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Risk Factors for Working in Confined Spaces: Contributions for Psychosocial Assessment

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Abstract: The recommendation of standards for companies supports the safety of workers. This study aimed to describe the psychosocial risk factors perceived by personnel that work in confined spaces. Qualitative study, conducted via interviews with 50 employees. Data were processed using the *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires* software, with a descending hierarchical classification. The psychosocial risk management model identified five risk dimensions and described the interface between the categories of work context and content: interpersonal relationships (29.58%), task planning (23.50%), role in the organization (17.83%), home-work interface (15.10%), and workload and work pace (13.97%). The risk factors identified from the workers'' perspective allow reviewing psychosocial assessment, management practices, and the advancement of scientific knowledge, essential to rethink current legislation and mental health care for professionals that work in confined spaces.

Keywords: psychosocial factors, working conditions, occupational health, occupational safety, personnel management

Fatores de Risco no Trabalho em Espaços Confinados: Contribuições para a Avaliação Psicossocial

Resumo: As normas regulamentadoras oferecem diretrizes às empresas para execução do trabalho, inclusive para a área de segurança. O objetivo foi descrever fatores de risco psicossocial percebidos por trabalhadores atuantes em espaços confinados. Estudo qualitativo, conduzido por meio de entrevistas com 50 trabalhadores. Os dados foram processados, segundo classificação hierárquica descendente, pelo software *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*. O modelo de gestão de riscos psicossociais, identificou cinco dimensões de risco distribuídas nas categorias de contexto e conteúdo do trabalho: relacionamento interpessoal (29,58%), planejamento de tarefas (23,50%), papel na organização (17,83%), interface casa-trabalho (15,10%) e carga e ritmo de trabalho (13,97%). Os fatores de risco identificados, na perspectiva dos trabalhadores, possibilitam a revisão de práticas de avaliação psicossocial, gestão e o avanço no conhecimento científico, importantes para subsidiar tomadas de decisão para o cuidado à saúde mental de profissionais atuantes em espaços confinados.

Palavras-chave: fatores psicossociais, condições de trabalho, saúde ocupacional, segurança do trabalho, administração de recursos humanos

Factores de Riesgo en el Trabajo en Espacios Confinados: Contribuciones para la Evaluación Psicosocial

Resumen: Las normas de reglamentación contienen lineamientos de ejecución de trabajo para las empresas, incluso para el área de seguridad. El objetivo de este estudio fue describir los factores de riesgo psicosocial percibidos por los trabajadores que actúan en espacios confinados. Este estudio es cualitativo, en que se aplicaron entrevistas a 50 trabajadores. Los datos fueron procesados, según la clasificación jerárquica descendiente, por el programa *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*. El modelo de gestión de riesgos psicosociales identificó cinco dimensiones de riesgo, distribuidas en las categorías de contexto y contenido del trabajo: relación interpersonal (29,58%); planificación de tareas (23,5%); papel en la organización (17,83%); interface casa-trabajo (15,1%); y carga y ritmo de trabajo (13,97%). Los factores de riesgo identificados por los trabajadores posibilitan la revisión de prácticas de evaluación psicosocial, gestión y avance en el conocimiento científico, importantes elementos para repensar la toma de decisión en la atención a la salud mental de profesionales que actúan en espacios confinados.

Palabras clave: factores psicosociales, condiciones de trabajo, salud ocupacional, seguridad del trabajo, administración de personal

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The working environment must be analyzed from a dynamic and complete perspective since it is constantly changing. We must consider the peculiarities and complexity of each situation, which involve different elements, including the worker. The execution of work activities, working conditions, and relationships established with colleagues, leaders and/or managers can be considered as risk or protection factors to the physical and mental health, safety, and dignity of workers (Pereira, Souza, Lucca, & Igutti, 2020).

According to their work attributions, workers are exposed to different types of risk, whether chemical, physical, biological, or psychosocial (Ministério do Trabalho e Emprego [MTE], 2019).

