https://doi.org/10.4322/rae.v15n2.e202108.en

ABERGO 2021
XXI CONGRESSO BRASILEIRO DE ERGONOMIA
XIV ENERGO FÓRUM DE CERTIFICAÇÃO DO ERGONOMISTA BRASILEIRO
XV FÓRUM DOS GRUPOS TÉCNICOS ABERGO

ERGONOMICS IN THE OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM

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SUMMARY: The Occupational Health and Safety Management System (SGSST) seeks to identify and evaluate occupational risks and meet the legal requirements of each economic sector. Ergonomics, for its part, is also related to protecting workers' health, establishing a close relationship, in their domains of specialization (physical, cognitive and organizational). In this sense, this article aims to characterize the articles that address Ergonomics and the Occupational Health and Safety Management System (SGSST) and identify which domains of ergonomics were used. This qualitative research chose the Knowledge Development Process-Constructivist (ProKnow-C) instrument to select literature, identify, analyze and reflect on SGSST characteristics. 31 articles were selected as a fragment of scientific literature, carrying out an advanced bibliometric analysis, identifying characteristics of the methodological approach and the techniques used for data collection. A list of methods or tools analyzed or used is presented and aspects of the domains of physical, cognitive and organizational ergonomics considered by researchers in their studies are identified. It was identified that cognitive ergonomics is being addressed from activities and training, worker performance assessment and stress control are beginning to be worked on. Regarding organizational aspects, the incursion of organizational culture in companies has contributed to working on the management of prevention activities with workers.

KEYWORDS: Ergonomics; Occupational health and Safety; ProKnow-C.

INTRODUCTION

Ergonomics seeks to adapt work to human beings, covering not only activities carried out with machines and equipment used to transform materials. It involves the entire relationship between the person and the productive activity. This involves, in addition to the physical environment, psychological and organizational aspects. Therefore, to achieve the desired results of work, both planning and design activities and control and evaluation activities they must

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include ergonomics with its physical, cognitive and organizational domains in order to obtain a complete management system (Iida & Buarque, 2016).

The International Ergonomics Association (IEA) defines ergonomics as the scientific study of the relationship between human beings and their means, methods and workplaces. Its objective is to develop, through the contribution of the various scientific disciplines that constitute a body of knowledge that, from an application perspective, should result in a better adaptation of technological means, work and living environments. Ergonomics considers the domains of physical, cognitive and organizational expertise to achieve a holistic approach (IEA, 2019).

Physical ergonomics studies the characteristics related to physical activities carried out by people, taking into account approaches to human anatomy, anthropometry, physiology and biomechanics. Cognitive ergonomics related to people's interaction with the environment, such as perception, memory, reasoning and motor response. Finally, organizational ergonomics deals with aspects related to socio-technical systems, addressing organizational structures, policies and processes (IEA, 2019).

To solve problems related to health, safety, comfort and efficiency, it is necessary to use the fields of ergonomics. The ergonomic approach is based on systems theory, analyzing the relationship between the worker and his tasks. Thus, risks can be controlled or reduced, considering human capabilities and limitations during project work and its environment. This approach can also help prevent errors and improve employee performance. It brings numerous benefits, both from a financial point of view for cost reduction and increased productivity, from a motivational point of view.

Likewise, obtaining safe work areas and ensuring the physical, psychological and social health of employees is a constant concern for organizations. To achieve these objectives, the Occupational Health and Safety Management System (SGSST) was developed. The main objective of an SGSST is to control losses, accidents, dangers and risks. The organization must identify what it must monitor and how to carry out this control. In turn, the Occupational Health and Safety Management System is considered a set of policies, strategies, practices, procedures, activities and functions related to safety (ISO, 2018; Kirwan, 1998; Mearns et al., 2003).

The SGSST must be designed and implemented considering that, when exposed to occupational risks, it is necessary to analyze the physical, biological, cognitive, mental and social dimensions. Furthermore, it includes individual variability, both inter- and intra-individual (Garrigou et al., 2007). A work situation, from an ergonomic point of view, is a complex, dynamically interrelated one, whose inputs (technical, environmental and labor tasks) determine human behavior at work (activities in terms of information and actions) and production (work results in terms of production and health), are the result of this system (Iida & Buarque, 2016).

However, the SGSST analyzes people, technology and the work environment separately. And, ergonomics proposes a systemic approach to aspects of human activity in the contribution of the scientific disciplines that shape it, resulting in better adaptation to work environments and environments (IEA, 2019). The application of ergonomics can improve worker productivity, occupational health, safety and satisfaction. Providing support to achieve the organization's objectives (Shikdar & Sawaqed, 2004).

Safety ergonomics analyzes the factors that influence people and their behavior in any working condition and critical safety issues (Abu-Khader, 2004; Lima et al., 2015; Vogt et al., 2010). These security assessments must incorporate sources of risk for humans and organizations working on daily analyzes and quantify them in a very realistic way (Colombo & Demichela, 2008).

