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Philippe Gendron, Louis Laurencelle, Claude Lajoie, François Trudeau, Julie Houle & Éric D. B. Goulet. *Change in heart rate variability during two firefighting work cycles.* Pages: 453-460.

This study aimed to determine whether the change in heart rate variability from pre to post firefighting is modulated by different work cycles. Thirteen male firefighters underwent two firefighting simulations that comprised two identical 25-min work bouts intercalated by a passive recovery period of either 20 min (T20) or 5 min (T5). The square root of the mean squared differences of successive R-R intervals (RMSSD) and aural temperature were measured at rest before (PRE) and after (POST) firefighting simulations. The decrease in RMSSD was different between firefighting simulations (T20: -10 ± 21.2 ms, T5: -19.9 ± 20.9 ms, interaction, $p = 0.02$). Post-firefighting aural temperature was greater ($p = 0.05$) in T5 (37.18 ± 0.53 °C) than in T20 (36.88 ± 0.49 °C). In conclusion, a shorter recovery period of 5 min between firefighting work bouts decreases post-firefighting heart rate variability, possibly attributed to a lower parasympathetic reactivation and a higher absolute value of body temperature.

- **Keywords:** firefighter, autonomic, cardiac, parasympathetic, body temperature, rehabilitation

Seher Kurtul & Nejdiye Mazican. *Prevalence and risk factors for self-reported symptoms of carpal tunnel syndrome among hospital office workers: a cross-sectional study.* Pages: 461-465.

Objectives. We aimed to determine the prevalence of self-reported symptoms of carpal tunnel syndrome (CTS) and associated risk factors among hospital office workers. *Methods.* This cross-sectional study was carried out between May and August 2021 with office workers actively working in a hospital in Izmir, Turkey. The Boston carpal tunnel syndrome questionnaire was used to evaluate the severity of self-reported CTS symptoms and their effect on the functional status of the participants. *Results.* The study included 151 people, 68.2% of whom were women. CTS symptoms were reported by 74.1% of the participants, the majority of whom (73.2%) were women. These reported symptoms were mild in 43%, moderate in 24.5%, severe in 5.3% and very severe in 1.3%. Significant differences were found between those with and without CTS symptoms regarding age, body mass index, previous diagnosis of CTS, daily work hours, using a wrist-supported mousepad and perceived workload ($p < 0.05$). *Conclusion.* CTS

symptoms of office workers in the hospital were associated with occupational characteristics as well as individual factors. These risk factors should be taken into account while planning for future preventive and interventional measures in workplaces.

- **Keywords:** computer use, hospital, carpal tunnel syndrome, office worker

S. Rajaram & G. D. Sivakumar. *Assessment of safety culture in the fireworks industry.* Pages: 466-473.

Workers in the fireworks industry are affected mentally because of hazards that occurred in and around the working environment which caused injuries/fire accidents due to carelessness of workers and poor maintenance of rules and regulations by management. Primary data were collected from 451 workers in 25 fireworks industries randomly. A structured questionnaire is developed to measure safety culture in the fireworks industry in terms of dimensions like work environment, worker awareness, process, governance and safety satisfaction. This instrument is tested for purification of items in terms of stability by various statistical tests like reliability and validity in statistical software like SPSS and AMOS. This field-based study examines safety culture among workers in the fireworks industry to find the real scenario in the workplace and give recommendations for management to control accidents and fire or explosions to save the lives of workers.

- **Keywords:** fire accident, safety culture, worker awareness, SPSS/AMOS

Sajjad Rostamzadeh, Alireza Abouhossein, Mohammad Hossein Chalak, Shahram Vosoughi & Roya Norouzi. *An integrated DEMATEL-ANP approach for identification and prioritization of factors affecting fall from height accidents in the construction industry.* Pages: 474-483.

Objectives. The decision-making trial and evaluation laboratory (DEMATEL) technique integrated with the analytic network process (ANP) is used for determination and prioritization of cause-effect relationships among factors affecting construction falls. *Methods.* Considering the 135 fall accidents collected between 2013 and 2018 from 15 residential construction projects, 70 factors and sub-factors affecting the occurrence of construction falls were determined based on safety experts' opinions. Questionnaires based on the former and the latter were then distributed among 10 occupational health and safety specialists to determine the effectiveness of the factors. The interactions and important degree of each factor are specified, using the DEMATEL-ANP approach. *Results.* Findings showed that organizational factors and their sub-factors have the greatest impact on construction falls and were considered as causal variables ($D - R > 0$), while individual and environmental factors were considered as the effect variables ($D - R < 0$). The results of prioritization using the ANP method showed that the work platform altitude, psychological/occupational stresses and interactions were ranked as the first through third priorities affecting the falls, respectively. *Conclusions.* It is necessary to implement a systematic strategy to reduce the unsafe conditions in construction projects and to pay more attention to organizational factors.

- **Keywords:** falls from height, construction industry, multi-criteria decision-making, DEMATEL-ANP

Peng Jin, Runtian Jiang, Qing Chen, Jintu Fan & Rong Zheng. *Design and evaluation of multifunctional protective clothing for tunnel workers.* Pages: 484-493.

By examining the requirements of tunnel workers, multifunctional tunnel protective clothing was proposed in this study. The traditional tunnel protective clothing was redesigned from the perspective of improving clothing structure and fabric. A safe and

protective clothing system, incorporating a harmful gas detection module, position monitoring module and data transmission module, was developed. Objective evaluation tests were carried out to verify the effectiveness of the proposed protective clothing. During the medium-intensity exercise phase, the average skin temperature and humidity of the participants who wore the new protective clothing were 1.0725 °C and 2.6% lower, respectively, than those who wore the conventional protective clothing ($p < 0.05$). Furthermore, the new protective clothing system exhibited a highly sensitive and complete feedback mechanism. The positioning error could be controlled within ± 10 cm, when the horizontal spacing distance of the base station was set to 200 m.

- **Keywords:** tunnel protective clothing design, comfort-related property, gas monitoring, position monitoring, individual protection

Nur Shuhaidatul Sarmiza Abdul Halim, Zaidi Mohd Ripin & Mohamad Ikhwan Zaini Ridzwan. *Effects of patient transfer devices on the risk of work-related musculoskeletal disorders: a systematic review*. Pages: 494-514.

Objectives. This study aimed to evaluate the efficacy of patient transfer assistive devices in reducing the risk of work-related musculoskeletal disorders (WMSDs) among nurses. *Methods.* PubMed, Scopus, Google Scholar and the Cochrane Database of Systematic Reviews were searched to identify studies with a quantitative assessment of the efficacy of patient transfer assistive devices on the incidence and injury claims of WMSDs as compared to the manual lifting of patients. A health impact analysis of the pre-post intervention of assistive device implementation was performed. The percentage of the reduction of forces, incidence of WMSDs, number of missed workdays and injury compensation claims were calculated, pooled and presented as boxplots. *Results.* A total of 25 studies met the inclusion criteria. The best post-intervention outcomes of assistive devices deployment in the healthcare setting included a reduction in WMSD incidence by 59.8%, missed workdays by 90.0% and workers' compensation claims by 95.0%. Additionally, hand force declined by 71% ($p < 0.05$) and 70% ($p < 0.05$) with the use of air-assisted devices and ceiling lifts respectively. *Conclusions.* Overall, the evidence suggests that patient transfer assistive devices, notably ceiling lifts and air-assisted devices, are effective in reducing the risk of WMSDs among nurses.

