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Patricia Tàpia-Caballero, María-José Serrano-Fernández, Maria Boada-Cuerva, Beatriz Sora & Joan Boada-Grau. *Influence that job characteristics, personality and burnout have on fatigue in professional drivers.* Pages: 1331-1341.

Objectives. Professional drivers drive for many hours without rest. This factor, in addition to the characteristics of the job, the vehicle, the environment and the driver, causes driver fatigue. Fatigue is one of the most common risk factors when driving because it causes drowsiness, decreases drivers' attention and may make them fall asleep at the wheel. In this article we propose a predictive model for professional drivers using the following variables: age, number of children, time spent at work, time spent inside the vehicle, personality, job characteristics (JDS), job content (JCQ) and burnout. **Method.** Participants were 509 professional drivers from various transport sectors recruited by non-probabilistic sampling. SPSS version 25.0 was used for statistical analysis. **Results.** The predictive capacity of variables that cause driver fatigue was determined. Exhaustion best predicts fatigue positively, while openness to experience best predicts it negatively. Burnout and certain personality characteristics are good predictors, whereas other variables, such as JCQ and JDS, are weak predictors. **Conclusions.** This study extends our knowledge of the factors that cause fatigue in professional drivers and underlines the importance of designing interventions aimed at reducing the incidence of fatigue, promoting greater driver well-being and lowering the incidence of accidents.

- **Keywords:** professional drivers, fatigue, burnout, personality, occupational health, labor risks

Fakhradin Ghasemi, Arash Ghasemi & Omid Kalatpour. *Prediction of human error probability during the hydrocarbon road tanker loading operation using a hybrid technique of fuzzy sets, Bayesian network and CREAM.* Pages: 1342-1352.

Objectives. The hydrocarbon road tanker loading operation is vulnerable to human error. The present study aimed to develop a methodology for predicting human error probabilities (HEPs) in various subtasks of this operation. **Methods.** First, task analysis was performed using hierarchal task analysis. Then, HEP was calculated using a hybrid technique of fuzzy set theory (FST), Bayesian network (BN) and cognitive reliability and

error analysis method (CREAM). FST was used for handling uncertainties regarding common performance conditions (CPCs) and the BN was employed for modeling the interrelationships among CPCs and HEPs. The weighted sum algorithm was used for quantifying conditional probability tables in the network. *Results.* Twenty-six subtasks were required for completing the road tanker loading operation. Investigating the internal parts of the tanker before the loading operation and attaching the ground rode clamp were the subtasks with highest HEPs. Working conditions and crew collaboration were the CPCs with the highest contribution to these errors. HEP was most sensitive to crew collaboration. *Conclusion.* Improving collaboration among the driver, site operators and control room operators, as well as increasing the knowledge of the road tanker driver regarding the hazards of incompatible chemicals, are the best practices for reducing HEPs in this operation.

- **Keywords:** human factors, error, performance, accident prevention

Marzieh Sadeghian, Saeid Yazdanirad, Seyed Mahdi Mousavi, Mohammad Javad Jafari, Ali Khavanin, Soheila Khodakarim & Amir Salar Jafarpishe. *Effect of tonal noise and task difficulty on electroencephalography and cognitive performance.* Pages: 1353-1361.

Objectives. The present study aimed to investigate the effect of tonal noise and task difficulty on electroencephalography (EEG) and cognitive performance. *Methods.* Twelve healthy volunteers participated in the present study. Four noise signals were generated by four prominence tone levels (0, 2, 5 and 9) at background noise levels of 55 dBA and frequency of 500 Hz using the Test Tone Generator from Esser Audio (USA). The participants were asked to perform the tasks with low, moderate and high levels of difficulty while exposed to the noises in an acoustics laboratory. The values of reaction time, correct rate and missed numbers were recorded during each step. Moreover, the EEG signals were measured. *Results.* The results showed that higher tone level and more task difficulty significantly decreased the correct rate, and increased the miss numbers. However, no significant effect was observed on reaction times. Furthermore, tone level and task difficulty significantly increased activity of the θ and β bands and decreased activity of the α band. *Conclusion.* Task difficulty and tone level could significantly affect the parameters of performance and the activity of EEG bands. Therefore, noise control can help sustain appropriate performance.

- **Keywords:** tonal noise, task difficulty, annoyance, electroencephalography, cognitive performance

Hamad Rashid & Salaheddine Bendak. *Development of a multicriteria decision-making model for selecting optimal aviation fatigue measurement methods.* Pages: 1362-1371.