According to a recent systematic review, these are the three categories to psychosocial risk factors: classical theories of stress, emerging theoretical models, and occupational risk management models (Carlotto et al., 2018). They help define concepts, variables, instruments, and measurement techniques for such constructs, both internationally (Leka & Cox, 2008) and nationally (Carlotto et al., 2018; Jacinto & Tolfo, 2017; Rodrigues & Faiad, 2019).

The theoretical model that supports this study was proposed for the construction of a European risk management program called Psychosocial Risk Management Excellence Framework (PRIMA-EF) and adapted by Leka and Cox (2008) to categorize psychosocial risk factors according to the content or context of the work. Content refers to working conditions and task organization whereas context relates to work organization and interpersonal relationships. The content category has four dimensions: task planning, workload and work pace, working schedule and environment, and equipment. The context category includes six dimensions of risk: organizational function and culture, organizational role, career development, decision and control latitude, interpersonal relationships at work, and home-work interface.

The Brazilian Employment Law establishes Regulatory Standards (NRs) regarding the assessment of psychosocial risk factors, including NR 33, which refers to the performance of workers in confined spaces (CS). A CS is described as any closed or partially closed work environment not built for human inhabitants because of unfavorable air conditions, toxic and flammable contaminants, and the risk of aspiration of solids or liquids that can compromise breathing and even bury workers. Every worker assigned to a CS must undergo specific tests for their role, including psychosocial risk factors tests (MTE, 2019).

The term "psychosocial assessment" has been used for NRs as a form of psychological assessment, defined in Law No. 4,119 of August 27, 1962 (item A, paragraph 1, Article 13), and predicts the assessment of psychosocial risk factors. Psychological assessment is defined as a structured process that seeks to identify psychological phenomena using methods, techniques, and instruments (Federal Council of Psychology [Conselho Federal de Psicologia – CFP], 2018).

During psychological assessment, the psychologist can decide which procedures and instruments will be used as long as they are recognized in the psychological scientific literature and based on the current regulations of the Federal Council of Psychology (*Conselho Federal de Psicologia* – CFP). For instruments, the psychologist can use fundamental sources (psychological tests, interviews, anamnesis and/or protocols, or behavior records) and, according to the context, use complementary sources of information (non-psychological techniques and instruments) (CFP, 2018).

To establish an interface between psychosocial assessment and performance in CS, the psychosocial risk factors to which workers are exposed must be identified considering the particularities and complexity of working in CS.

Since few studies discuss the performance of workers in CS as recommended in NR 33, we created the following question: What are the psychosocial risk factors related to work that are perceived by workers assigned to confined spaces? This identification can help create protocols or assessment instruments that support the psychologist's psychosocial assessment performance.

There are some observations regarding the difficulties and challenges related to measurement instruments, the definition of characteristics to be assessed for each position, and the need for assessment standardization (Rodrigues & Faiad, 2018). Thus, this research aimed to describe psychosocial risk factors perceived by workers assigned to confined spaces.

Method

Qualitative study, developed according to the Consolidated criteria for Reporting Qualitative research (COREQ) (Souza, Marziale, Silva, & Nascimento, 2021).

Participants

Workers qualified for activities in CS, risk degree III, of a company located in Southern Brazil. The site has a favorable structure and an occupational health team with psychology and occupational safety professionals, and all workers receive specific training according to the NR 33, which provides expanded information of the activities performed in CS.

As inclusion criteria, participants should be part of the company's own staff, be qualified, and perform activities in a confined space. The professionals who on leave of absence for any reason during the period of data collection were excluded.

Out of 144 workers, 50 who performed activities in CS participated in the study. The number of participants was defined according to the literature (Camargo & Justo, 2013) and the convenience for the stipulated period of data collection to categorize statements according to information homogeneity, that is, by lexical analysis, to meet the proposed objective.