Ergonomics goals are related to protecting workers' health, from reducing exposure to physical and cognitive overload, among other damages. The main objective is to improve, first and foremost, worker comfort, as well as their health, safety and efficiency. In this way, the application of ergonomic principles generates benefits for both the employee and the employer and can contribute to the continuous improvement of the organization. It is estimated that healthy employees can be almost three times more productive than those with health problems (Niu, 2010). In the field of occupational safety, it has stood out for promoting continuous improvement.

Ergonomics in SGSST involves not only technical issues of occupational safety, but also issues relating to human behavior in general (Maggi & Tersac, 2004). It is mainly associated with the well-being of workers, most often coordinated by the Department of Safety and Health (DST). This is why managers tend to inadvertently restrict their scope of intervention to the dangers of physical ergonomics, rather than benefiting from its help for organizational effectiveness, business performance or costs (Nunes, 2015). When identifying risks, it is necessary to understand not only the physical characteristics of the activity, but also the cognitive and organizational aspects and take them into account when designing security systems. Involving questions about commitment, learning, motivation and others are essential in the risk analysis process, as expressed in the contemporary vision that addresses the topic of occupational safety (Maggi & Tersac, 2004).

This article aims to characterize the researchers' approach and identify which domains of ergonomics are used in the Occupational Health and Safety Management System (SGSST). Therefore, the Knowledge Development Process-Constructivist (ProKnow-C) (Dutra et al., 2015; L Ensslin et al., 2017; S. R. Ensslin et al., 2014) was used as a tool, with the purpose of selecting the articles and develop an analysis that made it possible to survey research associating Ergonomics and SGSST.

METHOD

This section is divided into (i) Methodological structure; (ii) Intervention instrument; (iii) Portfolio selection and data collection process; (iv) Procedures for data analysis: advanced bibliometric analyzes and research opportunities.

Methodological structure

This research used a qualitative-quantitative method (Creswell, 2014) to analyze the problem and objective. As well as a bibliographical approach and action research parameters with the Knowledge Development Process-Constructivist (ProKnow-C) instrument.

The choice of methodological process in this scientific research is related to the problem being researched (De Oliveira Lacerda et al., 2014). This is an exploratory research that describes the characteristics of articles from a fragment of scientific literature, through action research, defining the limits to choose articles identified as relevant to analyze Ergonomics and OMSST. Action research refers to an evaluative, investigative and analytical research method aimed at diagnosing problems, that is, constructivist (Creswell, 2014).

Based on the research restrictions, the Bibliographic Portfolio (BP) is defined to be analyzed to identify the knowledge bases for Ergonomics and the Occupational Health and Safety Management System. In data collection, primary and secondary data are used. Portfolio selection uses primary data, since restrictions are made by researchers during the selection process. Bibliometric analyzes use secondary data, since the information is extracted from the articles. Thus, the presence of subjectivity is intrinsic to this process.

Intervention instrument - ProKnow-C

The tool adopted to achieve the results of this research was developed by LabMCDA at the Federal University of Santa Catarina, Brazil, which is called Knowledge Development Process-Constructivist (ProKnow-C) (Dutra et al., 2015; Leonardo Ensslin et al., 2012; S. R. Ensslin et al., 2014). This instrument is developed in four stages: (1) selection of the bibliographic portfolio; (2) bibliometric analysis; (3) systemic analysis and (4) formulation of research questions and objectives (Cardoso et al., 2015; Dutra et al., 2015; Valmorbida et al., 2016; Valmorbida & Ensslin, 2015).

To select the bibliographic portfolio at each stage, some activities are carried out. In stage 1, according to the researchers' perception, a limited set of relevant scientific articles aligned with the research topic is identified. In step 2, it presents the most relevant articles, authors, journals and keywords in PB. In step 3, a systemic analysis of the characteristics of the PB is carried out. In step 4, researchers can define the research question and objectives (Cardoso et al., 2015; Dutra et al., 2015; L Ensslin et al., 2017; Valmorbida et al., 2016; Valmorbida & Ensslin, 2015) . The article presents, as a delimitation, the development of stages 1, 3 and 4.

Process for portfolio selection and data collection

This process is identified as selection from the Gross Article Bank (BAB) and involves: (i) definition of keywords; (ii) selection of databases; (iii) search for articles in databases selected based on defined keywords; and, (iv) keyword adherence (Cardoso et al., 2015; Dutra et al., 2015; L Ensslin et al., 2017; Valmorbida et al., 2016; Valmorbida & Ensslin, 2015). The process limits were defined as follows: (i) articles published in scientific journals; (ii) articles published since 1997; (iii) search in the title, abstract and keywords of the articles; and, (iv) articles published in English and Portuguese. Access to the databases was carried out through the Federal University of Santa Catarina (UFSC) network. It is used to support the EndNote® X9 software (Thomson Corporation, 2018) to manage the databases used in the research process.