- **Keywords:** assistive device, patient transfer, nurse, work-related musculoskeletal disorders, lateral transfer, vertical lifting, ergonomics assessments

Guo Yanyu & Li Jizu. *The effect of emotional intelligence on unsafe behavior of miners: the role of emotional labor strategies and perceived organizational support*. Pages: 515-527.

The primary purpose of this study is to explore the mechanism of the four dimensions of miners' emotional intelligence (self-emotion perception, emotion application, emotion regulation, other-emotion perception) on unsafe behavior through a questionnaire survey of three state-owned coal mines in Shanxi, Shaanxi and Sichuan. Nearly 300 miners participated in the survey, and the response rate reached 83.3%. The study also examined the possible effects of miners' emotional labor strategies and perceived organizational support on unsafe behavior. The reliability and effectiveness of all measuring instruments are considered acceptable. The results show that emotional labor strategy plays an intermediary role in the relationship between emotional intelligence and unsafe behavior. Perceived organizational support plays a regulatory role in the relationship between emotional labor strategy and unsafe behavior.

- **Keywords:** emotional intelligence, surface acting, deep acting, perceived organization support, unsafe behavior

Rafal Mlynski & Emil Kozlowski. *Impulse noise measurement in view of noise hazard assessment and use of hearing protectors.* Pages: 528-537.

Experience shows the occurrence of situations when the measurements of impulse noise parameters are made with measurement equipment unsuitable for such conditions. The results of using such equipment were compared with the results of using equipment with a sufficiently large upper limit of the measurement range. The analysis was carried out on the example of noise generated during shots from a Mossberg smooth-bore shotgun and AKM rifle, as well as produced in the forge. The use of the unsuitable equipment allowed to indicate the exceeding of the exposure limit value of the peak value of the signal (LC_{peak}), but this is not always possible when determining the energy properties of the signal (LEX,8h). While the inadequate properties of the measurement equipment will generally not prevent the conclusion that noise in a particular workplace is hazardous to hearing, the results of measurements cannot be used to select hearing protectors.

- **Keywords:** impulse noise, noise measurements, exposure to noise, earmuffs, hearing protector selection

Yuanyuan Liu, Yunshuo Liu, Pingqing Liu, Dongxu Liu & Shuzhen Liu. *The spiritual force of safety: effect of spiritual leadership on employees' safety performance.* Pages: 538-546.

Objectives. Workplace safety problems are often catastrophic. There are both external and internal factors that influence employee safety performance. Strengthening internal factors is crucial to enhancing safety performance. *Methods.* Through a sense-making perspective, in the present study the impact of spiritual leadership on employees' career callings and safety performance was investigated, along with the moderating function of future work self-salience. A total of 339 paired leader-employee data were obtained. *Results.* Spiritual leadership significantly improved employee safety performance. Career callings served a mediating role between spiritual leadership and employee safety performance. The moderating effect of future work self-salience was significant. When future work self-salience was high, the influence of career callings on employees' safety performance was greater. *Conclusion.* The present results indicated that spiritual leadership sense-giving influences the development of employees' career sense and improves employees' safety performance in regard to spiritual motivation and pursuing career callings. In the present article, a theoretical and practical basis is provided for the safe development of organizations and society.

- **Keywords:** spiritual leader, ship, future work self-salience, career calling, safety performance, sense-making

Ying Ke & Qing Zheng. *Development of mining workwear with high ergonomic performance fabrics based on the modular design concept.* Pages: 547-554.

Workwear is urgently needed in mining that is applied to ensure the basic safety and performance of miners. However, the protective and ergonomic functions of workwear are limited. This study aimed to develop and evaluate a new design of mining workwear. According to the literature review and survey research, the problems of current workwear were identified. Afterwards, the design specification was determined based on the modular design concept, including basic modules of typical styles and colors, functional modules, load-carrying modules and visibility straps. Appropriate materials were also selected to make the prototype. The results show that the new workwear was able to provide adequate thermal protection and decent ergonomic performance. Design of a reflective strap significantly improved the conspicuosity of the clothing. The mining

workwear designed in this study has achieved good protection and wearing comfort. The modular design method has been proved effective in functional clothing design.

- **Keywords:** workwear, mining, modular design, protective clothing

Selçuk Uyumsal, M. Kürşat Fırat, Şahin Saka, Cüneyt Suzer, Müge Aliye Hekimoğlu, Hülya Saygi, Meral Türk, Osman Özden, Fatih Perçin, Serhat Engin & Ahmet Çabuk. *Evaluation of occupational health and safety risk factors in Turkish marine fish hatcheries.* Pages: 555-561.

In this study, the approaches of employees in marine fish hatcheries to occupational health and safety were determined. Cronbach's α coefficient was calculated as 0.858 in the reliability of the scale and scale factors based on internal consistency. In addition, factor analysis according to the varimax method was found to be approximately 64%. It was determined that 68% of the employees were not aware of the relevant laws. In addition, 85% of the employees are aware of the dangers and risks in their workplaces. In the event of a negative situation in the workplace, the rate of those who know their legal rights is 73% ($p \leq 0.05$). In addition, 91% of the employees stated that they would use their right to object in a risky situation and quit the job. Sixty per cent of the employees stated that their jobs can satisfy them sociologically and economically throughout their life.

- **Keywords:** occupational risk, safety, employee, marine fish hatchery, reliability analysis, factor analysis

Huipu Gao, A. Shawn Deaton, Roger Barker, Xiaomeng Fang & Kyle Watson. *Relationship between heat loss indexes and physiological indicators of turnout-related heat strain in mild and hot environments.* Pages: 562-572.

A validated physiological manikin method was used to qualify environmentally dependent correlations between firefighter turnout total heat loss (THL) and intrinsic evaporative resistance (Ref) heat strain indexes and core temperature rise in stressful work conducted in mild (25 °C, 65% relative humidity [RH]) and hot (35 °C, 40% RH; 40 °C, 28% RH) conditions. Five turnout suit constructions representing a wide range of breathability were selected. The observed correlations between measured material heat loss and core temperature showed that the THL heat strain index accurately forecast thermal burden in mild environments (<25 °C); while the Ref index provided accurate prediction in hot environments (>35 °C). They showed that the THL index did not predict heat strain in hot work environments. The findings of this study support incorporating both the Ref and THL heat strain indexes as dual metrics for characterizing the heat strain performance of turnout clothing fabrics.

- **Keywords:** firefighter heat stress, protective clothing, total heat loss, evaporative resistance, physiological manikin

Adbaru Esubalew Abate & Shalemu Sharew Hailemariam. *Improving work-related musculoskeletal disorders for sewing machine operators in Ethiopia.* Pages: 573-585.

Objectives. Awkwardly designed sewing workstations in the garment industry cause work-related musculoskeletal disorders (WRMSDs) that cause global health concerns for industrial sewing operators. This study was conducted with the aim of evaluating health risks and improvement interventions for sewing operators in Ethiopia. *Methods.* The strain index and standardized Nordic musculoskeletal disorder (MSD) questionnaire were used for data collection. Binary and multiple logistic regression analyses were used to

analyze the data and identify significant factors. *Results.* The study revealed that operators' sitting chair design in the sewing section has significant correlation with the occurrence of pain in different body parts, particularly in the upper and lower back body parts with a high odds ratio of more than 93% in the lower and upper back areas. Hence, the sitting chair was redesigned considering the operators' anthropometric measurements and workstation requirements to improve workers' safety and productivity. *Conclusion.* The study concludes that WRMSDs were significant in different body parts so it was crucial for appropriate intervention in redesigning the sewing workstations, particularly the sitting chair, to ensure health and safety of industrial sewing operators. The study therefore recommends implementation of the proposed ergonomic sitting chair to improve operators' safety and productivity.