Instruments

The script for data collection was elaborated based on field observations, technical visits, and immersion in the scenario using the experience of the researcher responsible for psychosocial assessment in the company, complemented by information available in the scientific literature (Carlotto et al., 2018; Jacinto & Tolfo, 2017; Leka & Cox, 2008) and validated by the Research Group on Health Measures (Grupo de Pesquisa sobre Medidas em Saúde – GPEMSA – CNPq – EERP – USP).

Worker characterization variables included sociodemographic data and 14 questions regarding the execution of activities in CS and the interface between psychosocial factors perceived by workers, such as: Describe the performance of activities in a confined space; What are the positive and negative aspects of performing an activity

in CS? Have you ever undergone psychosocial assessment? At what point? What is your opinion on this assessment?

Procedures

Data collection. For data collection, recorded interviews were conducted with 50 workers in CS who were invited to spontaneous participation. All interviews occurred from June to September 2018 at the participants' workplace and during their work shift after prior scheduling by telephone. They were performed individually by one of the researchers in a private room in the company, recorded and transcribed *verbatim*, with an average duration of 60 minutes. No workers refused to participate.

Data analysis. For the textual grouping of the data, the software *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires* (IRAMUTEQ) (Camargo & Justo, 2013), version 0.7, alpha 2 was used. The descending hierarchical classification (DHC) method was used, in which the texts are classified according to their words and the set of words is divided into semantic classes, defined based on repeated Chi-square tests (χ^2) (Camargo & Justo, 2013). After the description of textual domains, meanings were interpreted and categorized according to the theoretical framework proposed by Leka and Cox (2008).

Ethical Considerations

Ethical aspects followed Resolution No. 466/12 of the National Health Council. The research project has been approved by the Research Ethics Committee of the School of Nursing at Universidade de São Paulo (CAAE No. 60906216.2.0000.5393).

Results

Participants' age ranged from 31 to 54 years, with a mean of 40.0 years and standard deviation of 6.0 years. All interviewees are male. The period of experience for the execution of activities in CS was between 1 and 31 years, with a mean of 7.7 years and standard deviation of 7.9 years.

The corpus showed 61,262 occurrences (words and forms) with 3,037 distinct words and 2,866 words with a single occurrence. The use of the corpus was 73.14%.

The general corpus was produced with the help of IRAMUTEQ and consisted of 50 Initial Context Units (ICU) and 1,217 text segments (TS), divided into two subcorpora. The researchers called the subcorpora "Work" (31.8% of the corpus) and "Worker" (68.2% of the corpus), each divided into domains called work context and content according to the theoretical framework used (Figure 1).