Filtering begins by excluding unaligned articles, conference papers, or books. Then duplicate items are eliminated. The next step is to; selection by aligning the title with the theme, then those with an aligned summary were selected. Finally, a complete review of their content was carried out to define which ones will be called Bibliographic Portfolio (BP).

The last part of the article selection corresponds to the Representativeness Test. It selects articles from PB references. The filtering process is carried out using the same criteria: aligned by title, scientific relevance, selection of relevant and recent ones written by renowned authors, review of the abstract. Once selected by aligned summary, these works are read in full, checking which are aligned with the research topic. The Bibliographic Portfolio selection process including the representativeness test is illustrated in the flowchart in Fig. 1.

Thus, the stage of the Bibliographic Portfolio selection process is completed, and then the content analysis stage begins.

Procedures for data analysis

Advanced bibliometric analysis and research opportunities aim to generate knowledge for researchers about certain characteristics of the topic under investigation. This bibliometric analysis identifies and highlights specific variables / basic characteristics, in BP articles and their references (Dutra et al., 2015; L Ensslin et al., 2017; S. R. Ensslin et al., 2014; Valmorbida et al., 2016) . From the knowledge of this information, the researcher can then collect additional data on the subject, as he makes inferences and supports his choices.

In this research, we present the variables that allow us to expand knowledge on the topic: (i) type of methodological approach to the research; (ii) nature of the methodological approach;

(iii) scope of the study; (iv) unit of analysis; (v) data collection techniques; and, (vi) tools used in empirical studies.

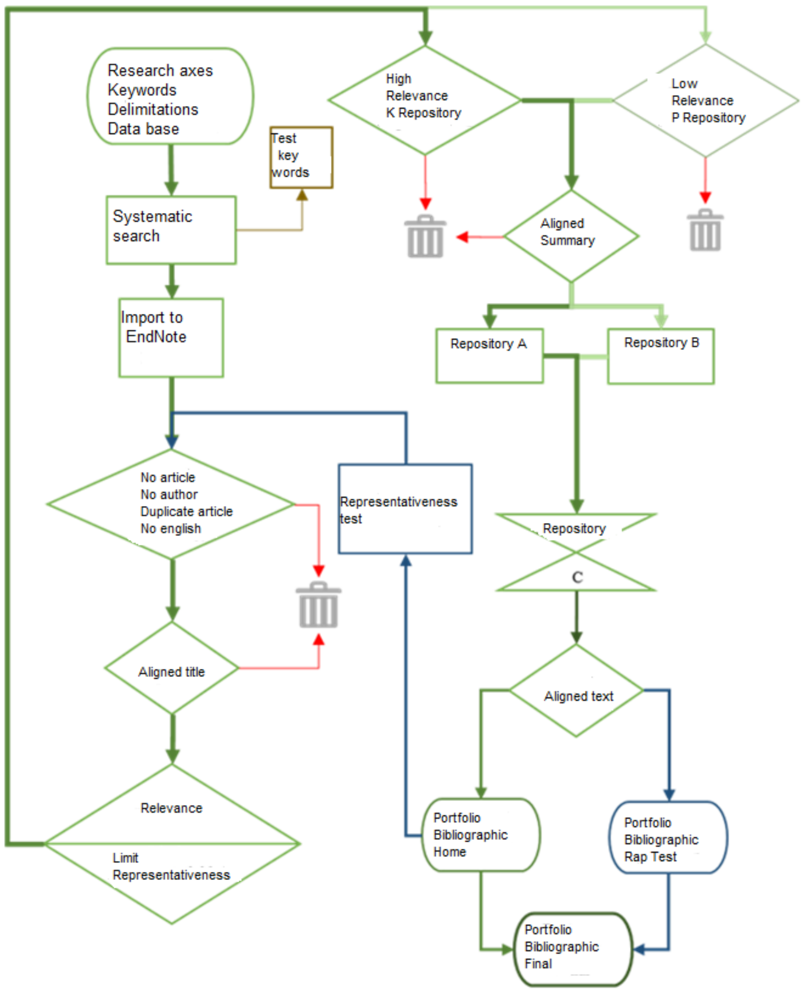

Figure 1. Portfolio selection process

RESULTS AND CONSIDERATIONS

The database query resulted in 11,602 documents. After applying the ProKnow-C selection process, shown in Fig. 1, 31 articles were selected. According to the selection and delimitation criteria applied by the researchers, it was considered that they address the topic of Ergonomics and Occupational Health and Safety System.

