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## Occupational stress and professional exhaustion syndrome (burnout) in workers from the petroleum industry: a systematic review

*Estresse ocupacional e síndrome do esgotamento profissional (burnout) em trabalhadores da indústria do petróleo: uma revisão sistemática*

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### Abstract

**Introduction:** workers in the petroleum industry perform roles in a variety of areas and work in some of the most adverse working conditions, which may result in adverse effects, such as occupational stress and burnout. **Objective:** to investigate the association between work environment within the petroleum industry and occupational stress/burnout in its workers, along with psychosocial factors in these workers with their associated physical symptoms. **Methods:** systematic literature review conducted using nine bibliographic databases. Articles included in the review were observational epidemiological studies written in English, Spanish, and Portuguese published between 1994 and 2014, with scores above 13 points, referring to the criteria from the Checklist for Measuring Quality. **Results:** the theme of most of the selected studies was regarding identifying the sources of occupational stress that are associated with psychosocial factors. **Conclusion:** workers from the petroleum industry are subjected to many occupational stress factors that have an influence on the physical, psychological and social aspects of their health. Further investigation of this theme can stimulate the development of strategies able to promote a better quality of life and improved working conditions for professionals in this sector.

**Keywords:** occupational stress; professional exhaustion; burnout; petrochemical industry.

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## Introduction

The professional categories that act in the petroleum industry began attracting attention due to the peculiarities of the work involved, such as being confined on offshore oil platforms, for 14-day periods, and lack of lighting and heat on the refineries, as well as the risks regarding explosions and fire at both locations<sup>1</sup>, which indicates the existence of occupational stress and professional exhaustion syndrome (burnout) as health problems that affect different groups of workers<sup>2-4</sup>.

Occupational stress occurs when the individual is unable to meet the demands required by his/her job, which cause distress, discomfort, behavioral changes, sleep disorders and negative feelings<sup>5</sup>. Burnout is defined as a negative response to chronic occupational stress, which is described by the presence of three dimensions: a) emotional exhaustion, characterized by a lack of energy and depletion of resources, leading to feelings ranging from hopelessness, sadness, irritability all the way to physical symptoms such as weakness, headaches, nausea, musculoskeletal and sleep disorders; b) depersonalization, characterized by indifference, disengagement and alienation regarding social groups and work; and c) reduced personal accomplishment at work, characterized by low productivity, making the individual feel unhappy and dissatisfied with his/her professional development<sup>6</sup>.

On a professional level, the most common factors related to burnout are decreased work quality, professional errors, negligence and recklessness. This situation can generate insecurity within the group and, consequently, degrade interpersonal relationships and increase the likelihood of accidents<sup>2</sup>. On an organizational level, burnout can be related to working structure, lack of autonomy for workers and frequent changes in the configuration of rules and regulations. In an economic context, this syndrome leads to increased costs incurred due to absenteeism and workers' treatment for their physical and mental symptoms, not to mention the expense of recruiting and training new staff to replace lost team members<sup>4,7,8</sup>. Burnout syndrome can also be associated with mental disorders such as depression, anxiety disorders (panic and social phobia) and drug abuse/dependence, such as alcohol and other psychoactive substances<sup>8</sup>.

Despite being initially studied among workers who deal directly with the public, such as teachers and health professionals<sup>9,10</sup>, burnout was identified among offshore workers<sup>4</sup> due to the occupational stress factors of this job, such as inhospitable locations (for example, the North

Sea, being subjected to adverse weather situations, difficulty accessing emergency situations etc.), confinement (isolation on platforms for several days), unpredictability (regarding safety at work and environmental conditions) and shift work (in addition to the confinement, having to work 12 to 24-hour shifts). Early studies began being developed in the North Sea and the South China Sea and, later on, in the Norwegian Sea<sup>4,11,12</sup>.

In the context of the world's petroleum industry, studying burnout and occupational stress has been primarily supported in a model that classifies environmental factors, such as organizational stress factors<sup>13</sup>, into five categories<sup>9</sup>: intrinsic work factors, roles in the organization, interpersonal relationships in a working context, career development, structure and organizational environment. By using these five categories it is possible to identify and select the appropriate options to prevent and minimize the problems behind the syndrome.

Although being scientifically relevant, such kind of studies are still rather uncommon in the literature, with the development and improvement of research playing a crucial role regarding this subject. Systematic reviews are very useful for this purpose, since they are designed to be methodical and reproducible, guiding the development of research projects, identifying which methods were used in a given area and indicating new directions for future research<sup>14</sup>. Therefore, the aim of this study was to investigate the association between the working environment in the petroleum industry and occupational stress and burnout in its employees, as well as the psychosocial factors and physical symptoms that are associated with it.

