows the total correlation value between the independent variables and the dependent variable, where we find that the correlation coefficient was estimated at 0.688, and after squared and corrected, it became 0.455, meaning that 45% of the variance found in musculoskeletal disorders is explained by one or more predictor variables, and the estimation error indicates large errors. Kind of relatively in the model. To verify the significance of the model, a regression analysis of variance (Anova) was performed, as shown in the following table:

Table 05. Regression analysis of variance for Musculoskeletal disorders

The source of variance	the sum of squares score	Degree of Freedom	The average of squares	Value (f)	Probability value (Sig)
Regression	3250.257	4	812.564	26.282	0.05
Remaining	3617.251	117	30.917		
Total	6867.508	121			

It is suggested from the previous table that the value (F) preserved is significant at the level of 0.05, and this indicates that the referral equation is acceptable, and knowing the individual volume for each independent variable in the variable (musculoskeletal disorders) the holdings (β) were extracted as shown in the following table:

Table 06. Beta coefficients for the contribution of independent variables in predicting musculoskeletal disorders

Independent variables	coefficient β	standard error	value of standard β coefficient	t-test value	probability value (Sig)
Constan	-7.533	2.222		3.390	0.001

High work requirements quantity	0.466	0.134	0.253	3.470	0.001
Work pace	1.034	0.153	0.490	6.766	0.05
Stress	0.232	0.073	0.228	3.162	0.002
Sleep disorders	-0.242	0.100	-0.172	2.424	0.01

We note from the table above the contribution of the variable of high quantitative work demands, pace of work, stress, and sleep disturbances in predicting musculoskeletal disorders with standard beta values of 0.253, 0.490, 0.228, and 0.172, respectively, since the probability value of these variables was less than 0.05.

4- Discussing the results:

There has been some controversy surrounding the acceptance of psychosocial variables as risk factors for musculoskeletal disorders due to the difficulty of conceptualizing a causal mechanism, however we will attempt to provide some explanations for these phenomena. What we noticed is that the pace of work was the first main reason for the occurrence of musculoskeletal disorders. According to the results of the study, the possible explanation is that the accumulation of tasks due to malfunctions in machines, the lack of availability of work tools, and frequent interruptions to the pace of work due to urgent requests, production standards, or reasons imposed by Organization, as well as sick absence and a shortage in the number of workers, which results in delays in completing tasks, which requires working overtime and compensatory hours, often leads to cases of slackness and delays in work, which makes workers exposed to the physical burden by excessively adopting uncomfortable positions without Taking rest breaks in order to complete their tasks: such as continuous and fixed sitting or standing, and fixed and repetitive bending positions, which may harm physical health. Here, the Occupational Health and Safety Council (OHSCO) (2007) indicates that using the same areas of the body repeatedly, especially with a lack of rest periods, It leads to fatigue and tissue damage, and thus, pain and discomfort. This can happen even if the level of exerted effort is low and the working positions are unobtrusive, so when it comes to repeating tasks, one should take into account not only the frequency of the task, but also: how long it takes workers to do the task, the required body position, The amount of force used by the worker.

Subban's strategy indicates the necessity of distributing rest periods throughout the daily work period if the work pace is high (morning and evening breaks extending from 10 to 15 minutes), and rest periods extending from 3 to 5 minutes in each working hour due to the constraints

imposed by body positions. Critical (DGHT, 2007, p. 32) Lack of rest periods results in complete fatigue, as continuous activation of the body for long periods of time combined with insufficient recovery, leads to the accumulation of fatigue-based symptoms Veldhoven, (2013) and this has been reported By workers, the symptoms of fatigue do not disappear except by relaxation or rest, and if fatigue occurs repeatedly over a long period of time, the high level of muscle activation will begin to affect other body systems, such as the immune system and especially the sleep system Veldhoven, (2013), and the pace Work and musculoskeletal disorders among plumbing workers. Among the studies whose results agreed with our findings, we mention what was stated by the Canadian Center for Occupational Health and Safety (CCOHS, 2014) and HSE Occupational Health and Safety Statistics (2017), which indicated that musculoskeletal disorders It is related to work patterns, including the pace of work that does not allow sufficient recovery between body movements.

Simoneau, ST-Vincent, Chicoine, (1996) demonstrate through their study that workers cannot adapt their work pace throughout the working day or week according to their condition or level of fatigue. It is recognized that the pace of work controlled by external factors becomes more restrictive and coercive than that which is not.

Plumbing workers who report high quantitative requirements are likely to report high stress at work, given the stressful work environment within the organization, and considering that stress is a result of psychosocial factors, whether combined or individual, and these psychosocial aspects in turn participate in the emergence of orthopedic disorders. Muscle stress is either associated with work stress or independent of it. Among the studies that are consistent with our results, we mention Gembarovski, (2015) and the study of Choobineh et al., (2010), which reported that high work demands and low work control, as well as low social support, have a strong association with the development of musculoskeletal disorders.