Parameters were defined to analyze the characteristics of the selected articles. This article presents the advanced variables that allow generating information about the research carried out. To understand the stage of evolution of the topic, the variables considered relevant are presented in relation to the characteristics of the research analyzed. The research design includes interrelated elements that reflect its sequential nature and contribute to explaining the results. Researchers must decide on the links between the research steps and the purpose of their study and the research approach and methods. The variables, described below, offer knowledge of the pillars of the PB fragment, contributing to the choice of new research.

Advanced Variables

The analyzes are presented below: methodological approach, nature of the methodological approach, scope of the study, unit of analysis, techniques used for data collection. A list of methods or tools analyzed or used in the selected articles is presented. Finally, aspects of the domains of physical, cognitive and organizational ergonomics considered by researchers in their studies are highlighted.

The first characteristic identified was the type of methodological approach to the research. This approach refers to identifying how the different ways of approaching or treating reality are identified, related to different conceptions that we have of this reality. The methodological approach was classified as: modeling, theoretical-conceptual, literature review, simulation, survey, case study, action research and experiment. The number of each type of approach is illustrated in Fig. 2. Scientific literature reviews were conducted on most articles, but case studies were used to present research results.

In 8 articles the researchers used a combination of several types of methodological approaches. For example, in the article "Using leading indicators to measure occupational health and safety performance" it was a case study with action research and simulation (Sinelnikov et al., 2015).

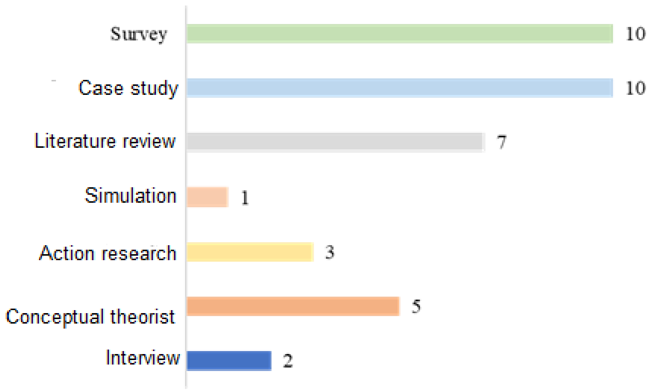

Figure 2. Methodological approach to the research

Regarding the nature of the approach, we sought to identify whether it was qualitative, quantitative, descriptive and predictive. It was possible to identify that 14 articles provided a qualitative description of the results. In the other 17 cases, a combination of quantitative and qualitative research techniques was used by the authors seeking to increase the validity of the results.

It was also identified where the results of the articles could be implemented, taking into account the scope of information on which the authors based themselves. The scope of the study information was classified into: company, economic sector, region (2 or more cities), national and international (Fig. 3).

In 10 of these studies, international information was used, without applying concepts of laws or standards from any particular country or economic sector and in 10 of the articles, the information was based on company-specific data, 9 articles analyzed national data and 2 regional.

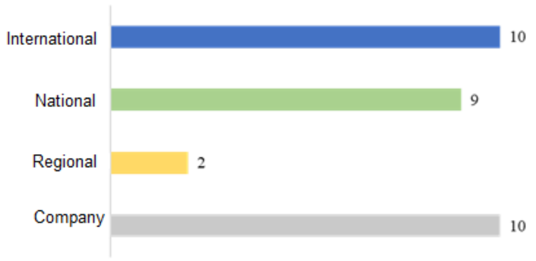

Figure 3. Scope of study information

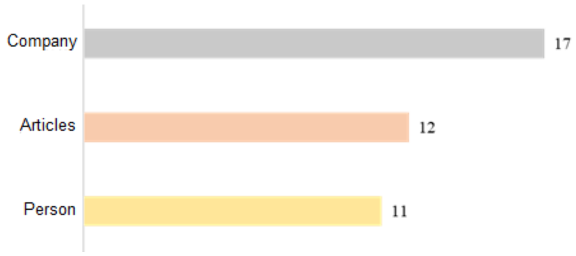

Figure 4. Source of information

The following analysis follows the origin of the information. The articles were classified according to the unit of analysis used by the researchers, namely: people, articles, products, organizational unit and companies. It was possible to identify that 17 were based on internal documents and company data, 12 based their results on the analysis of published scientific literature, 11 correspond to questionnaires or interviews carried out with people. Data presented in Fig. 4.

Likewise, collection techniques were identified, which were classified as questionnaire, interview, company document, observation and public document. To carry out data collection, in 2 of the articles observations were made in workplaces or people's work. 5 conducted interviews and 14 administered questionnaires. In 25 of the investigations, the authors used company documents and 3 public documents, information presented in Fig. 5.