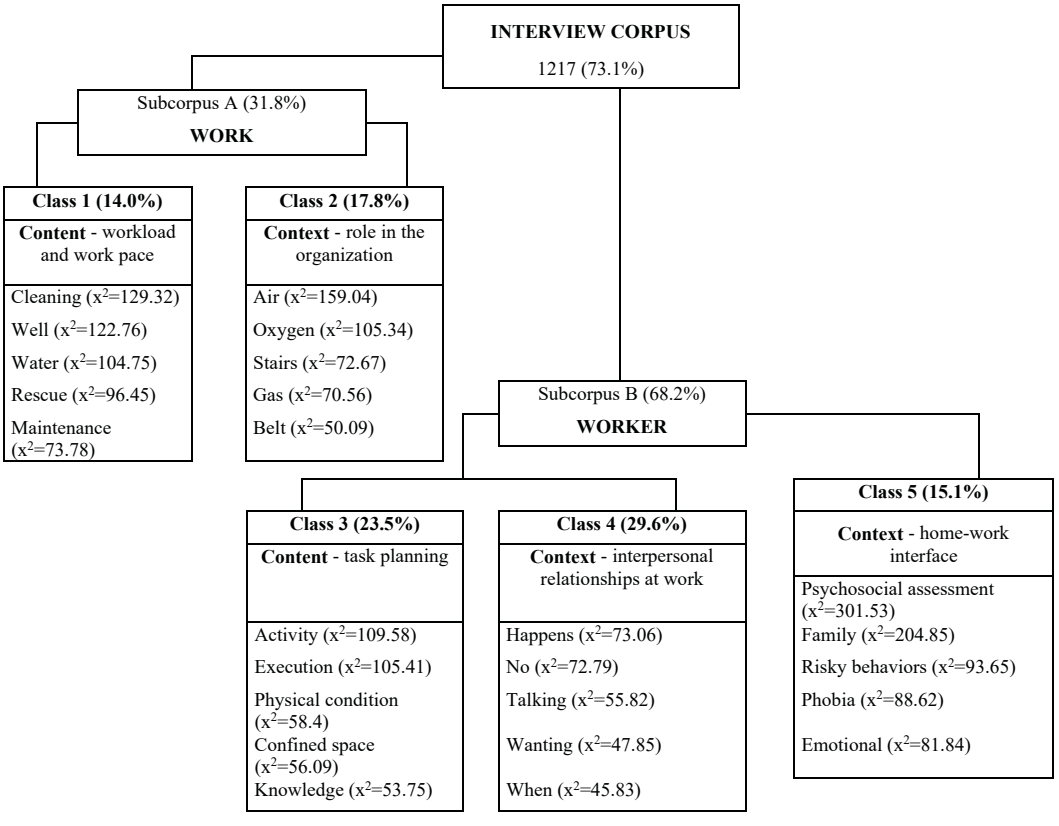

Figure 1. Dendrogram with the percentage of Elementary Context Units in each class and words with higher chi-square (χ2) provided by the software IRAMUTEQ – Western Paraná, Brazil, 2018. Source: Elaborated by the authors .

Subcorpus A – "Work" showed the perception of the CS worker on the technical execution of "Work" and is formed by class 1 with 170 TS (14.0%), identified by the authors as work content, which showed the "workload and work pace" dimension. Psychosocial risk factors are associated to qualitative and quantitative aspects of the workload, the difficulty of work, and the speed of task execution. Representative statements are exemplified below: "In the confined space the worker has to twist, turn, climb, squat, and could even get hurt" (P 26); "The confined space that I find most peculiar is a 40-meter deep well that is flooded with water and clay" (P 13); "Working inside the well is hard and very complicated. In a calm sea, every man is a pilot, but coming up is much more difficult" (P 29); "The worker never knows what he will find in the confined space and, therefore, what the work will demand from him. You get there and you can find only water and dirt, or you can find methane gas or other gases" (P 29); "When you work with the rescue of persons or with equipment, such as hose nozzles and vertical rescue, for example, you need a lot of strength" (P 5).

The subcorpus is also formed by class 2, with 217 TS (17.8%), which represented the context of work by the "role in the organization" dimension and indicates psychosocial risk factors related to work overload, ambiguity, conflict, insufficient roles, and mainly the worker's responsibility for other people during activities in CS. Statement examples: "You may fall, feel shortness of breath, or feel insecure in a confined space when you cannot eliminate all gases that are harmful to health" (P 4); "I always warn younger workers. The most significant and worrying risks are electricity and air quality. Even though we work in teams, I check more than once" (P 10); "The lack of communication during activities in a confined space is a major problem. When I arrive to measure the air and sign the forms, I alert all workers about the importance of conversation" (P 5); "All workers need to be clear about their role they during the execution of the activity in CS, whether they are a watchman, supervisor, or worker" (P 15); "Confined spaces are small, cramped, and of difficult locomotion. The worker faces the risk of falling, air quality, and the stairs to go down can be literally rotten" (P 24).

Subcorpus B – "Worker" reflects behavioral aspects and their intra- and extra-organizational relationships, with two subdivisions, the first of which represented the largest number of TS analyzed and created a new subdivision (Figure 1), which housed class 3, with 286 TS (23.5%).