## Method

The employed method consisted of a systematic review of the literature, which followed the methodology described in the Statement for Reporting Systematic Reviews and Meta-Analyses of Studies (PRISMA)<sup>15</sup>, which refers to epidemiological studies that investigated the association between occupational stress and professional exhaustion syndrome (burnout) in workers from the petroleum industry.

The following databases were consulted: Lilacs, IBECs, MEDLINE, Biblioteca Cochrane, SciELO, PubMed, Scopus, Web of Science and SiBI (ODTBase). The following inclusion criteria were used: articles published between 1994 and 2014 in Portuguese, English and Spanish that had an observational epidemiological study design

(cross-sectional, case-control and cohort – which are the most widely used types to evaluate the association between variables).

### Search strategy

The descriptors listed in the Health Sciences Descriptors (*Descritores de Ciências em Saúde - DeCS*) and the Medical Subject Headings (MeSH) were used, with searches based on the keywords, title and/or abstract of the article. The initial selection was based on a reading of the summary, and, whenever this was insufficient to define them, the articles were read in their entirety. Another strategy was to search in the reference lists of the selected articles manually. All the steps (search, selection and assessment of the articles) were taken independently by two researchers; any disagreements between them were resolved through discussion and consensus.

The descriptors used from the DeCS were: “saúde do trabalhador”, “esgotamento profissional”, “estresse ocupacional”, “professional burnout”, “agotamiento profesional”, “indústria petroquímica”, “petroleum industry” and “industria del petróleo”. The descriptors used from the MeSH were “professional burnout”, “petroleum industry” and “offshore workers”. The search keys were decided

upon according to each of the databases consulted. For example, the following search key was adopted in the SciELO database: (“*estresse ocupacional*” OR “*esgotamento profissional*” OR “Burnout” OR “*saúde do trabalhador*”) AND (“*petróleo*” OR “Offshore” OR “*indústria petroquímica*”).

### Evaluating the quality of the studies

The articles were evaluated and given a score according to the methodological criteria proposed by the Checklist for Measuring Quality<sup>16</sup> (**Chart 1**) – an instrument applied to the design of the articles to assess their quality –, which makes it possible to evaluate the information, the internal (biases and inconsistencies) and external validity and the ability to detect the significant effect of the study.

This article employed the version consisting of 27 items, with items related to experimental studies being deleted. Thus, 17 items were evaluated in the end (**Chart 1**), a stage in which the articles could be given up to 18 points. Articles with a classification above 70% (13 points) were considered as having great methodological rigor and were included in the study. These same criteria were used by other authors in national review articles<sup>17-19</sup>.

**Chart 1** Items from the Checklist for Measuring Quality\* used to qualitatively assess the articles

✓ Is the hypothesis/aim/objective of the study clearly described?
✓ Are the main outcomes to be measured clearly described in the Introduction or Methods section?
✓ Are the characteristics of the patients included in the study clearly described?
✓ Are the distributions of principal confounders in each group of subjects to be compared clearly described?
✓ Are the main findings of the study clearly described?
✓ Does the study provide estimates of the random variability in the data for the main outcomes?
✓ Have the characteristics of patients lost to follow-up been described?
✓ Have actual probability values been reported?
✓ Were those subjects who were prepared to participate representative of the entire population from which they were recruited?
✓ If any of the results of the study were based on “data dredging”, was this made clear?
✓ In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?
✓ Were the statistical tests used to assess the main outcomes appropriate?
✓ Were the measures used accurate?
✓ Were the participants in the different groups recruited from the same population?
✓ Were the participants in the different groups recruited during the same time period?
✓ Did the analysis include an appropriate adjustment for the confounding variables?
✓ Were the participant losses considered during the study?

\* Adapted from Downs and Black<sup>16</sup>

## Data extraction

Following this step, the studies that reached the required score were used in our review and had their information extracted for comparison. The following data were selected: author, country and publication year, study design, location where the study was conducted, sample size, study objective and score from the study quality analysis, instruments used, sources of occupational stress, psychosocial factors and associated physical symptoms, and main results.