- **Keywords:** musculoskeletal disorders, work, stations, sewing operators, ergonomics, workers' safety

Jain A. R. Tony B & M.S. Alphin. *Evaluation of the biodynamic response of the hand–arm system and hand-tool designs: a brief review.* Pages: 586-595.

Hand-operated tools transmit a high magnitude of vibration exposure to the hand–arm system that causes occupational diseases. The health effects caused in various countries for the past years due to usage of hand tools are necessary to identify the occupational disorders. Researchers have conducted various studies on biological effects, hand-transmitted vibration exposure and biodynamic responses throughout the years. This article goes over each of these studies in detail, as well as identifying areas where more research is needed. The majority of studies deal with the following topics: general guidelines for hand-transmitted vibrations; assessment techniques of vibration exposure; hand-tool evaluation methods; influence of hand-tool design to overcome the biomechanical effects; and finite element modelling for quantifying vibration exposure. In response to this, understanding the biodynamic behaviour of the hand–arm system is useful for better ergonomic intervention in hand tools to reduce fatigue and increase comfort.

- **Keywords:** vibration exposure, occupational diseases, vibration guidelines, hand-tool designs, objective and subjective measurements, finger models

Cennet Çiriş Yildiz, Dilek Yildirim & Kardelen Günay. *The effect of personal protective equipment use on nurses' tendencies to make medical errors and types of their medical errors: a cross-sectional study.* Pages: 596-603.

This study was conducted to determine the effect of nurses' use of personal protective equipment (PPE) during their care practices on their tendency to make medical errors and the types of medical errors. The study was conducted with 505 nurses in Turkey between May 2021 and June 2021. Descriptive statistics, the Kruskal–Wallis H test, Spearman's correlation test and the Mann–Whitney U test were used to analyze the data. During the COVID-19 pandemic, nurses often used PPE on different levels. A significant relationship was determined between the type of PPE used by the nurses and falls, hospital infections and patient monitoring/material safety ($p < 0.05$). The conclusions in this study reveal the necessity of increasing the usability, safety and effectiveness of PPE used by nurses in health institutions.

- **Keywords:** medical error, nurses, personal protective equipment

Abdulqadir Mohamed Suleiman. Comparison of ConsExpo estimated exposure levels to glycol ethers during professional cleaning work to existing regulatory occupational exposure limit values. Pages: 604-612.

Objectives. Researchers have shown that cleaning workers have an increased risk of asthma and rhinitis, mainly due to exposure to chemical substances present in the cleaning products they use. Among the important substances are glycol ethers, increasingly used as components in cleaning products. This study aimed to assess exposure levels of glycol ether in professional cleaning products and compare them to existing regulatory exposure limit values. *Methods.* Information from safety data sheets of the products is used to identify the glycol ethers present in the cleaning products and their respective concentrations. Other sources were used to obtain the relevant data required for use in the tool to generate exposure assessments. Exposure levels for various cleaning work exposure scenarios were estimated using the ConsExpo Web tool. *Results.* The estimated exposure values are significantly lower than the existing regulatory occupational exposure limit (OEL) values for the different glycol ethers. *Conclusions.* The study showed that the risk of exposure to glycol ethers by inhalation from professional cleaning products is minimal as exposure estimates were much below the regulatory OEL values.

- **Keywords:** safety data sheet, exposure assessment, ConsExpo Web tool, exposure scenario, cleaning work

Sari Tappura, Roosa Haapavirta & Aki Jääskeläinen. Designing a map for measuring and managing safety performance. Pages: 613-626.

Objectives. The purpose of this study is to present a model – the safety performance map – that specifies the key factors influencing organizations' safety performance and suggests the relationships between the identified factors. There is a need for an exhaustive illustration of the path leading to occupational health and safety (OHS) supporting measuring, managing and developing OHS proactively. *Methods.* A qualitative multiple-case study consisted of three stages: design, iteration and testing of the created model. An interview study was conducted in four companies from different industries, and later the model was tested in three complementary companies. The companies involved represented the metal, food, forest and chemical industries; industrial services; and infrastructure and house construction. *Results.* The study identified a total of 42 individual factors that fall under the following seven main perspectives on OHS: OHS management, OHS leadership, structure, processes, culture, individual behavior and performance. *Conclusions.* The study suggests the safety performance map to illustrate the path leading to OHS and indicative causal relationships between the factors affecting it. The same factors affecting OHS recur in all of the included industrial contexts. The study answers the call for proactive performance measurement and more balanced measurement systems for safety.

- **Keywords:** occupational health and safety, safety management, safety leadership, safety performance, performance measurement

Farideh Golbabaie, Esmaeil Karami, Majid Shahi, Zahra Safari & Kaykāvus Azrah. Modeling and investigating the effect of parasol installation on solar radiant temperature reduction using COMSOL Multiphysics. Pages: 627-641.

Objectives. Occupational activities in open spaces can experience excessive heat exposure caused by sunlight and other artificial sources in these professional environments can be one of the current and future challenges of occupational safety and health due to increasing global warming. Use of lightweight portable parasols is the first

available control measure to reduce the radiation emitted by the sun in outdoor workplaces, which has been used for a long time. *Methods.* Due to the lack of study and results on the effect of using parasols in scientific literature, this modeling study was conducted to investigate the effect of sunshade installation on radiant temperature reduction of the sun in outdoor work using COMSOL Multiphysics version 5.5. *Results.* In general, six different shapes of portable parasols in different positions were modeled and the average radiant temperature reduction effectiveness (TRE) was about 30% in the presence of different parasols. The designed conical, simple and pyramidal sunshades showed the most effectiveness, respectively. *Conclusions.* The results show that changing variables such as the axis, installation height and shape is more effective for improving parasol efficiency to reduce the radiant temperature below it.

- **Keywords:** heat exposure, COMSOL, parasol, effect, modeling, sun radiant temperature

Salwa Sofri, D. M. Reddy Prasad, Mohammad Hazwan Bin Azri & Aisah Timbang. *Analysis of chemical engineering curriculum to improve process safety competency.* Pages: 642-650.

Continuous process safety (PS) development is the key to maintaining a good PS system, and its competency plays a substantial role. However, PS incompetency can still be demonstrated in several process-related accidents, particularly major catastrophic incidents. To mitigate this gap, universities' PS education is analysed. Because PS is an important element of chemical engineering (CE), this study seeks to identify the most prevalent PS subjects taught in the top 300 Quacquarelli Symonds ranking (2019) universities. Findings indicate that PS education remains insufficiently addressed in undergraduate CE curricula over the years. Twelve common topics, i.e., human factors; management of hazards, incidents, and risk; design; fire and explosion; legislation and standards; sustainability; process control; economics; toxicology; and software are identified. Notably, sustainability is acknowledged to be a new common PS topic, depicting its demand for industrial evolution. Ultimately, strengthening the collaboration between universities and industries is required to develop graduates' PS competency.