This class has been assigned to the content domain and the dimension called "task planning" and relates to what the worker does and the reason why he does it. Psychosocial risk can be identified when skills are used inadequately or when the worker is exposed to a fragmented work. Statement examples: "Attention, concentration, and decision-making are needed. Activity in confined spaces is not for any worker. Not all workers have a profile for this activity" (P 42); "The activity is not only about being able to enter the confined space, the worker must have the physical condition for it" (P 43); "The worker needs to feel minimally prepared regarding his physical condition. The worst thing is to have a worker do an activity that he thinks is no use" (P 19); "I don't believe the saying, 'trust me, everything gonna be all right.' I like to have knowledge about the procedure and, adequate physical condition is needed" (P 41); "Knowing how to work as a team and having knowledge about the task to be performed is essential" (P 32); "The worker must have knowledge and not just hold the supervisor responsible for the activity. There must be adequate dialogue between the workers involved in the activity" (P 19).

Class 4 had the highest representation of the corpus, with 360 TS (29.6%), and relates to psychosocial risk factors associated with limited and insufficient relationships with supervisors, interpersonal conflict with colleagues, and lack of social support. Among the statements: "It is a risk if the worker cannot identify if something wrong has happened" (P 12); "I may want to say something and want to make a decision which someone else can see I am going to make a mistake, so he has to come here and, because of good interpersonal relationship, talk" (P 1); "Interpersonal relationships are essential (P 9); It is risky behavior to put an inexperienced worker who is unwell and does not want to use his right of refusal" (P 25); "Situations such as pressure at work can make the worker inattentive because he will want to do the service faster" (P 41); "In risky situations in which workers do not speak and need someone else to mediate the relationship, I think it is very difficult, especially in our work context" (P 19).

> The worker cannot work in action and adventure or want to beat records and seem better than other workers. Do not congratulate someone who works fast in a confined space, on the contrary, congratulate those who used the safety of work (P 34).

> Because of a bad interpersonal relationship you could let the worker do the wrong thing and not tell him that. This could happen! I have never seen this happen here, here the workers have good interpersonal relationships and good interpersonal relationships create trust between each other (P 1).

Class 5, the first subdivision of this corpus, was associated with the dimension called "home-work interface" and represented 15.1% of the corpus analyzed, with 184 TS. Its content varied between the presence or absence of conflicting demands of work and home, lack of support at home, and the relevance of emotional and behavioral assessment of workers who perform activities in CS. Examples: "With psychosocial assessment, the psychologist can identify situations of fear, stress, and anxiety" (P 12); "Irritability, phobia, and sadness are enemies of the worker who performs activities in CS" (P 42); "Workers who do not know how to listen and who feel like masters of themselves are a risk in the execution of activities in CS" (P 36); "It is complicated if the worker feels bad emotionally, if he leaves home to go to work with some financial or family problem; or if he consumes alcohol or other drugs" (P 8); "I know that family, financial, and work issues greatly influence the execution of activities. I see that when

work becomes mechanical the risk is even greater because you have time to think about other things" (P 9).

> About the emotional condition I think the worker needs to be well with his family, with his financial condition, and his marital issue has to be fine. I think that if the worker is unwell with the family issue he cannot access the confined space (P 25).

Discussion

Psychosocial assessment, as predicted in NRs, should include the principles of at least one of the theoretical models corresponding to psychosocial risk factors and current employment law (CFP, 2018; MTE, 2019). The responsible professional must include, from an objective and subjective perspective, the dynamic interaction between the individual characteristics of the workers and the environmental, organizational, relational, and external factors of the work to which they are exposed. A limited number of instruments or protocols supports the practice of psychosocial assessment, the definition of which variables are most relevant, and the record of psychosocial risks, especially from the perceptions of workers, using qualitative methodologies that allow this identification (Vasconcelos & Trentini, 2021).

Regarding the understanding of the corpus "Work," the analysis of the dimension "workload and work pace" presupposes the identification of the offer of training related to qualitative and quantitative aspects of workloads, difficulty of work, and performance speed and correct posture. Furthermore, the worker's skills, resources, and knowledge convenient to his work must be verified to minimize occupational risks. Difficult tasks with physical and mental requirements, such as CS activities, should foresee breaks and rest time (Leka & Cox, 2008).