## Results

### Results from the search and selection

Figure 1 shows the articles selecting process flowchart. The literature search initially resulted in 169 articles, 156 of which were identified by searching the databases and 13 by manually searching the references section of the articles

found in the databases. 128 of these were excluded for being duplicates and/or not strictly meeting the subject under study. 32 of the remaining 41 were excluded for not meeting the inclusion criteria of this research: 20 of the excluded articles were related to literature reviews or qualitative research, 5 articles did not have the full version available (without free access), 5 were articles that referred to accidents on platforms and 2 articles received low scores during their quality evaluation. Thus, there were 9 articles that underwent evaluation in our review.

### Characteristics of the studies

As Table 1 shows, most of the selected studies' objectives are related to occupational stress factors: identification of the occupational stress sources, burnout frequency, absenteeism indicators, health risks from shift work, evaluation of sleep parameters and mental health associated with occupational stress factors or demands/requirements of the job.

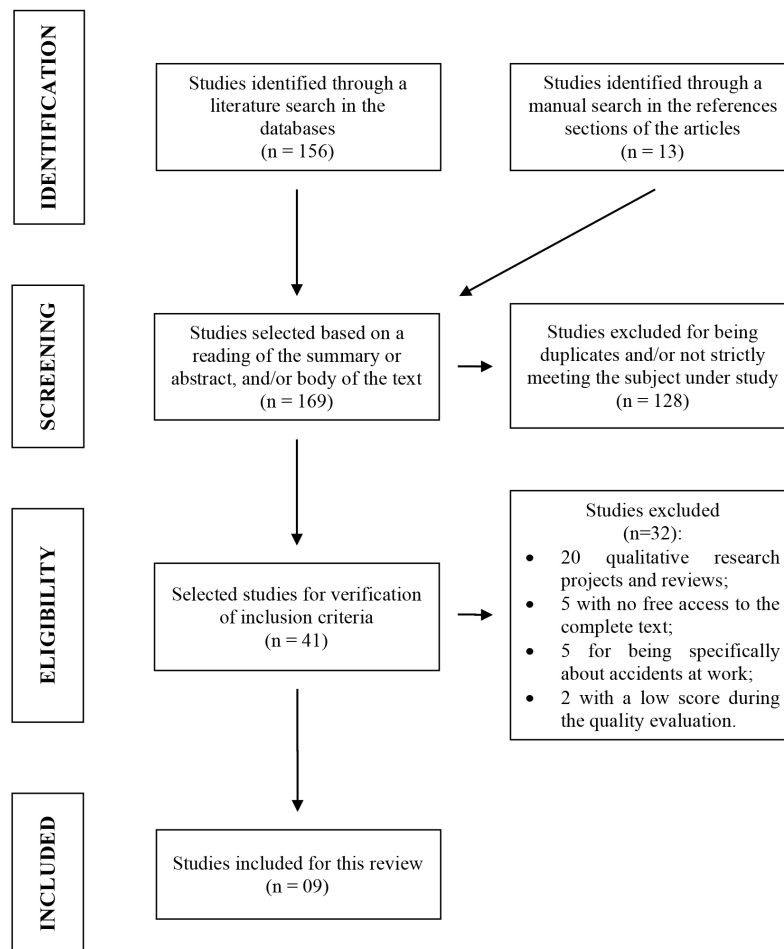


Figure 1 Flow diagram showing the result of the search of the information sources, selection and inclusion of the articles in the systematic review, in accordance with the recommendations set out in PRISMA<sup>15</sup>.

**Table 1** Characteristics of the studies included in the systematic review regarding occupational stress and burnout syndrome in workers from the petroleum industry

Authors	Country of publication/year	Study design	Location of study completion	Sample size	Study objective	Score from the study quality analysis(*)
Sutherland and Copper <sup>2</sup>	United Kingdom/1996	Cross-sectional	Platform	310	To identify sources of stress that can be reduced or eliminated by an organizational change	16
Hellesoy, Gronhaug and Kvitastein <sup>4</sup>	Norway-North Sea/2000	Cross-sectional	Platform	2061	To estimate the frequency of burnout in the offshore environment and to analyze its dimensions in this context	17
Wong et al. <sup>11</sup>	China/2002	Cross-sectional	Platform	561	To explore sources of occupational stress observed among workers.	16
Chen, Wong and Yu <sup>21</sup>	China/2009	Cross-sectional	Platform	561	To explore the association between mental health and occupational stress and to identify ways of coping with diseases	16
Ljosa and Lau <sup>12</sup>	Norway/2009	Cross-sectional	Platform and refinery	1697	Association between the regime of onshore and offshore shift work, and problems in the domestic and social life of the workers.	17
Ljosa, Tyssen and Lau <sup>20</sup>	Norway/2011	Cross-sectional	Platform	1336	To investigate the association between psychosocial and individual factors and mental distress among workers.	18
Menezes et al. <sup>22</sup>	Bacia de Campos, Rio de Janeiro, Brazil/2004	Cross-sectional	Platform	179	To evaluate sleep parameters among workers and to investigate their association	15
Silva Júnior and Ferreira <sup>13</sup>	Brazil/2009	Cross-sectional	Platform	355	To investigate the predictive power of environmental stress factors in the three burnout dimensions	15
Oenning, Carvalho e Lima <sup>23</sup>	Brazil/2014	Retrospective cohort	Refinery	782	To identify risk factors for absenteeism from sick leave among workers from a petroleum company	16