- **Keywords:** chemical engineering, process safety, engineering education, curriculum, safety management

Vesna Spasojević Brkić, Tamara Golubović, Aleksandar Brkic & Abdulghder Mohamed Alsharif. *Influence of human factors on risk associated with pressure equipment.* Pages: 651-660.

Objectives. The analysis of previous research shows that indicators of human factors have not been sufficiently integrated into the models for risk assessment of pressure equipment to date. Therefore, the goal of this article is the creation of a universal measurement scale to assess the current condition of the impacts of human factors on the risk of pressure equipment exploitation in factories and plants. *Methods.* A research instrument with nine constructs and 61 dimensions was designed and tested on a sample size of 268 companies, by reliability, exploratory and confirmatory factor analysis. *Results.* The final model contains exact quantification of nine constructs described by 27 influencing human factors on risk associated with pressure equipment exploitation. *Conclusions.* The most influencing construct is 'communication', whereas the construct 'organizational change management' is the least influencing. Also, applying Pareto analysis shows that the most important constructs identified are 'communication', 'safety and health at work', 'potentially hazardous materials and equipment', 'maintenance/inspection', 'human error' and 'trainings and competences of employees for crisis situations'. It is a recommendation for the process industry enterprises, where pressure equipment is in operation, to include the obtained model in the risk assessment processes they are using.

- **Keywords:** human factors, pressure equipment, questionnaire, construct, dimension

Fatemeh Kargar-Shouroki, Hamidreza Mehri & Faeze Sepahi-Zoeram. *Biochemical and hematological effects of lead exposure in Iranian battery workers.* Pages: 661-667.

Objectives. The purpose of this study was to evaluate the hematotoxic, hepatotoxic and nephrotoxic responses following lead exposure among battery workers. Methods. Seventy-eight battery workers exposed to lead and 78 non-exposed subjects were studied. Fasting blood samples were collected to assess kidney and liver function and hematological parameters. To determine the breathing zone and blood lead levels (BLLs), the samples were analyzed in accordance with NIOSH methods 7082 and 8003, respectively. Results. The battery workers had significantly higher breathing zone lead and BLLs than the non-exposed group. In battery workers, most hematological parameters, including red blood cells, hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration, have significantly decreased. In contrast, the white blood cell count has shown a significant increase as compared to the controls. The mean levels of alanine aminotransferase and aspartate aminotransferase as biomarkers of liver damage and the creatinine serum levels as a result of renal failure were significantly higher in the exposed group than in the non-exposed group. Conclusions. These observations indicate that occupational exposure to lead exceeding its current threshold limit value and biological exposure index is associated with hematological symptoms and liver and kidney dysfunction.

- **Keywords:** lead, hepatotoxicity, hematotoxicity, nephrotoxicity, battery workers

C. Schoose, A. Cuny-Guerrier, S. Caroly, L. Claudon, P. Wild & A. Savescu. *Evolution of the biomechanical dimension of the professional gestures of grinders when using a collaborative robot.* Pages: 668-675.

Using a cobot could relieve workers of strenuous and repetitive tasks while preserving their expertise. To understand the consequences of using a cobot on the occurrence of musculoskeletal disorders (MSDs), within a theoretical framework based on activity-centred ergonomics, an example cobot used in grinding activities in a real work situation is studied. This article analyses the evolution of the biomechanical dimension of the professional gestures of grinders when using the cobot. Effort linked to tool carrying and the vibrations perceived were reduced. Repetitiveness decreased but workers did not accomplish the entirety of their task. The work postures did improve for different joints but not for all, which shows the advantage of varying the contexts of using a cobot and taking into account workers' strategy diversity. To investigate other explanatory elements of the effects on MSDs, these results must be linked to the evolution of the other dimensions of professional gestures.

- **Keywords:** musculoskeletal disorders, collaborative robot, professional gestures

Na Liu, Quanlin Pu, Yan Shi & Yunhong Zhang. *Social facilitation effects in online coaction: the moderating role of social comparison direction.* Pages: 676-684.

Online and face-to-face coactions are widely used work organization modes. This study aims to investigate the effect of social comparison direction on task performance when people coact online. A total of 40 individuals were recruited to participate in a 2 (coaction type: online and face to face) × 3 (social comparison direction: upward, downward and no comparison) × 2 (phase: pre-comparison and post-comparison) within-subject experiment. The participants performed visual search tasks while their response time and

search accuracy rates were measured. Results showed that the participants were reported to perform faster when they coacted online than face to face. The upward comparison led to a stronger social facilitation effect than the downward and no comparison directions, either in online or face-to-face coaction. These findings provide practical implications in the design of coaction modes for groups and teams working remotely.

- **Keywords:** coaction, social comparison, social facilitation effect, organization design, work mode

Sabriye Ercan, Tuba İnce Parpucu, Zeliha Başkurt & Ferdi Başkurt. *Gender differences, ergonomics risks and upper quadrant musculoskeletal pain in hairdressers. Pages: 685-689.*

Objectives. This study examined ergonomic risk levels and upper quadrant musculoskeletal pain (UQMP) levels of hairdressers, and the difference and correlation between genders. *Methods.* Volunteers participating in the study were assessed with the descriptive data form, rapid upper limb assessment (RULA), Cornell musculoskeletal discomfort questionnaire (CMDQ) and disabilities of the arm, shoulder and hand (DASH) score. *Results.* In total, 229 (female, 26.6%; male, 73.4%) hairdressers participated in the study. Prevalence of the first three frequencies of pain in the musculoskeletal system was 48.5% in the neck, 41.5% in the upper back and 33.6% in the shoulder. The mean DASH score of the hairdressers was 10.75 ± 10.70 , quick DASH-work modulated score was 6.85 ± 10.24 and mean ergonomic risk score was moderate to high (5.36 ± 1.22) according to RULA. Although there was no difference in terms of gender in the ergonomic risk level, a higher level of UQMP was significant in females ($p < 0.05$). RULA score correlated with CMDQ and DASH scores in both genders ($p < 0.05$). *Conclusions.* Hairdressers perform their jobs in work environments with moderate to very high ergonomic risk levels. There is a possibility of UQMP in hairdressers, especially females, due to the effect of their movement patterns as a requirement of their profession.

- **Keywords:** hairdresser, upper quadrant, musculoskeletal pain, ergonomics, gender

Qian Ma, Guojun Wang, Sven Buyle & Xuan Jiang. *Cause analysis of unsafe acts of pilots in general aviation accidents in China with a focus on management and organizational factors. Pages: 690-703.*

Objectives. General aviation (GA) safety has become a key issue worldwide and pilot errors have grown to be the primary cause of GA accidents. However, fewer empirical studies have examined the contribution of management and organizational factors for these unsafe acts. Flawed decisions at the organizational level have played key roles in the performance of pilots. This study provides an in-depth understanding of the management and organizational factors involved in GA accident reports. *Methods.* A total of 109 GA accidents in China between 1996 and 2021 were analysed. Among these reports, pilot-related accidents were analysed using the human factors analysis and classification system (HFACS) framework. *Results.* The significant effects of managerial and organizational factors and the failure pathways on GA accidents have been identified. Furthermore, unlike traditional HFACS-based analyses, the statistically significant relationships between failures at the organizational level and the sub-standard acts of the pilots in GA accidents were revealed. *Conclusions.* Such findings support that the GA accident prevention strategy that attempts to reduce the number of unsafe acts of pilots should be directed to the crucial causal categories at HFACS organizational levels: resource management, organizational process, failure to correct a known problem, inadequate supervision and supervisory violations.