An intensive pace of work with greater exposure to risks causes diseases, physical malaise (fatigue and postural problems), and psychological problems (mental workload) (Leka & Cox, 2008). Working in confined spaces requires adequate physical and mental conditions since the space is inadequate, the temperatures are adverse, and there could be excessive noise and toxic products or contaminants (Rodrigues & Faiad, 2018).

Regarding the risk factors associated with "workload and work pace," research conducted with workers from 14 plastic industries in the Metropolitan Region of Salvador identified that an increased work pace, reduced pauses between activities, and a high cognitive demand cause irregular postures in workers during tasks which require repetitive movements. Physical and psychosocial demands (repetitive work, low task control, time pressure, and job dissatisfaction) thus compose a universe of unfavorable conditions for workers' health (Fernandes, Asunción, & Carvalho, 2010).

The "role in the organization" dimension indicates psychosocial risk factors related to work overload, ambiguity, conflict, insufficient roles, and mainly the worker's responsibility for other people during the execution of CS activities. Therefore, workers must know their job and be clear about their attributions, responsibility, and autonomy. Psychosocial risks related to this dimension include unnecessary demands, overworking, communication failures, lack of specification in the role of workers, and lack of support from those involved in the work environment (Leka & Cox, 2008).

The lack of recognition, omission, or mismanagement of risks continuously exposes the worker, aggravating his health conditions and interfering in the work process (Araujo & Oliveira, 2019). This can cause physical or psychological harm and results from working in shifts, work overload, technical disability, and unproper training and emotional self-control of the worker (Chirico, 2017).

A review of the literature on occupational stress in the activity of the oil industry observed that the working conditions considered as stressors are confinement, changes in shift, and work overload. These factors were particularly associated with lack of social support, use of alcohol and illicit psychoactive substances, cognitive memory deficit, depression, and relationship problems (Dias, Santos, Abelha, & Lovisi, 2016).

Despite the results described, subcorpus B "Worker," which had greater content representativeness in the corpus, reflected on the "planning of tasks." This dimension is associated with conditions to which workers are exposed during activities in CS, including physical, cognitive, and behavioral requirements, and refers to the lack of variety or short work cycles, the fragmentation or automation of tasks, and the perception of activities as meaningless and/or indicating sub/overuse of the worker's skills (Leka & Cox, 2008).

Regarding psychosocial risk factors, we emphasize that each worker develops their own perception according to the work environment to which they are is exposed. Workers do not always recognize, by direct observation, the risk to which they are exposed and often do not have access to this type of information. Therefore, knowing what risks workers are exposed to during activities is essential to create preventive risk management programs and has been one of the main challenges for the promotion of occupational health and safety (Araujo & Oliveira, 2019; Zanelli & Kanan, 2018).

Moreover, besides identifying risk factors, workers also recognize protective factors, including: healthy communication; possibility of reconciling work-life; positive leadership practices; identification of satisfaction and meaning at work; and healthy relationships (Zanelli & Kanan, 2018). The worker's personal and subjective characteristics influence the way he perceives and assesses exposures, whether occupational or psychosocial (Eddy, Wertheim, Kingsley, & Wright, 2017).

The confined space has reduced access, limitation for entry and exit, high risk, and reduced length of stay; a place that was not designed for human occupation. Guidelines related to safety measures must thus be followed since the underassessment or low perception of existing risks and the lack of preparation can

cause work accidents. Therefore, working in CS requires task planning to minimize psychosocial risk factors using skills and maintenance of interest, engagement, and appropriate support to the worker (Silva & Braga, 2020).