(\*) Checklist for Measuring Quality<sup>16</sup>

We found only two studies regarding the occurrence of burnout syndrome in workers from the petroleum industry, one foreign article (Norwegian) by Hellesoy et al.<sup>4</sup> and one Brazilian, by Silva Júnior and Ferreira<sup>13</sup>. However, all the articles referred to the relationship between the working space in the petroleum industry and the effects of occupational stress on workers' health.

Most of the studies were cross-sectional (n = 8), with one being a retrospective cohort study. Among these studies, six were international and three Brazilian. Most of the international studies were based in the North Sea while most of those based

in Brazil were conducted in Bacia de Campos, Rio de Janeiro. Oil extraction platforms were the main locations for these studies (n=7), with one being a study conducted in both locations (platforms and refineries) and only one conducted at a refinery (**Table 1**).

The sample size varied greatly from 179 to 2061 participants, with predominantly male individuals aged between 20 and 65 years (**Table 1**).

As regards the methodological quality of the articles, 16.2 had the average score awarded, the highest score being 18 points and the lowest 15. The

highest score (18) was given to the article by Ljosa et al.<sup>20</sup>. In this study, the selection bias or systematic errors were controlled; as is true for the confounding variables, the participant losses were taken into account and the methodological steps were well described. Studies that scored lower did not report the actual values of probability (*p*-value or its significance level) or the main confounding factors (**Table 1**).

The most diverse instruments were used (**Table 2**), the most frequent ones being: the Occupational Stress Scale (OSS) (n=2) to evaluate occupational stress and scales adapted to the Maslach Burnout Inventory (n=2), with one of them having already been validated (Scale for

Evaluating Environmental Stress factors in the Offshore Context – EACOS) to evaluate burnout. The Coping with Shift Work Questionnaire (CSQ) (n=1) was used to evaluate coping strategies, while the Hopkins Symptom Checklist (HSLC5) (n=1) was used to evaluate anxiety and depression. One study used the General Health Questionnaire (GHQ) (n=1) to assess psychological morbidity, while another study used the General Nordic Questionnaire for Psychological and Social Factors at Work (QPS Nordic) (n=1) to evaluate the association of psychological and social factors related to well-being at work. Questionnaires designed by the authors were used in four of the studies.

**Table 2** Characteristics of the studies included in the systematic review regarding occupational stress and burnout syndrome in workers from the petroleum industry and main results