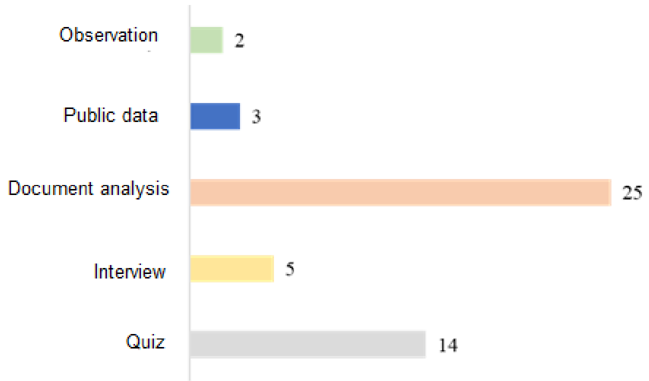

Figure 5. Data collection techniques

An important topic for researchers is identifying which methods and tools were used in the studies. In the articles analyzed, it was possible to identify several tools, some implemented in full and others with adaptations. The list of tools or methods used or analyzed in the portfolio articles are presented in table 1. Some used in the information collection process, such as Safety climate survey (Payne et al., 2010) and Process hazard analysis (PHA) (Kariuki & Löwe, 2007). Others to perform statistical analyzes such as Regression analysis (management-by-exception active; MBEA) (Molnar et al., 2019) and T-test (González et al., 2003). Likewise, SGSST assessment methods such as the Safety Element Method (SEM), Universal Assessment Instrument (UAI), Safety Diagnosis Criteria (SDC), Occupational Health and Safety Self-Diagnostic Tool (OHSSDT), The pyramid of chemical major accident prevention (PYRAMAP) (Sgourou et al., 2010).

In the same table 1, information was recorded on which aspects of the ergonomics domains were mentioned by the authors. During the analysis carried out on each article in the portfolio, it was identified which parts of physical, cognitive and organizational ergonomics were considered by the authors when developing the research. Articles focused on organizational climate, for example, emphasize aspects of organizational ergonomics and may not include aspects from other domains (Hoffmeister et al., 2015; Payne et al., 2010). Likewise, we identified that a group of researchers used macroergonomics (domain of organizational specialization) in implementing the SGSST, using the MacroErgonomic Analysis and Design method (MEAD) and Macroergonomic Analysis of Structure (MAS) as working tools (Haro & Kleiner, 2008).

The advanced analysis allowed us to understand the characteristics of the ergonomics and SGSST articles. It was identified that ergonomics is used more frequently to analyze the physical aspects of worker risk. However, it is practically not used applying the domains of expertise (physical, cognitive and organizational) in a comprehensive way as part of the SGSST. An opportunity was identified to continue the research with the construction of models aimed at implementing or evaluating the SGSST, using the ergonomics specialization domains to improve risk control in occupational activities.

Ergonomics is a necessary and integral part of the activity that health and safety considers, seeking to adapt operational and commercial working conditions to the needs and capabilities of human beings, rather than requiring them to adapt to the work environment. It considers human well-being and overall system performance (Radjiyev et al., 2015).

DISCUSSION

The objective of this study was to examine articles on Ergonomics and the Occupational Health and Safety Management System. We had two general objectives: to examine some characteristics of the researchers' approach and to determine which domains of ergonomics were present in the SGSST.

Through the process of analyzing the selected articles, it was possible to observe that ergonomics is not approached with a holistic view, but rather a specific one. Aspects of organizational ergonomics are being addressed by experts and researchers are advancing implementation criteria for this domain (Haro & Kleiner, 2008; Hoffmeister et al., 2015; Payne et al., 2010). In six articles, the theme of the SGSST was aspects related to worker training (Asadzadeh et al., 2013; Boatca & Cirjaliu, 2015; Givehchi et al., 2017; Hoffmeister et al., 2015; Nwankwo et al., 2020; Tamim et al., 2019) and in two those related to stress generated by occupational activities (Eskandari et al., 2021; Niu, 2010), both are part of the aspects of cognitive ergonomics. This shows that aspects of cognitive and organizational ergonomics are beginning to be worked on in organizations.

This study has some limitations. First, although more than 5,095 ergonomics articles and more than 6,507 SGSST articles were selected for classification, we cannot exhaust all related publications due to the interdisciplinary nature of ergonomics and SGSST. Secondly, the classification of an article depends not only on the professional knowledge of each reviewer, but also on their personal judgments of substantial contribution to each category, therefore, subjectivity is inevitable in this classification process. More rigorous criteria for classifying articles should be further studied. Furthermore, most of the areas identified for the contribution of ergonomics to OMSST should only be considered as areas of somewhat mature contribution, they are not necessarily the most promising areas of research, since the most promising areas may be those that are not yet popular.

Tabela 1. Métodos ou ferramentas utilizadas e Domínios de ergonomia.