As for context, analysis shows the "interpersonal relationships at work" dimension, which is directly related to the limited and insufficient relationship with supervisors, interpersonal conflicts with colleagues, and lack of social support. When the worker realizes that he has a good interpersonal relationship, that he is satisfied with the physical conditions of the work environment, that he has support and collaboration in the tasks, and that he works with an appropriate number of people who have methods of communication he will perform better (Kebe, Chiocchio, Bamvita, & Fleury, 2018).

The subcorpus "Worker" also includes the "home-work interface" dimension, which concerns situations such as conflicting demands between home-work and social support. An appropriate work-life balance can be difficult to achieve, particularly when workers are facing accelerated and intensive work, work in shifts, irregular schedules, inadequate treatment from administrators and co-workers, and have no control over the content and organization of work (Leka & Cox, 2008; Leka, Jain, Cox, & Kortum, 2011). The psychosocial assessment professional must know the physical properties of the workplace, understand how activities are performed according to NR 33, identify physical and psychosocial risks, and thus discover the behavioral and cognitive skills required and personal and family aspects that can affect task performance.

Workers mentioned psychosocial assessment, recommended in NR 33, as important. This indicates their demand to be heard about situations with which they live, including insecurity, fear, stress, anxiety, family, and financial and/or social problems, and can significantly contribute to the development of mental health care strategies for workers. A study with 158 electricians from the maintenance sector of an electric power company in Northeastern Brazil identified a prevalence of 20.3% of common mental health disorders (Souza, Carvalho, Araújo, & Porto, 2010).

Dimensions of psychosocial risk factors identified according to the perception of workers allowed us to describe the interface between the context and content of work and workers and the execution of activities in confined spaces, thus advancing scientific knowledge on workers' health and subsidies for psychosocial assessment. We must recognize psychosocial risk factors related to the work environment to understand unsafe work practices and the workers' mental health from the perspective of biopsychosocial care.

Psychosocial assessment should include the principles of at least one of the theoretical models corresponding to psychosocial risk factors and current employment law. The assigned professional must cover, from an objective and subjective perspective, the dynamic interaction between the individual characteristics of workers and the environmental, organizational, relational, and external factors of work. However, the development of instruments or protocols for this practice requires qualitative methodologies that help identify psychosocial risks, since the performance and the investigated variables are still unclear (Vasconcelos & Trentini, 2021). We have observations regarding the difficulties and challenges related to measurement instruments, the definition of characteristics to be assessed for each position, and the need for assessment standardization (Rodrigues & Faiad, 2018).

Our results thus corroborate with studies mentioned considering that the support of managers, the worker's perception of risk, job satisfaction, information factors, and safety awareness can prevent accidents. Moreover, the underrecognized relevance of mental health in the work environment affects the implementation of preventive and corrective intervention measures that reduce psychosocial risk factors.

Data collection was performed in a place that favors the worker's health care with frequent and qualified training, a specific team with health professionals, and regular psychosocial assessment. In other companies with different conditions, the perceptions of workers may be different from the reality presented.

Nevertheless, psychosocial risk factors related to the work environment (workload and pace; role in the organization) and to the worker (task planning; interpersonal relationships at work; home-work interface) must be described to consider the worker's health from a biopsychosocial perspective and not simply as a sum of individualities.

Specifically in CS work, new demands and responsibilities, pressure to perform tasks, control over activity performance, stress, anxiety, phobia, and specific activity characteristics can affect the worker's physical, psychological, and/or behavior. The workers' statements showed their perceptions and the possible risk factors for the quality of activity execution in CS, indicating the complexity between workers' health and their work environment.

Accidents in the workplace and occupational diseases can affect workers, businesses, and public health. Therefore, actions that seek to prevent, minimize, and avoid psychosocial risk factors are essential and must include environmental, sociocultural, biological, and psychological phenomena of work to advance scientific knowledge about the psychosocial risk factors in CS and its effects on the workers' physical and mental health.

Finally, risk factors identified from the perspective of workers allow reviewing psychosocial assessment and management practices and advancing scientific knowledge, essential to rethink the current legislation and the mental health care of professionals working in confined spaces.

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