Authors	Instruments used	Sources of occupational stress	Main results	
			Psychosocial factors and associated physical symptoms	Main conclusions
Sutherland and Copper <sup>2</sup>	Technical report containing three questionnaires designed by the authors.	<ul style="list-style-type: none"> <li>Lack of career prospects;</li> <li>Insecurity regarding work conditions;</li> <li>Lack of stimulus;</li> <li>Physical and climatic conditions at work;</li> <li>Unpredictable and excessive workload;</li> <li>Air transport to platform;</li> <li>Necessity to adapt to new technologies.</li> </ul>	<ul style="list-style-type: none"> <li>Concern with family/domestic issues while at work;</li> <li>34% of the sample are smokers and 16% reported being high alcohol consumers.</li> </ul>	<ul style="list-style-type: none"> <li>A stress control program becomes effective when it is directed to the specific problems and sources of stress identified in certain groups of people;</li> <li>Stress management must run hand-in-hand with company management;</li> <li>The sources of stress that were most associated with dissatisfaction at work were: lack of career prospects (25.3%), underutilization and low demand (27%) and shift work (8%).</li> </ul>
Hellesoy, Gronhaug and Kvitastein <sup>4</sup>	Questionnaire adapted based on the Maslach burnout inventory (MBI) to the offshore context.	<ul style="list-style-type: none"> <li>Dangerous conditions;</li> <li>Shift work;</li> <li>Air transport to platform;</li> <li>Fire and explosion risks.</li> </ul>	<ul style="list-style-type: none"> <li>Feeling of not having a close relationship with colleagues (lack of social support and assistance coping);</li> <li>Worry in regards to family while at work;</li> <li>Alienation;</li> <li>Lack of focus and motivation;</li> <li>Sleeping problems.</li> </ul>	<ul style="list-style-type: none"> <li>Lesser frequency of burnout in married individuals and greater frequency of in young unmarried individuals;</li> <li>Low frequency of burnout compared with other professions ("Helping professions");</li> <li>Association of negative emotions with coping focused on emotion.</li> </ul>
Wong et al. <sup>11</sup>	OSS (Occupational Stress Scale) adapted based on questionnaires designed by Cooper.	<ul style="list-style-type: none"> <li>Noise;</li> <li>Vibration;</li> <li>Safety;</li> <li>Feeling of putting oneself and others at risk by making a mistake.</li> </ul>	<ul style="list-style-type: none"> <li>Not being able to exercise ones role in the family while on the platform;</li> <li>Lack of career prospects.</li> </ul>	<ul style="list-style-type: none"> <li>The results found in Chinese workers were different from those found in the previous study conducted in the United Kingdom: the only widely reported stress factor was the home/domestic interface; there were few reports regarding problems in relation to the structural and organizational climate.</li> </ul>

(To be continued)



**Table 2** Continuation...

Authors	Instruments used	Sources of occupational stress	Main results	
			Psychosocial factors and associated physical symptoms	Main conclusions
Chen, Wong and Yu <sup>21</sup>	General Health Questionnaire (GHQ); <i>Occupational Stress Scale.</i>	<ul style="list-style-type: none"> <li>• Noise;</li> <li>• Vibration;</li> <li>• Lack of lighting and ventilation;</li> <li>• Shift work;</li> <li>• Adverse weather conditions;</li> <li>• Confinement.</li> </ul>	<ul style="list-style-type: none"> <li>• Home/work interface;</li> <li>• Lack of social support and assistance coping.</li> </ul>	<ul style="list-style-type: none"> <li>• Occupational stress significantly associated with a worsening state of mental health of the worker;</li> <li>• Coping in terms of focusing on the problem was positively associated with improved mental health and that regarding focusing on emotion was associated with mental health problems.</li> </ul>
Ljosa and Lau <sup>12</sup>	Coping with Shift Work Questionnaire (CSQ).	<ul style="list-style-type: none"> <li>• Shift work;</li> <li>• Family separation.</li> </ul>	<ul style="list-style-type: none"> <li>• Problems in social and domestic life;</li> <li>• Lack of social support as a coping strategy.</li> </ul>	<ul style="list-style-type: none"> <li>• Coping by focusing on the problem and social support was associated with a small number of reports involving problems in social and family life; self-criticism was associated with a greatest number of reported problems;</li> <li>• Ambiguity in relation to positive and negative aspects of shift work comparing the refineries and platforms.</li> </ul>
Ljosa, Tyssen and Lau <sup>20</sup>	Hopkins symptom checklist (HSLC5); The General Nordic Questionnaire for Psychological and Social Factors at Work (QPS Nordic).	<ul style="list-style-type: none"> <li>• Shift work arrangements;</li> <li>• Isolation;</li> <li>• Extreme weather conditions;</li> <li>• Risks of accidents;</li> <li>• Shift work, especially nightshifts.</li> </ul>	<ul style="list-style-type: none"> <li>• Problems at home interfering at work;</li> <li>• Lack of social support.</li> </ul>	<ul style="list-style-type: none"> <li>• Mental distress identified using the HSLC is greater among men and associated with a low level of support and a high level of interference from family problems.</li> </ul>
Menezes et al. <sup>22</sup>	Questionnaire designed by the authors.	<ul style="list-style-type: none"> <li>• Irregular sleep patterns;</li> <li>• Work by turns.</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulties sleeping: poor quality sleep, difficulties getting to sleep, disturbed sleep, feeling tired after sleep;</li> <li>• Nightmares and sleepwalking.</li> </ul>	<ul style="list-style-type: none"> <li>• Sleeping problems and feelings of sadness are mostly reported by workers on the night shift compared to those on the day shift.</li> </ul>
Silva Júnior and Ferreira <sup>13</sup>	Scale for Evaluating Environmental Stress factors in the Offshore Context (EACOS) adapted from the MBI (specifically for professionals who have no contact with customers and validated for Brazilian workers in the offshore context by Silva Júnior).	<ul style="list-style-type: none"> <li>• Being submitted to rules and discipline;</li> <li>• Shift work;</li> <li>• Adverse working conditions;</li> <li>• Feeling of insecurity (access to medical attention on the platform is precarious).</li> </ul>	<ul style="list-style-type: none"> <li>• Long periods away from the family;</li> <li>• Relationship and performance problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Identification of the three predicting dimensions for burnout;</li> <li>• Younger workers are more prone to burnout;</li> <li>• Suggestions for measures that can contribute towards reducing burnout among workers.</li> </ul>