- **Keywords:** general aviation accidents, human factors analysis and classification system, unsafe acts, organizational factors

Guido Alfaro Degan, Andrea Antonucci, Gianluca Coltrinari & Dario Lippiello. *Problems related to measuring the transmissibility of anti-vibration gloves: possible efficacy for impact tools used in mining and quarrying activities*. Pages: 704-716.

This article takes into account some of the most relevant studies investigating the transmissibility of anti-vibration (AV) gloves. AV gloves are almost useless at the palm level in the low frequencies (<31.5 Hz), while they generally start to have an appreciable reduction of the vibration over 400 Hz. In their use with impact tools, having a low dominant vibration frequency usually between 25 and 60 Hz for chipping hammers and drills, and less than 30 Hz for pneumatic breakers, the average transmissibility reduction at the palm level is 13% (minimum 2%; maximum 26%) when used with hammers, and 1% (increment of 4% and reduction of 6%) when used with breakers. The transmissibility at the finger level, especially in the low frequencies, is almost nothing or produces an increase of the vibration. Other problems related to the increase of the applied force and the reduction of dexterity are reported.

- **Keywords:** anti-vibration gloves, hand-arm vibration, breakers, hammers, mining, quarrying

Michael Parenteau, Chen (Julian) Chen, Berenice Luna-García, Marita del Pilar Asmat, Albert Rielly & Stefanos N Kales. *Fatigue in NTSB investigations 2013–2019: evidence of accidents and injuries*. Pages: 717-722.

This study updates the prevalence of operator fatigue as a causative factor in accidents investigated by the National Transportation Safety Board (NTSB) and the associated injury severity in fatigue-related accidents. In total, 394 investigations were analyzed and 12% of them identified fatigue. The prevalence of fatigue varied among the transportation modes, ranging from 28% of aviation to 7% of marine. Most fatigue-related accidents (48%) occurred during late night or morning. Compared to non-fatigued operators, fatigued operators were more involved in severe or fatal injuries (odds ratio [OR] 2.30; 95% confidence interval [CI] [1.66, 2.95]) and injuries to non-operators (OR 3.32; 95% CI [2.70, 3.95]). Obstructive sleep apnea (OSA) was identified as a probable cause, contributing cause or finding in 15% of fatigue-related accidents, and in 85.7% of these accidents the operator met OSA screening criteria. Thus, opportunities remain for preventing fatigue-related accidents, including through more systematic operator screening for OSA.

- **Keywords:** fatigue, injury severity, National Transportation Safety Board, obstructive sleep apnea, time of day, transportation safety

Runting Zhong, Jingxian Liao & Yunlong Xu. *Fatigue assessment of sedentary office workers using smartphones: a preliminary study*. Pages: 723-734.

Objectives. Smartphone-based gait assessment provides a novel method to evaluate fatigue. This study aimed to examine self-reported fatigue and gait parameters recorded using a smartphone before and after an 8-h work day in bank workers, and identify the relationship between self-reported fatigue and gait parameters. *Methods.* One hundred bank workers (aged 20–45 years) were tested before and after an 8-h work day using a reaction time test, self-reported fatigue scale and gait test. Spearman correlation coefficient analysis and partial least squares regression were used to identify the

relationship between self-reported fatigue and gait parameters. *Results.* Reaction time and self-reported fatigue increased significantly after work. Gait parameters (step frequency, minimum acceleration, acceleration root mean square, step regularity and step counts) decreased; step time and step time variability increased significantly ($p < 0.05$). We found a significant correlation between changes (Δ) for Δ work engagement and Δ step frequency ($r = -0.20, p < 0.05$), Δ work engagement and Δ step time ($r = 0.21, p < 0.05$), and Δ work tasks and Δ step symmetry ($r = -0.20, p < 0.05$). *Conclusion.* This study suggests that step frequency, step time and step symmetry measured using a smartphone have the potential to be used as predictors of work fatigue.

- **Keywords:** fatigue, fatigue assessment, gait, occupational health, smartphone

Laura Filosa & Vanni Lopresto. *Semi-quantitative methodology to assess health and safety risks arising from exposure to electromagnetic fields up to 300 GHz in workplaces according to Italian regulations.* Pages: 735-746.

This article is focused on a semi-quantitative methodology to assess and manage the health and safety risks arising from exposure to electromagnetic fields (EMFs) up to 300 GHz in workplaces as well as to identify the priorities of intervention, based on the requirements of European Directive 2013/35/EU and Italian regulations. The study includes a synthetic overview of the effects arising from EMF exposure and the related regulatory framework on protection. Furthermore, an in-depth analysis is carried out on the risk assessment process as well as on the technical and organizational measures for risk mitigation and their adaptation to the specific requirements of workers at particular risk, based on technical standards and best practice guides issued by international and national (Italian) standardization bodies.

- **Keywords:** risk assessment, health and safety, electromagnetic fields, workers' exposure, workers at particular risk

Prasanna Venkatesan Ramani & Talanti Ravi Arun Kumar. *Developing a schedule integrated automated safety planning tool for residential construction projects.* Pages: 747-755.

Construction safety culture can be greatly improved if safety planning is done hand-in-hand with project planning. This article investigates the integration of construction scheduling with construction safety planning by developing an automated safety planning add-in (ASPA) for Microsoft Project. A risk assessment database was developed that analysed the frequency and severity of hazards associated with construction tasks and the risk level of each hazard was calculated. The developed ASPA compares the ongoing construction activity in the schedule with the safety database, and an automated safety report is produced as a spreadsheet containing details of task name, risk priority, task start and end dates, and hazard and safety regulations related to the tasks. The schedule integrated ASPA was then tested for efficacy by implementing in a real-time project. The ASPA facilitated the safety engineers to plan daily activities by prior envisaging of hazards and safety regulations through schedule-based report generation.

- **Keywords:** safety planning, automated safety reports, construction safety regulations, construction hazards, risk assessment

Guodong Ni, Ziyao Zhang, Zhipeng Zhou, Han Lin & Yaqi Fang. *When and for whom organizational identification is more effective in eliciting safety voice: an empirical study from the construction industry perspective*. Pages: 756-764.

Safety voice (SV) is a form of voice in which employees express opinions or concerns about organizational safety. It plays an important role in preventing accidents and promoting safety performance. The purpose of this study is to reveal the emotional factors and boundary conditions behind employee engagement in SV, especially in the construction context. This study, therefore, investigated how organizational identification (OID) drove construction project participants' SV using a three-way interaction model of perceived insider status (PIS) as an individual difference and safety climate (SC) as an organizational contextual difference. The proposed model was tested using a sample of 357 participants in different construction projects. The results showed that OID was positively correlated with SV. The interaction effect of OID and PIS on SV depended on SC, with PIS enhancing the identification-voice relationship at a low level of SC and weakening it at a high level of SC.

- **Keywords:** safety voice, organizational identification, perceived insider status, safety climate, construction industry

Joyce Soares e Silva & Márcia Astrês Fernandes. *Validation of the Brazilian version of the questionnaire for detection of sick building syndrome*. Pages: 765-772.