Method/tools analyzed or used	Physical Ergonomics	Organizational Ergonomics	Cognitive Ergonomics	Authors	Year
Safety climate survey		Organizational climate, process in audits, self-assessments and inspections, defined systems and processes	autonomy for decision making, assessment of safety risks before doing work	Payne, S. C., Bergman, M. E., Rodríguez, J. M., Beus, J. M., Henning, J. B.	2010
Qualitative Comparative Analysis (QCA)		Organizational complexity, Contract management, OHS planning, Project management, Management commitment, Safety climate, Operational risk management, Site management, Personnel management	Roles and responsibilities, Learning, Performance evaluation	Winge, S., Albrechtsen, E., Arnesen, J.	2019
Statistical Analysis (The mean and standard deviations). F-test	Improve the physical fitness of all employees associated with reducing loss cases	Identify the most dangerous jobs or working conditions, ergonomically speaking, using sources such as discomfort reports, worker injury and illness records, medical records, or job analyses. Improve the physical fitness of all employees associated with reducing loss cases	Global approach to ergonomics in risk prevention	Wurzelbacher, S., Y. Jin	2011
Fuzzy Analytic Network Process (FANP)		Safety performance includes organizational, environmental and individual factors. The role of organizational factors in workplace accidents and the relationship between the safety climate and safety outcomes, such as compliance with safe work practices. Organizational factors: management commitment to safety (MC), employee participation (EP), safety communication (SC), blame culture (BC), safety training (ST), interpersonal relationships (IR), supervision of security (SS), reward system (RS) and continuous improvement (CI). Perception of safety rules and regulations (PR).	Risk Taking (RT), Emotional Instability (EI), Safety Consciousness (SA), Job Satisfaction (JS), Fatigue (FA), Job Competence (WC), Workload (WL), Job Stress (WS).	Eskandari, D., Gharabagh, M. J., Barkhordari, A., Gharari, N., Panahi, D., Gholami, A., Teimori-Boghsani, G.	2021
Longitudinal statistical models, IBM SPSS version 25 using generalized estimating equations (GEE)		Indicators to manage occupational safety. Frequency or severity of negative security incidents, such as property loss or injuries.		Yorio, P. L., Haas, E. J., Bell, J. L., Moore, S. M., Greenawald, L. A.	2020
Production management systems, health and safety management systems)	Control of musculoskeletal risks with the design of the equipment, the types of strenuous movements performed. Equipment design and workstation layout.	Ergonomic design of workplaces and product quality levels, production procedures		Caroly, S., Coutarel, F., Landry, A., Mary-Cheray, I.	2010
Process hazard analysis (PHA), Human reliability analysis (HRA): THERP, SLIM, cognitive reliability and error analysis method (CREAM), technique for human event analysis (ATHEANA) {nuclear industry is more mature than in the chemical process industry. HAZOP and fault tree analysis. process industries safety management, PRISM		The integration of human factors analysis into PHA to identify, understand, control and prevent human-related failures. Analyzes the factors behind the occurrence of human error.		Kariuki, S. G., Lowe, K.	2007
organizational design and management (ODAM) in ergonomics, Macroergonomic Analysis of Structure (MAS), Rapid Universal Safety and Health (RUSH) system (The RUSH system was created using sociotechnical and system safety concepts), System safety		Company-documented safety information and employee perceptions (climate, culture), System environmental expectation (regulations), and system expectation of the environment (regulatory support). participatory ergonomic interventions in the	Perception of security role and responsibility of identified stakeholders, Provide security training support	Haro, E., Kleiner B. M.	2008

human system integration: Preliminary Analysis, Event Tree Analysis, Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), Fault Hazard Analysis, Subsystem Hazard Analysis, System Hazard Analysis, Cause–Consequence Analysis, MacroErgonomic Analysis and Design method (MEAD).		dynamics of communication in the workplace. Levels of organizational complexity, centralization and formalization.			
	Adverse ergonomic working conditions can cause visual, muscular and psychological disturbances such as eye strain, headaches, fatigue, MSDs such as chronic back, neck and shoulder pain, Cumulative Trauma Disorders (CTDs), Repetitive Strain Injuries (RSI) and Repetitive Movement Injuries (RMIs).	The organization of work, the organization of working time, the different working hours (daytime versus various types of shift work).	Psychological job demands, decision latitude, and social support are three key measures of workplace psychosocial factors that affect workers' health. Psychological tension, anxiety and depression.	Niu, S. L.	2010
Simulation of full-scale workplaces. Autoconfrontation method		Participatory methodology, participatory approach to management.		Kuorinka, I.	1997
Knowledge management (KM)			Existing individual (personal) knowledge, structural knowledge (i.e. knowledge codified in manuals, reports, databases and data warehouses) and organizational knowledge (learning activity within the organization) in the vast domain of practical applications.	Sherehiy, B., Karwowski, W.	2006
human reliability analysis. Model for Successful Ergonomics Intervention		Ergonomic intervention, reduction of human errors, increased productivity and speed of execution.	The importance of the organizational environment from a social, physical and metal point of view. Ergonomic intervention begins and ends with training.	Boatca, M. E., Cirjaliu, B.	2015
A regression analysis was conducted to examine the relative roles of transformational, transactional (management-by-exception active; MBEA), and safety-specific leadership for different safety behavioral outcomes (compliance behavior and safety initiative behaviors) and for minor and major injuries.		Communicate safety issues and values during daily work. Security climate. Leader behaviors.		Molnar, M. M., Schwarz, U. V. T., Hellgren, J., Hasson, H., Tafvelin, S.	2019
BME (in free translation 'Ergonomic Assessment Model'), Passive observation was used during twelve Work Environment Safety Group (WESG), participatory observation, a process where theoretical framework, empirical fieldwork and case analysis evolve simultaneously. Strategic analyses and improvement work for safety on plant level, Risk analyses and improvement work for safety on assembly plant level, Follow up and assist the work of WESG, work with strategies for ergonomics and work safety, Risk analyses, work with the BME mode, Discussions about production problems and how to solve, Follow-up results of solutions, An open meeting for any suggestions or subject, Improvements of the process, Information	Each work task is evaluated in terms of posture, strength requirements, and task frequency. The final assessment is expressed in risk values.	Participatory model between the engineer and the safety representative.		Tornstrom, L., Amprazis, J., Chritstmansson, M., Eklund, J.	2008
Balanced scorecards (BSC) Human Resources Performance Model (HPM). Critical Incident Stress Management (CISM)		Integration of human factors in the safety management of aviation companies. Human factors (man, machine, process), safety culture, industry adaptability, human factors, scope		Vogt, J., Leonhardt, J., Köper, B., Pennig, S.	2010