Human fatigue has been proved to directly cause or contribute to a significant share of aviation accidents. Although fatigue measurement is a major input to any solution that targets reduction of fatigue adverse influences on aviation operations, there is a critical lack of evidence on what optimum sets of fatigue measurement strategies could be applied given the vast organizational and operational differences between various industry players. The current study utilizes the published aviation safety literature, the technology acceptance model and expert opinion to propose a new multicriteria decision model, the aviation fatigue measurement selection model, to decide on what fatigue measurement methods are most suitable for each aviation operator. The model addresses the validity, user acceptance, cost and other limitations of each currently acknowledged fatigue measurement method. The model was then applied through comprehensive scenario-based simulations and was found to be sensitive to changes in user preferences and valid.

- **Keywords:** aviation fatigue, multicriteria decision-making, expert opinion, fatigue measurement

Hernâni Veloso Neto, Pedro Arezes & Béda Barkokébas Junior. *Adaptation and psychometric validation of a questionnaire about organizational safety culture and climate for the Brazilian reality.* Pages: 1372-1386.

Surveys are the most widely used instruments to assess safety opinions, attitudes and behaviours of workers, as a reflection of a dimensional manifestation of an organization's safety culture. The fact that there are few instruments of this nature adapted to the Brazilian reality motivated the attempt to validate tools used in Portugal in this field. The questionnaire to workers about occupational safety culture and climate (QTCCS) will be explored in this article. The main objective is to present the data from the cultural adaptation and psychometric validation process of this instrument, and it can be confirmed that this intention was properly achieved. Through a study carried out with a sample of 200 workers from a company in the northeast of Brazil, it was statistically confirmed that it is possible to maintain the factorial structure of the original instrument when applied to Brazilian workers of different characteristics.

- **Keywords:** organizational safety culture, QTCCS, cultural adaptation, psychometric validation, Brazil

Azam Maleki-Ghahfarokhi, Mahmood-Reza Azghani & Iman Dianat. *Effects of handle characteristics of manual hand tools on maximal torque exertions: a literature review.* Pages: 1387-1402.

The present study was conducted to review the literature on the effects of handle characteristics of manual hand tools including handle diameter, shape and material on forearm supination/pronation, wrist flexion/extension and wrist ulnar/radial deviation torque strengths to assist ergonomists and designers in developing guidelines to improve workstations and hand tool designs. Twenty-seven papers meeting the inclusion criteria were reviewed. The study provides different points that can be applied to improve the design of hand tools with an emphasis on handle diameter, shape and material, and highlights various methodological issues including interactions among variables affecting maximum torque strength, posture, torque exertion using one or two hands, torque exertions in multiple anatomical axes, using gloves, upper extremity anthropometry and test protocols, which should be considered in future research.

- **Keywords:** handle diameter, handle material, handle shape, hand tool

Abdulqadir Mohamad Suleiman. *Determining the prerequisites for effective workplace inspection by the occupational safety and health regulatory authority using cognitive work analysis.* Pages: 1403-1418.

Objectives. Earlier attempts to understand inspection work and improve inspection effectiveness are based on how controls are conducted and the interactions between the inspectors and inspection subjects. This study aimed to determine workplace occupational safety and health inspection effectiveness prerequisites using cognitive work analysis, an approach for design and evaluation of work domains, focusing on activities and work constraints. *Methods.* Data were collected through semi-structured interviews and a survey with labour inspection authority inspectors, and by reviewing inspection reports and earlier studies on workplace inspections. These were used in the first three cognitive work analysis phases to identify the prerequisites of effective workplace inspection and designing inspection strategies. *Results.* An abstraction hierarchy showing the affordances was prepared, with purpose-related functions identified as the inspection

effectiveness prerequisites. A contextual activities template and a decision ladder for inspection work were prepared. Strategy maps for on-site control were created, allowing design of structured and organized workplace inspection strategies supporting the work domain's purposes. *Conclusion.* The analysis dimensions served the study sufficiently, providing the purpose-related functions with their respective subgoals and subsidiary functions that provided the prerequisite for effective workplace inspections and allowed for designing structured and organized strategies for on-site workplace inspection.