Objectives. This study aimed to perform content and construct validation of the questionnaire for detection of sick building syndrome for health-care workers in the Brazilian context; and to evaluate the length of employment in relation to the level of exposure to occupational risks that trigger occupational disease. *Methods.* This methodological and cross-sectional study consisted of validation of the questionnaire for detection of sick building syndrome for Brazil, and application of this to health workers. The questionnaire was validated through two axes: content and construct by contrasted groups. *Results.* The general index corresponded to 0.81, considering the instrument validated as to content. Fleiss' *K* index showed an inter-rater agreement of 68.59%, with a free margin of 0.53. Regarding the analysis by contrasted groups, there was a significant association with the two contrasted groups for time of work in the building and in the sector with some variables described as follows: age group, level of education, time of work in the position, satisfaction with the usual working hours, promotion of workers, etc. *Conclusion.* It is hoped that the validation of this questionnaire can contribute to a greater visibility of this pathology in the Brazilian worker's health scenario.

- **Keywords:** sick building syndrome, health personnel, validation study, surveys and questionnaires, nursing

Sanjgna Karthick, Sharareh Kermanshachi, Apurva Pamidimukkala & Mostafa Namian. *A review of construction workforce health challenges and strategies in extreme weather conditions*. Pages: 773-784.

Construction sites continue to operate despite inclement weather, exposing workers to unpleasant working circumstances that can lead to various physical and mental health challenges. A thorough literature review yielded 21 challenges for hot weather conditions such as heat stroke, kidney disease, heat cramps, anxiety and depression, and 20 challenges for cold weather conditions like asthma, frostbite, musculoskeletal disorders and hallucination. Workers vulnerable to hot and cold weather based on demographic characteristics were identified. The study also provides 27 strategies to address the

challenges experienced in hot and cold weather conditions. Some of these include ensuring that workers stay hydrated, scheduling sufficient rest periods and allowing workers to self-pace. The results of this study will help construction decision-makers and project managers understand the difficulties faced by a field workforce who labors in extreme working conditions on construction sites and will facilitate adoption of strategies that can prevent weather-related physical and mental health problems.

- **Keywords:** construction workers, extreme weather, worker health, worker safety, health challenges

Patrick N. Okonkwo & Jan A. Wium. *Investigating the effectiveness of health and safety management systems within construction organizations.* Pages: 785-795.

Objectives. Previous studies presented the advantages of implementing health and safety management systems (HSMSs) in the construction industry. Few studies have investigated the effectiveness of HSMSs in developing countries. This study adopts a strategic management and multilevel perspective to assess the three main construction HSMS types in South Africa in terms of their adequacy across 14 HSMS dimensions. *Methods.* A literature review identified 14 health and safety (H&S) management dimensions as building blocks of the strategically developed component of a HSMS. Statistical methods analysed the feedback from a questionnaire survey amongst 59 construction companies on the adequacy of three HSMS types observed in these companies across 14 HSMS dimensions. *Results.* Differences between the three H&S management types were identified, with inadequacies in three of the 14 H&S management dimensions across all three HSMS types. The three dimensions are accountability and incentives for employee participation, management of subcontractors, and employee competence and training. This could indicate less attention is paid to behavioural-based safety control strategies. *Conclusions.* The study quantified the differences between the three H&S management types and will help contractor organizations to improve their HSMSs.

- **Keywords:** construction safety, developing countries, management system, multinomial logit model

Canan Yılmaz & Aykut H. Turan. *The causes of occupational accidents in human resources: the human factors theory and the accident theory perspective.* Pages: 796-805.

Objectives. Despite many precautions taken in our country, the number of occupational accidents elevates continuously. In the literature, the causes of accidents due to human error are usually determined by a single theory base. However, according to the combination theorem, the real causes of occupational accidents can only be found by adopting more than one theory. The main purpose of this study is to evaluate the causes of occupational accidents in human resources with a combination of human factors theory and accident theory. *Methods.* We examined 600 occupational accident reports and analyzed the data with SPSS version 20.0. *Results.* Five basic dimensions of occupational accidents related to human resources were determined. Occupational accidents caused by tiredness and inadequacy differ in favor of the fatal accident type, while the others differ in favor of the injury accident type. The dimensions of tiredness and erroneous behavior differ in favor of the cut injury type, while other accidents differ in favor of the fall from height type. *Conclusion.* In the context of the combination theorem, the most dangerous causes of occupational accidents due to human resources are overload and ergonomic traps. Tiredness, inexperience and inadequacy dimensions are among the other most dangerous causes.

- **Keywords:** human resources management, occupational accidents, human factors theory, accident theory, combination theorem

Cristian Castillo, Mohammad Shahriari, Fabricio Casarejos & Pedro Arezes. *Prioritization of leading operational indicators in occupational safety and health. Pages: 806-814.*

New approaches are necessary to ensure the effectiveness of an occupational safety and health management system (OSHMS), which include the development of new methods that would facilitate the measurement of the proactive operational status. This study addresses the development of a tool that contains leading operational indicators in occupational safety and health (OSH), with the main objective of prioritizing these indicators according to the consensual opinion of groups of experts. The Delphi method was applied to this manageable list to prioritize the indicators through three rounds, and consensus was obtained on which indicators are most relevant, both for each individual group of experts and for all experts. This tool allows each company to customize the indicators that are most appropriate for its own reality by considering the report of these indicators. This tool can be a part of a safety dashboard model and considers only the most relevant indicators.

- **Keywords:** Delphi method, leading operational indicators, occupational safety and health, prioritization, safety dashboard model

Banu Bayar, Asalet Aybüke Güp, Dilara Özen Oruk, Özge İpek Dongaz, Eralp Doğu & Kılıçhan Bayar. *Development of the postural habits and awareness scale: a reliability and validity study. Pages: 815-820.*

Objectives. The aim of this study was to develop a scale that assesses postural awareness and habits, as well as to establish the validity and reliability thereof. *Methods.* The 19-item postural habits and awareness scale (PHAS) was developed. The scale has a score range of 0–95, with a higher score indicating good posture and awareness. A total of 278 healthy adults with an age range of 18–65 years were included in the study. The sociodemographic form, short form 36 health survey (SF-36) and body awareness questionnaire (BAQ) were used to test the validity and reliability of this newly developed scale. *Results.* From factor analyses, it was observed that the items clustered into four factors, which explained 55.99% of the variance. Cronbach's α for each factor of the scale varied between 0.619 and 0.832. A high correlation was observed regarding test-retest reliability of the scale ($r = 0.905$). *Conclusion.* This newly developed self-reported scale allows for the comprehensive determination of both postural habits and awareness together. The PHAS is a valid and reliable scale that can be used by professionals who are interested in posture.

- **Keywords:** healthy, posture, ergonomic, awareness, habits

Mandowa Johanes, Matsa Mark & Jerie Steven. *A global review of implementation of occupational safety and health management systems for the period 1970–2020. Pages: 821-836.*

Objectives. Global awareness on occupational safety and health management systems (OSHMSs) has increased exponentially with time over the years. Evidence in the public domain shows there is still much skepticism and reluctance in implementing OSHMSs, particularly in least developed and developing countries. The primary objective of this theoretical review was to analyze available evidence of research gaps on OSHMS implementation globally over the period 1970–2020. *Methods.* The review adopted a descriptive mixed-methods design premised on its ability to provide a platform for data triangulation that is paramount in enhancing the authenticity of the review

findings. *Results.* Many studies conducted on implementation of OSHMSs were bereft of examining the challenges of OSHMS implementation. The review further exposed some OSHMS implementation disparities existing between the developed and the developing world, hence a conclusion can be drawn that a 'one size fits all approach' to OSHMS implementation may not ideal for many workplaces. *Conclusion.* This review recommends contextualization of OSHMS implementation taking into consideration other differing environmental factors. Ultimately, propagation of further research will exude the challenges associated with implementation of OSHMSs and their causal factors, thereby providing the basis for establishment of problem-driven solutions to increase uptake of OSHMS in workplaces.