(To be continued)

**Table 2** Continuation...

Authors	Instruments used	Sources of occupational stress	Main results	
			Psychosocial factors and associated physical symptoms	Main conclusions
Oenning, Carvalho e Lima <sup>23</sup>	Secondary data obtained from electronic medical records at the occupational health service.	<ul style="list-style-type: none"> <li>• Heavy physical workload;</li> <li>• Discomfort regarding the working “positions”.</li> </ul>	<ul style="list-style-type: none"> <li>• Hypertension;</li> <li>• Musculoskeletal diseases;</li> </ul>	<ul style="list-style-type: none"> <li>• Female, being a smoker or ex-smoker, being dissatisfied with work and reporting abnormal sleep were significantly associated with absenteeism from work due to illness;</li> <li>• Individuals with sleep problems are more likely to miss work.</li> </ul>

In addition to the aforementioned articles, which were adapted from the Maslach Burnout Inventory (MBI), there was one technical report (n=1) that contained aspects of work, involvement in accidents, social support and lifestyles; one questionnaire (n=1) to identify the sleeping patterns during shift work; and secondary data from electronic records (n=1) to collect data associated with sleeping difficulties, with stressful life events and psychosocial factors. Two studies used more than one psychometric scale: Chen et al.,<sup>21</sup> who used the GHQ and OSS instruments; and Ljosa et al.<sup>20</sup>, who used the QPS Nordic and the HSCLC5.

The studies conducted on platforms<sup>2,4,11,13,20-22</sup> emphasized factors that are associated with occupational stress (**Table 2**), such as boarding regime and shift work (trouble sleeping, unpredictability, confinement for long periods, mainly working night shifts), inadequate working conditions (noise and vibration on the platform, risks of fire, explosions, adverse weather conditions, precarious access to medical care on platforms and long-haul air transport), work arrangements with rigid rules and discipline and the fact that workers can feel isolated from their families and socially distant, with little privacy. The workers can feel that they are putting themselves and others at risk, that they need to adapt to new technologies in addition to the interpersonal problems among them.

However, the studies on the refineries<sup>12,23</sup> emphasized the consequences of labor environment for workers' lives, evidencing a population that is more prone to respiratory, cardiovascular and musculoskeletal diseases, in addition to the existence of psychological symptoms, such as sadness, anxiety and occupational stress.

Some studies showed results related to stress coping strategies and social support. The problems that arise from alcohol and other psychoactive substance use, including feelings of grief, sadness, frustration and insecurity, appeared to be related

to the characteristics of the environments in both workplaces (platforms and refineries)<sup>4,20,21</sup>.

Other important results were also identified, such as sleeping problems and feelings of grief, which are more often reported by night-shift workers compared to those working the day shift; in addition to being female, a smoker or former smoker, being dissatisfied with work and reporting sleep problems are predictors of absenteeism from work due to disease<sup>23</sup> (**Table 2**).

## Discussion

The literature review shows that the studies in this area are mainly descriptive and focus on work carried out on platforms. These studies have been mainly devoted to identifying the different occupational stress factors in this working context, with only a few specific studies regarding the occurrence of burnout syndrome in workers from the petroleum industry.

This review included studies identifying that the petroleum industry is related to a number of occupational stress sources (shift work, overwork, confinement and a boarding regime, loud noises, vibration etc.) that are associated with psychosocial factors, such as alcohol and drug use, sleeping disorders, memory difficulties, depression, lack of social support and difficulties in interpersonal relationships.

The description of the activities of this industry included in this review suggests a complexity that requires its workers receive constant attention, in addition to ensuring that they are supported by teamwork and cooperation. As previously described, the activities at the refineries are different from those on the platforms, but the two processes involve characteristics of a “complex, continual working, dangerous and collective”<sup>24</sup> nature. According to the authors, all work involving petroleum is dangerous



and unhealthy, which is due to the fact that there are risks inherent to the work process and the toxicity of the products used, in addition to the risks found in the working environments, such as heat, noise and vibration, as well as the accidents.