A relationship between sleep disorders and musculoskeletal disorders. Schwarz, (2018) points out our daily need for sleep and pain to survive, so continuous impairments of the systems that regulate sleep will lead to clear negative effects on health and psychological well-being; Pain is a strong behavioral motivation that works to protect the individual from harm. He gave an example of this, where the danger signal sensed by the brain when accidentally touching a hot stove will trigger a reflexive withdrawal of the hands to avoid tissue damage. He stressed that pain in itself is not considered a negative phenomenon, but if the brain continues to produce pain even after the pain has been cured for a long time, the pain can develop and persist and is likely to be affected by nerve inflammation and central sensitization. Among previous similar studies, we mention the study of Canivet, Ostergren, Choi et al., (2008), which also found a relationship between musculoskeletal disorders and sleep disorders. In the same context, a study (Lusa, et al., 2015) shows that lower back symptoms are common and persistent among firefighters and that

sleep disturbances strongly predict the membership of the course of these pains.

The relationship between stress at work and musculoskeletal disorders is partly supported by the result of statistical analysis of many studies, as we mention studies (Skov, et al., 1996; Cail & Aptel., 2005; Zakerian et al., 2009; Eatough, et al. (2012; Taylor & Green. 2015; Ansari et al., 2016; Da Silva. Da Silva. Gontijo, 2017; Vinstrup et al., 2018; Elsheikh, 2018) and the study of Aqaniyya, (2012) who investigated the relationship between stress and disorders. Bone-muscle. Although the evidence is still very limited in explaining the phenomenon, some recent research, particularly from EMG studies, has indicated that direct biological effects of “stress” are possible on the musculoskeletal system. Some of these effects are similar to those seen through biomechanical stressors, eg increased muscle tension, while others may be specific responses to stress, eg increased blood cortisol levels or changes to pain receptors. It is also possible that some factors described as psychosocial variables have an indirect effect on the occurrence of musculoskeletal disorders by modifying exposure to biomechanical risk factors (either attenuating or amplifying risk factors Michael, S., Kerr, (1998). The study of Magnago T., et al, (2010) indicates that there is a relationship between high stress at work and pain in the neck, shoulders, and lower back among salespeople. The explanation for this is that working in high-stress work positions prompts the body to secrete the psychological stress hormone at high levels. Such as cortisol and adrenaline, and high secretion of these hormones causes decreased blood circulation and damage to the musculoskeletal system. Schwarz, et al., (2018) adds, “Under normal circumstances, the body benefits from increases in stress hormones, but exposure to prolonged periods or high levels of cortisol It leads to a number of unfortunate biological events.

Stress responses include four systems that may interact with the musculoskeletal system: stress-related central nervous system excitation that increases the level of reticular formation activity, which in turn increases muscle vitality. The increase in muscle vitality is the main mechanism, because it increases muscle rigidity, and thus also increases the osteo-muscular weight of the muscles and tendons and results in the risk of developing osteo-muscular disorders. It has been experimentally proven (Schleifer, et al., 2008; Eijkelhof, et al., 2013; Taibet, al., 2016;), that shoulder muscle activity increases when exposed to psychosocial stress, with increased static weight in the shoulder.

In summary, there is much evidence in neurobiological contexts that supports the idea of a reciprocal relationship between stress and musculoskeletal disorders. In light of the subjective and multidimensional nature of the experience of pain, musculoskeletal disorders must be understood as multifactorial entities that include neurobiological, biomechanical, and psychosocial factors. This justifies a biopsychosocial approach to prognostic and causative factors of disorders.

5- General conclusion:

Musculoskeletal disorders have been recognized as an important cause of illness and disability in many occupational populations over the past few decades, and the sheer volume of disorders and their profound impact in the workplace have generated momentum for studies to identify contributing factors to the incidence of work-related musculoskeletal disorders.

Psychosocial risk factors may be associated with the occurrence of musculoskeletal disorders through several pathways. Psychosocial factors may have a direct effect on the spine through changes in postures adopted, movements, and forces exerted. Psychosocial factors may lead to stress resulting in chemical and physiological responses such as increased secretion of hormones contributing to muscle tone, affecting pain perception and in the long term potentially leading to the development of musculoskeletal disorders. Psychosocial factors can influence workers' awareness and change the ability to cope with pain and illness and, conversely, may increase the likelihood of developing musculoskeletal disorders and the development of episodic pain into chronic pain.

Work-related musculoskeletal disorders appear to have many causes, including psychosocial risk factors. While emphasis has been placed on physical and biomechanical burden factors as major determinants of musculoskeletal disorders, little research has been done into the interactions between psychosocial risk factors and musculoskeletal disorders. Muscular in the local context, despite what Western literature exudes in this field.

This study raised the question about the mechanism behind the occurrence of musculoskeletal disorders, by predicting psychosocial working conditions, and workers' negative perceptions of those conditions in the work environment, which is essentially an environment with multiple and high risks (the plumbing sector).

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