- **Keywords:** occupational safety and health, occupational safety and health management system, decent work, International Labour Organization, Sustainable Development Goals

Fauzi El Kadri Filho & Sérgio Roberto de Lucca. *Ergonomic and psychosocial risks related to musculoskeletal problems among Brazilian labor judges in telework during the COVID-19 pandemic.* Pages: 837-846.

Objectives. The aim of this study was to evaluate the ergonomic and psychosocial risks in telework and their relationship with musculoskeletal problems in Brazilian labor judges during the COVID-19 pandemic. *Methods.* A cross-sectional study was conducted with 119 participants. Data were collected through a sociodemographic and occupational questionnaire, from the Brazilian versions of the revised Maastricht upper extremity questionnaire (MUEQ-Br revised), the rapid office strain assessment (ROSA-Br) and the Nordic musculoskeletal questionnaire (NMQ), added to a numerical pain scale. *Results.* According to the ROSA-Br, 47.06% of the participants showed an outcome where it is considered that there is a need for immediate intervention in the workplace. Results of the ROSA-Br and the MUEQ-Br revised presented a significant correlation with the intensity of complaints in the neck and shoulders in the last 12 months and in the last 7 days. The total score of MUEQ-Br revised presented more important correlations with problems in these body regions and with the intensity of complaints in the upper back, wrists/hands and lower back in both periods. *Conclusions.* Companies should propose ways to assess the ergonomic and psychosocial risks among their employees in telework as a way to prevent the occurrence of musculoskeletal problems.

- **Keywords:** occupational health, ergonomics, risk factors, musculoskeletal pain, teleworking

Somayeh Tahernejad, Mohsen Razeghi, Mohammad Abdoli-Eramaki, Hossein Parsaei, Mozghan Seif & Alireza Choobineh. *Recommended maximum holding time of common static sitting postures of office workers.* Pages: 847-854.

Objectives. A posture maintained for a long period can be harmful to the health of office workers. This study aimed to estimate the recommended ergonomic duration for maintaining different sitting postures. *Methods.* Forty healthy male and female students participated in this experiment designed to measure perceived discomfort caused by maintaining common static sitting postures of office workers in a simple ergonomic set-up for 4 min. The Borg CR10 scale was given to the participants to assess the discomfort in different body parts, before and after each experiment. Based on the mean group discomfort level of 2, the recommended holding time of each posture was estimated. *Results.* The recommended holding time and its discomfort score for each studied posture were tabulated. The shortest holding time of a posture was obtained for the moderate neck flexion (1.61 min), and the longest holding time was obtained for a

leg posture with 90° knee flexion (6.45 min). *Conclusions.* The recommended holding time in this study may help to assess the risk of musculoskeletal disorders (MSDs) in office workers and train the individuals involved in office tasks in proper sitting behavior.

- **Keywords:** sitting behavior, posture variability, prolonged sitting, sedentary behavior, maximum holding time, dynamic sitting

Yun Teng, Yuwei Sun, Xinlin Chen & Mei Zhang. *Research on effective recognition of alarm signals in a human-machine system based on cognitive neural experiments.* Pages: 855-862.

The rational design of the alarm signal in the man-machine system is an important factor in determining the occurrence of safety accidents. Neuroergonomics provides a new perspective for the study of the cognitive process of alarm signals, which can reveal the mechanism of human perception of visual alarm signals from the cognitive level of the brain, thereby identifying the effectiveness of alarm signals. This study simulates the new energy vehicle cooling man-machine system, uses the automatic control interface of the test cooling water system as the stimulation material, and uses the event-related potential technology in cognitive neuroscience to conduct experimental verification. The experimental results showed that: three kinds of alarm signals (color, color+shape, color+orientation) all induce visual mismatch waves, and the effective response of human to the alarm signal is color+orientation, color+shape, color from small to large, which provides a reference for the design of alarm signal.

- **Keywords:** human-machine system, alarm signal, neuroergonomics, cognitive neurological experiment

Hosseinali Rangkooy, Afshin Rahmati & Behzad Fouladi Dehaghi. *Base transceiver station antenna exposure and workers' health.* Pages: 863-868.

Objectives. With the rapid development of technologies related to the communications industry, human exposure to electromagnetic fields has increased during recent decades. The study aimed at investigating the effect of exposure to waves emitted from the base transceiver stations (BTS) on workers' health. *Methods.* 240 workers participated in the study. In order to determine the general health conditions in two groups, along with electromagnetic waves exposure measurement, the general health questionnaire (GHQ) was completed and the data on blood parameters were assessed. *Results.* The mean age and job experience in the case and control groups were 34.1 ± 4.8 and 10.1 ± 6 years and 31.6 ± 5.5 and 8.8 ± 7 years, respectively. According to the GHQ results, only anxiety and insomnia subscales showed a significant difference between the two groups. The white blood cell and red blood cell counts in the case and control groups were 6715.6 ± 1591 and 7594 ± 2416 , $5.3 \times 10^6 \pm 4.6 \times 10^5$ and $5.05 \times 10^6 \pm 5.39 \times 10^5$ per ml, respectively. Analysis of the results showed that the difference between the two groups was significant. *Conclusion.* The results revealed that blood parameters in the BTS operators showed more changes. Thus, it can be concluded that these health impacts result from occupational exposure to BTS waves.

- **Keywords:** electromagnetic field, health, workers

Qi Zheng, Jing Zhan & Xiliang Feng. *Working safety and workloads of Chinese delivery riders: the role of work pressure.* Pages: 869-882.

Using a sample of 9133 food delivery riders from T, a Chinese food delivery platform, this study applies a binary probit model to analyse influences of food delivery riders' workloads on the incidence of occupational injuries using self-control theory. We have

found that food delivery riders' quantity of weekly orders delivered has an inverted U-shaped correlation with occupational injuries and those who rely heavily on platform income have a lower risk of injuries than those who rely less on platform income. After handling the problems of endogenous and missing variables through an instrumental variable method and robustness test, the conclusion is still robust. Moreover, work pressure is a mediator for workload influence on occupational injuries, but the platform safety training is not a boundary condition, for possible lacking in contents of workload control. Individuals with the experience of occupational injuries are less willing to continue working as food delivery riders.

- **Keywords:** Chinese food delivery riders, occupational injuries, workloads, work pressure, self-control theory

Clara Rodríguez-Gude, Yaiza Taboada-Iglesias & Margarita Pino-Juste. *Musculoskeletal pain in musicians: prevalence and risk factors – a systematic review.* Pages: 883-901.