		of application, use in complex systems, safety culture, primary or secondary mode of application, regulatory application.			
Responsible Care Process Safety Code (RCPSC), CIMAH regulations, API RP 750, US OSHA PSM Program, Safety Case, ExxonMobil OIMS, ILO PSM Framework, API RP 75, EPA RMP, COMAH regulations, AIChE/CCPS Risk Based Process, Safety (RBPS) Model, BP OMS, SEMS Regulation, Energy Institute High-Level PSM Framework, Operational Risk Management (ORM) Model, CSChE PSM Guide 4th edition, IOGP/IPIECA OMS Framework, Process Safety Information Management System (PSI4MS), Contractor Management System (CoMS), Emergency Planning and Response (EPR) model, IPSMS model		Human factors (man, machine, process), safety culture, industry adaptability, human factors, scope of application, use in complex systems, safety culture, primary or secondary mode of application, regulatory application.	Training requirement, inductive or deductive approach.	Nwankwo, C. D., Theophilus, S. C., Arewa, A. O.	2020
Caused-based methodology		Critical safety activities performed. Lack of compliance with the process. Inadequate instructions and control procedure.	Inadequate assessment of training and competence.	Tamim, N., Laboureur, D. M., Hasan, A. R., Mannan, M. S.	2019
Project Management Body of Knowledge. Software Engineering Institute (SEI). Cal Path Method (CPM). Preliminary Hazard Analysis. Methodology for analysis of system dysfunction (MASD). Systemic structured methodology of risk analysis (MOSAR). Risk Assessment Model (RAM). PVA-Kaizen. Kaizen-blitz.	Skill, health and physical condition	Internal communication, culture, organizational approach, communication.	Worker attitudes, motivation.	Badri, A., GBODOSSOU, A. NADEAU, S.	2012
RULA - Rapid Upper Limb Assessment, REBA - Rapid Entire Body Assessment, OWAS - Ovako Working Posture Analysis System, PATH - Posture, Activity, Tools and Handling, Biomechanical or digital human modelling, Body Discomfort Map (e.g. Corlett and Bishop Map), JCQ - Job Content Questionnaire, PLIBEL, Rodgers Muscle Fatigue Analysis, Psychophysical Material Handling Data, NIOSH Lifting Equation, Energy Prediction Model, ACGIH Threshold Limit Value, Washington State (WISHA) Lifting Calculator, Ohio Bureau of Workers Compensation (BWC) - Lifting Guidelines, Health & Safety Executive (HSE) (MAC tool), Psychophysical Upper Extremity Data (e.g. "Snook and Ciriello Tables"), Strain Index, OCRA, TLV for Hand Activity (ACGIH), TLV for Upper Limb Muscle Fatigue (ACGIH), Health & Safety Executive, (HSE) Assessment of Repetitive Tasks (ART tool), Muscle fatigue equations, Lumbar Motion Monitor (LMM)/other trunk electrogoniometer, Electronic Wrist Goniometer, Grip Dynamometer, Pinch Dynamometer, Instrumented Hand Tools (for force measurement), Heart Rate Monitor, Push/Pull Force Sensors, Electromyography, Vibration Measurement, Motion capture/measurement (optical, requiring cameras), Motion capture/measurement .	Musculoskeletal assessment			Lowe, B. D., Dempsey, P. G., Jones, E. M.	2019
Model of safety culture		Safety management and leadership, Strategic Management, Supervisor activity, Proactive safety	Skills management	Reiman, T., Pietikainen E.	2012