Ferreira and Iguti<sup>24</sup> report that the danger of working in the petroleum industry leads workers to feel insecure. Five of the nine analyzed studies report workers' fear of fire, explosions and accidents. Sutherland and Cooper<sup>2</sup> claim that this feeling of insecurity is related to a lack of motivation, professional dissatisfaction and feelings of sadness and frustration. Other factors, such as adverse weather and physical conditions, air transport to the platform, vibration and noise on platforms, poor ventilation and lighting are also regarded as characteristics of a dangerous job.

Another important characteristic that the authors point out is the complex character of this industry, which is due to the unpredictability of events and large number of responsibilities, such as inclement weather, machine handling and dealing with highly flammable products, aspects that were also noticed in most of the studies selected in our review. According to one of these studies<sup>11</sup>, workers suffer from a feeling that they are putting their colleagues and themselves in danger due to the possibility that they might make some kind of mistake. Other studies<sup>4,23</sup> highlight the physical impact caused by an overload of responsibilities and extended shift work, heavy lifting and uncomfortable body postures, for example.

Leite<sup>1</sup> points out that, as the oil production cannot stop, the workers are the ones who have to take turns to keep it going. The result of this is continuous work. Shift work was one of the most cited sources of stress among the studies<sup>4,20-22</sup>. As reported by the author, the main difficulties that arise from shift work are: sleep disturbance, impaired social and family life and behavioral changes (smoking, inappropriate diet and psychoactive substance use, for example).

According to the literature<sup>1,24,25</sup>, one of the most striking characteristics of the petroleum industry is its interdependent nature, which gives the system a collective character and requires feelings of unity and teamwork, a fact that can result in performance and relationship problems. These studies show that one of the possible reasons that would lead to these problems is the breakdown of interpersonal relationships, which results from confinement and intensive work<sup>13</sup> or even changes in working partners that leads to a constant need for social adjustment<sup>4</sup>.

In regards to the characteristics of the work, we identified many psychosocial factors that are associated with occupational stress in this industry.

In addition to those already mentioned, there is also a feeling of not having a close relationship with co-workers, feelings of isolation and sadness as well as performance problems. Psychosocial work factors refer to interactions between the environment and working conditions, organizational conditions, working roles and actions, as well as the efforts and individual and family characteristics of the workers<sup>26</sup>. Thus, working conditions have a relevant influence on worker's health, making it possible to consider them as favorable or unfavorable.

According to the analyzed publications, the main physical symptoms that workers under occupational stress may present are: musculoskeletal disorders, a feeling of physical exhaustion, chronic fatigue syndrome and hypertension. Whereas in respect to the psychological symptoms, the cited symptoms are irritability, insomnia, tension, anxiety and depression.

It is important to emphasize that the study by Wong et al.<sup>11</sup> points out that the findings regarding occupational stress sources in Chinese workers were different from those found in the classic study<sup>2</sup> and those cited as a reference in other studies conducted in the United Kingdom, as they describe that the only widely reported stress factor was the home/family interface, with only a few instances where there were reports of dissatisfaction in relation to the structural and organizational atmosphere. While taking the cultural factors of China into consideration, the authors explain that traditional Chinese culture is based on hierarchical respect, and an importance given to "team spirit" and that the responsibilities of the individual towards the community is extremely necessary for professional success. This not only encourages interpersonal harmony, but also considers disharmony unacceptable in teams.

The study conducted in the United Kingdom points out that transportation, shift work and dissatisfaction in relation to the structural and the organizational climate were considered to be greater sources of stress. Even in the different contexts and cultures, the same results were obtained in both the international and national studies.

As previously mentioned, our study only identified two articles that specifically focused burnout syndrome in workers from the petroleum industry. In the first article, the authors<sup>4</sup> adapted the MBI to be used in the platform work environment and identified the three dimensions of burnout, as described by Maslach<sup>6</sup>. Although being modestly frequent, the authors also pointed to a fourth and new dimension defined as "worry in regards to home while at work". The authors also found a lower

frequency of burnout in married individuals and a higher frequency in young people.