Objectives. This study aimed to determine the prevalence and regions of the body in which musculoskeletal injuries occur in musicians, as well as to identify risk factors related to their occurrence. *Methods.* A search was carried out in the PubMed, Scopus, Web of Science and Cinahl databases for publications between 2006 and 2020. Observational studies on the prevalence of musculoskeletal injuries or their risk factors in musicians aged 18–65 years were eligible for inclusion, and the methodological quality and risk of bias were assessed. *Results.* In total, 31 studies on multiple instruments and 17 studies on individual instruments were included. Quality was rated as high in 65% of the studies. Lifetime prevalence of injuries ranged from 46 to 90% and current prevalence from 9 to 63%. The most common region of pain was the neck, being present in all instrument families. Being female is a predisposing factor to the appearance of musculoskeletal problems in musicians. *Conclusions.* Musicians frequently suffer musculoskeletal injuries. The most common regions of the body in which these injuries occur are the neck and shoulders. Numerous risk factors were found to be predisposing to musculoskeletal injuries. We note that there are fewer studies on specific instruments.

- **Keywords:** playing-related musculoskeletal disorder, musician, risk factor, prevalence, pain

Quan Xu, Mengyun Wang, Yaoliang Wu, Kuiyuan Qin, Yuan Li, Xuqun You & Ming Ji. *Linkage of calling and burnout among Chinese airline pilots: the role of psychological capital and organizational identification.* Pages: 902-910.

Objectives. Burnout of airline pilots has an extremely adverse impact on their physical and mental state, their work efficiency and safe operation of airlines, and is thus an important issue in occupational safety and health. Therefore, it is crucial to identify factors that may reduce burnout among airline pilots. Drawing on conservation of resources theory, the present study investigates the relationships between calling, psychological capital, organizational identification and burnout in order to understand the mechanisms underlying pilot burnout. *Method.* A cross-sectional survey was conducted to measure calling, psychological capital, organizational identification and burnout among a sample consisting of 242 Chinese commercial airline pilots (age: M 31.60 years, SD 6.44). Correlation analysis, mediation analysis and moderated analysis were conducted. *Results.* The results showed that calling has a direct and negative effect on pilot burnout, and an indirect effect on burnout through influencing psychological capital. Moreover, organizational identification was found to positively moderate the negative relationship between calling and pilot burnout. *Conclusion.* This study contributes to deepening theoretical research on burnout, and provides empirical evidence for effective

intervention in the burnout of airline pilots, which is beneficial to reduce pilot human error and ensure flight safety. Future research directions are also discussed.

- **Keywords:** burnout, calling, psychological capital, organizational identification, occupational safety and health

Fawad Ahmed, Zhengde Xiong, Naveed Ahmad Faraz & Ahmad Arslan. *The interplay between servant leadership, psychological safety, trust in a leader and burnout: assessing causal relationships through a three-wave longitudinal study.* Pages: 912-924.

COVID-19 pandemic has brought unprecedented psychological challenges for frontline healthcare workers, especially nurses, causing anxiety and depression leading to burnout. The responsibility of healthcare leaders has increased manifold to deal with such challenges. This study attempts to employ the conservation of resources theory to examine the relationship between servant leadership and nurses' burnout, with the mediating role of psychological safety and the moderating effect of trust in leader. A three-wave longitudinal design was employed for data collection from 1204 nurses from 27 hospitals in China. The partial least squares structural equation modeling technique was used for data analyses with SmartPLS version 3.2.8. The findings endorse that servant leadership at time 1 significantly reduces nurses' burnout measured at time 3 through the mediating role of psychological safety measured at time 2, and that a higher level of trust in the leader enhances the impact of servant leadership in reducing nurses' burnout.

- **Keywords:** burnout, servant leadership, psychological safety, trust in the leader, conservation of resources theory

Nehla Rmadi, Imen Sellami, Mounira Hajjaji, Kaouthar Jmal Hammami & Mohamed Larbi Masmoudi. *Work productivity loss due to musculoskeletal symptoms in the shoe and leather industry.* Pages: 925-930.

Objectives. This study aimed to explore the work productivity loss (WPL) due to musculoskeletal symptoms (MS) and its explanatory psychosocial, ergonomic and personal factors in Tunisian shoe and leather industry workers. *Methods.* We conducted a cross-sectional survey among 337 workers. We evaluated WPL using the work productivity and activity impairment questionnaire. We used the Nordic questionnaire to assess the MS prevalence, the job content questionnaire of Karasek to examine the psychosocial work environment and the quick exposure check (QEC) tool to estimate the ergonomic exposure levels. *Results.* The mean WPL was $44.9 \pm 33\%$. In the multiple linear regression model, WPL was positively correlated with a history of MS, professional seniority, a rhythm perceived as restrictive, low social support and decision latitude, the number of symptomatic sites and the QEC strain level of the back. *Conclusion.* There was a decline in work productivity due to MS that results from a combination of personal, psychosocial and biomechanical factors. Once addressed, both work productivity and workers' well-being should be restored.

- **Keywords:** work productivity, absenteeism, presenteeism, musculoskeletal diseases, risk factors

Haihui Yao. *A model for establishing resilience safety culture for the construction industry.* Pages: 931-940.

The increasing construction injury and fatality rate implies that conventional safety culture is unable to match the increasing requirement of construction industry safety.

One promising approach is establishing resilience safety culture for the construction industry. For this aim, a hypothesized model was developed and 420 data for testing the model were collected by the present study. Structural equation modeling was employed to test the hypothesized model by fitting the data into the model. Finally, a model consisting of 10 dimensions with 13 relationships was established. A fuzzy analytic hierarchy process was employed to make a comparison between the proposed model and the other two prevalent models. It was concluded that the proposed model performs better in complying with real situations and considering sufficiently necessary dimensions and relationships. However, it is a bit hard to be easily and fully understood, which points to the direction of further work.

- **Keywords:** resilience safety culture, structural equation modeling, construction industry, fuzzy analytic hierarchy process

Hossein Akbari, Mitra Hannani, Masoud Motalebi Kashani, Marzie Sadaf, Hamid Reza Saberi, Sedighe Dehghani Bidgoli & Fahimeh Karamali. Measurement of barriers to perform periodic examinations: development and psychometric properties scale. Pages: 941-949.

Objectives. Due to recent changes in workplace risks, it is required to investigate the motivations of employees and employers for occupational examination performance. This study aims to develop a self-report scale to overcome prior methodological defects and evaluate barriers of performing periodic examinations. *Methods.* The study was conducted with 200 participants, including employers, occupational health inspectors, occupational physicians and occupational health experts working in the industrial sector, aged 25–70 years. The subjects supplied sociodemographic information and completed the experimental version of the instrument. *Results.* Exploratory factor analysis (EFA) provided evidence for a five-factor model, including knowledge, quality, law, capability and service, with 62.68% variance. Confirmatory factor analysis (CFA) proved stability rates of both models (root mean square error of approximation [rmsea] = 0.062, comparative fit index [CFI] = 0.92, Tucker–Lewis index [TLI] = 0.906, incremental fit index [IFI] = 0.921, normed fit index [NFI] = 0.835, relative fit index [RFI] = 0.808). The scale also revealed appropriate levels of reliability ($\alpha = 0.916$ and composite reliability [CR] >0.7) and validity (average variance extracted >0.5). *Conclusion.* The psychometric characteristics of the scale demonstrated acceptable validity and reliability. This study developed this valid instrument to be used by health decision-makers for assessing barriers of performing periodic examinations.

- **Keywords:** barriers, occupational periodic examinations, psychometric, scale, validity, reliability