		development, Management of working conditions, Management of work processes.			
Model of workplace safety with concentric layers of the work system, socio-organisational context and the external environment. Model of a sociotechnical safety control structure in STAMP		Sociotechnical system for safety at work		Carayon, P., Hancock, P., Leveson, N., Noy, I., Sznelwar, L., Van Hootegem, G.	2015
Quantitative survey		Monitor an organization's ability to safely execute safety management system procedures for continuous improvement (e.g., safety management leadership, contingency planning).		Sinelnikov, S., Inouye, J., Kerper, S.	2015
Simple modeling of the relationship between resilience and safety	Anthropometry, physiology. Improvement of the physical environment	Optimize the socio-technical system. Organizational structures in human behavior and security. Quality of work processes.	Cognitive psychology. Training and satisfaction of staff members.	MOREL, G., AMALBERTI, R., CHAUVIN, C.	2009
Safety Element Method (SEM), Universal Assessment Instrument (UAI), Universal Assessment Instrument (UAI), Safety Diagnosis Criteria (SDC), Occupational Health and Safety Self-Diagnostic Tool (OHSSDT), The pyramid of chemical major accident prevention (PyraMAP)		Relationships Organizational and human factors. Inter-relationships: Relationships between technical, organizational and human factors, Intra-relationships: Relationships between the safety management system and the organization and the external environment.		Sgourou, E., Katsakiori, P., Goutsos, S., Manatakis, E.	2010
Integrated safety management model.		Leader motivation, Leader discussion, Leader unity/commitment, Trust in leader, identify cooperation problems.	Leader performance, Personal conflict, Working conditions, Harassed employees, Work environment, Power struggles	Lofquist, E. A.	2010
Psychometric analysis of the Organizational Performance Metric – Monash University (OPM-MU), classical test (exploratory factor analysis) and item response (Rasch model analysis)		Responsibility for OHS, Consultation and communication on OHS, Management and leadership commitment, Positive feedback and recognition for OHS, Prioritization of OHS, Risk management, Systems for OHS (policies, procedures, practices).	Empowerment and involvement of employees in OHS decision-making	Shea, T., De Cieri, H., Donohue, R., Cooper, B., Sheehan, C.	2016
Machine learning (ML) approaches, Boruta feature selection technique and decision tree.				Poh, C. Q., Ubeynarayana, C. U., Goh, Y. M.	2018
Modelagem multinível		Formal OHS audits. Continuous OHS improvement. Workers and supervisors have the information they need to work safely. Positive recognition. Resources or equipment to do the job safely.	Employees are always involved in decisions that affect their health and safety. Those responsible for OHS have the authority to make the changes they identify as necessary.	Sheehan, C., Donohue, R., Shea, T., Cooper, B., De Cieri, H.	2016
Ergonomics Climate Assessment	Workstation project	Employee Wellbeing, Communication, Employee Engagement. Monitoring the effectiveness of the ergonomics program.	Employee performance. Employee knowledge and training. Work project	Hoffmeister, K., Gibbons, A., Schwatka, N., Rosecrance, J.	2015
fuzzy cognitive maps (FCM) methodology, Monte Carlo simulation	Environmental conditions	Communication and resources, work team, documented work instructions.	Training, instructions and education on safety and accident prevention, improvement of working conditions and job satisfaction. Pain and anguish due to work, work pressures	Asadzadeh, S. M., Azadeh, A., Negahban, A., Sotoudeh, A.	2013
Methods Nordic Occupational Safety Climate Assessment, Questionnaire was employed to evaluate safety climate in cross-sectional design.		Management of non-conformities and hazards, worker participation, organizational management structures, work team.	training	Givehchi, S., Hemmativaghef, E., Hoveidi, H.	2017

CONCLUSION

The results of the present study contribute to a greater understanding of the relative importance of how aspects of the physical, cognitive and organizational domains of ergonomics are being addressed within the SGSST, the guidelines of the approaches taken by researchers.

The main conclusions indicate that organizational aspects have gained strength in companies' management activities, identifying the need to focus risk prevention efforts on developing or strengthening the safety climate perceived by workers.

It is crucial to create trust on both sides, management and workers, so that the safety and proposed modifications are fruitful and not just compliance with legal requirements.

It is considered necessary to develop new research to define monitoring procedures considering the domains of specialization of cognitive and organizational ergonomics, allowing the identification of occupational risks with an interaction of the various factors present in occupational activities, not limited only to physical ergonomics. This global approach can contribute to the continuous improvement of the organization and the well-being of workers.

ACKNOWLEDGMENT

Este estudo foi financiado pela Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) Brasil – Código de Financiamento 001.

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