Silva Júnior and Ferreira<sup>13</sup> evaluated the predictive power of six environmental stress factors (relationship problems and work performance, organizational structure, work/family interface, security, career and supervision and intrinsic work factors) in the three burnout dimensions (emotional exhaustion, depersonalization and lack of professional achievement) with a scale for evaluating environmental stress factors in the offshore context (EACOS), which was developed and validated by the authors themselves based on two instruments to evaluate sources of stress at work by Chen et al.,<sup>21</sup> and Sutherland and Cooper<sup>2</sup>; and the burnout inventory by Maslach, validated by Silva Júnior for Brazilian workers in the offshore context.

The data pointed to the following results: stress factors were identified as “work/family interface”, “organizational structure” and “relationship and performance problems”, which constituted emotional exhaustion predictors; whereas the “organizational structure” and “intrinsic work factors” stress factors appeared to be linked to depersonalization, while the “security” stress factor was characterized as the only predictor for professional inefficiency.

It is important to highlight that the occurrence of burnout syndrome or occupational stress-related problems also depend on the strategies employed by the individuals to deal with stressful events in their lives. Within the studies it is possible to identify some tools that are able to promote and protect the health of the individual when faced with environmental stress factors, such as coping and social support. Coping in terms of the problem was positively associated with improved mental health in two studies<sup>4,21</sup>. Coping generally consists of active approach strategies in relation to the stress factor, such as solving and managing problems<sup>27</sup>. While focusing on the problem, the individual engages in managing or modifying the situation that causes the stress, the objective being to control or deal with the threat, detriment or challenge. Coping focused on emotion is different. It is aimed at regulating emotional responses caused by the stressful situations faced by that individuals. This kind of coping can manifest itself from feelings of separation or simply palliative attitudes regarding the source of the stress, such as denial or avoidance<sup>27</sup>.

Social support was identified as a suitable strategy to deal with occupational stress factors in two studies from our review<sup>2,20</sup>. It is important to stress that a lack of social support and the interference from family problems at work are associated with the organizational context and

conflicting interpersonal relationships<sup>4,12,13,21,23</sup>. One of the studies<sup>4</sup> found a lower burnout frequency in married individuals, which can be explained by the spouse providing such social support. The literature<sup>19,28,29</sup> indicates that individuals subjected to an unwelcoming environment, with little or no social support, and who are subject to a specific stressful situation, would be more vulnerable to stress-related health problems. However, upon reading the scientific literature from the area<sup>19</sup>, individuals that have adequate social support would tend to react more positively to stressful situations compared with individuals with little or no social support.

It is worth mentioning that one study<sup>2</sup> pointed out that the relatively high salaries, both on the platforms and in the refineries, mean that the workers do not quit, even when faced with such negative effects on their health. According to statistics from the International Labour Organization, as cited by Ferreira and Iguti<sup>24</sup>, workers from the petroleum industry are among those who receive the highest wages in this sector of the industry.

We observed that from the total number of articles included in the review (41 studies), many additional studies – 13 studies (31.7%) – were manually selected from the lists of references from the articles that were initially identified in the databases. Despite efforts made to include a large number of bibliographical databases in the review, there were some studies that may not have been included.

Publication bias seems to stand for the main aspect of weakness regarding results' validity<sup>30</sup>, referring to studies that had not been published due to the results obtained (absence of statistically significant results, for example). It is also possible that many studies were not found because they are not published in the journals indexed in the databases under investigation. It is therefore important to recognize the possibility of interpretation bias, since a systematic review is itself a task that involves data interpretation. It is also worth highlighting that the vast majority of studies identified are cross-sectional, which prevents the cause-and-effect relationship from being established, i.e. between occupational stress/burnout and the sources of occupational stress and psychosocial factors.

## Conclusion

Based on the review's results, the petroleum industry appears to be a work environment that can present adverse environmental conditions that potentially cause professional exhaustion and occupational stress in its workers. It was possible

to identify that the psychosocial factors of the job and the physical symptoms were associated with occupational stress factors in workers from this industry, mainly regarding the boarding regime, the shift work and the risks of accidents occurring at work. Emphasized aspects among the physical and psychosocial symptoms were: family and social isolation, psychoactive substance use/abuse, musculoskeletal disorders, insomnia and fatigue. There are several articles that have described the importance of using stress coping mechanisms employed by these individuals, such as coping and social support.

## Authors' contributions

Dias FM: data collection, analysis and interpretation, manuscript writing; Santos JFC: design, data collection, involvement in the manuscript writing and significant contribution in its critical review; Abelha L: substantial contribution to the project and important contribution to the critical review; Lovisi GM: project design, involvement in the data analysis and interpretation in addition to the final approval of the version to be published.

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