- **Keywords:** cognitive work analysis, workplace inspection, work domain, occupational health, effectiveness, control strategy, on-site control

Magdy A. Sabaa, Azza M. Hassan, Amany Kamal Abd-Alla, Eman E. Hegazy & Wesam Hatem Amer. *Needle-stick and sharps injuries: awareness, prevalence and risk factors of a global problem in healthcare workers at Tanta University Hospitals, Egypt. Pages: 1419-1429.*

Objectives. This study aimed to assess the level of awareness, prevalence and risk factors of needle-stick and sharps injuries (NSSIs) in Tanta University Hospitals, Egypt to develop a well-established preventive strategy. *Methods.* A total of 662 healthcare workers (HCWs), including nurses and physicians, who attended work during the last 6 months of 2019 were included. Data were collected on a structured questionnaire distributed during their working time. *Results.* Of 662 participating HCWs, 486 were nurses and 176 were physicians. Good awareness (86.1 and 83.1%) of the participants about safe injection policy and sharp disposal after use was observed. Nurses showed a significantly higher percentage of poor awareness score (79.1%) than physicians (20.9%). NSSIs in our hospitals reached 60.4%. Nurses (67.9%) had higher risk of NSSIs than physicians (39.8%; $p < 0.001$). NSSIs were significantly less likely to occur for HCWs who were aware of safe injection and sharp disposal policies. NSSIs were frequent with specimen collection (16.4%), injections (15.5%) and sharp disposal (14.6%). Only 110 (27.5%) have reported their injuries. *Conclusion.* A comprehensive program that addresses institutional, behavioral and device-related factors that contribute to the occurrence of NSSIs and reporting systems is needed.

- **Keywords:** epidemiology, needle-stick and sharps injuries, healthcare workers

Ren Xiangfang, Shen Lei, Zhang Xiyang, Chen Han, Huang Yan & Jin Peng. *Design and research of life-saving cotton-blended miners' clothing. Pages: 1430-1438.*

Miners face a series of potential safety hazards in underground work, among which the life-saving function of miners' clothing is particularly important. This article investigates the causes of current mine accidents and the impact of the mine environment, analyses the design and research status of miners' uniforms from the perspective of the market and academia, and emphasizes and puts forward the idea of optimizing the design of miners' uniforms through the characteristics of miners' underground operation and the requirements for their protective performance. Based on the 2F (fashion, function) design model, the basic principles of miners' clothing design are summarized. The design of miners' clothing is studied from three design factors: positioning element, structural design and protective fabric. The purpose is to improve miners' clothing for comfort, positioning, life-saving, hygienic, antimicrobial, etc., shorten search and rescue times, and improve rescue times in mining accidents, to increase the survival rate.

- **Keywords:** miner uniform, location, multifunction, life-saving, cotton-blended

Emily J. Haas & Patrick L. Yorio. *Behavioral safety compliance in an interdependent mining environment: supervisor communication, procedural justice and the mediating role of coworker communication.* Pages: 1439-1451.

Objectives. Although a focus on safety communication between managers and employees has been prevalent, research around coworker influence in this communication has been fragmented in the literature. *Methods.* To examine these issues, researchers gathered survey data from 1955 mine employees from surface stone, sand and gravel (SSG) and industrial mineral operations across the USA between 2016 and 2018, and studied the effects of relationships between justice perceptions, supervisor communication and coworker communication on behavioral safety compliance. *Results.* Using structural equation modeling, coworker communication partially mediated the direct effects of supervisor communication and justice perceptions on behavioral safety compliance – where the indirect effects were greater for justice perceptions. *Conclusion.* The results demonstrate the value in formal and informal communication paths to facilitate employee safety compliance; and that enhanced perceptions of job fairness and adaptability enhances coworker communication, further improving compliance in an interdependent environment.

- **Keywords:** interdependent work environment, procedural justice, safety communication, structural equation modeling, supervisor-coworker relationships

Sugat B. Bajracharya, Arabinda Mishra, Abid Hussain, Kamala Gurung, Luja Mathema & Bidya Banmali Pradhan. *Do working and living conditions influence brick-kiln productivity? Evidence from Nepal.* Pages: 1452-1460.

The brick-kiln (BK) sector in Nepal is largely an informal sector. This study investigated the influence of working and living conditions (WLCs) in BKs on productivity at two levels – BK level and workers' level – using primary data collected from 781 workers and 80 BK entrepreneurs in 12 districts of Nepal. WLCs were assessed based on the provision of nine amenities to workers at BKs. Correlation and regression analyses revealed that WLCs have a positive influence on both BK level as well as workers' level productivity. Moreover, large BKs with better investment in zig-zag technology and mechanization are more likely to spend on improving WLCs than small BKs, who are reluctant to invest in WLCs due mainly to a lack of financial resources. The study suggests an integrated approach emphasizing equally improved WLCs and cleaner technology in the BK sector to transform it into a healthier and socio-environmentally responsible industry.

- **Keywords:** working and living conditions, informal sector, brick-kiln workers, productivity, Nepal

Rashid Heidari moghaddam, Mehrdad Anbarian, Saeed Ilbeigi, Leili Tapak & Mohammad Hamed Hosseini. *Team manual handling: a systematic review for identifying research gaps.* Pages: 1461-1472.

Objectives. Team manual handling, a process still common in many jobs, can affect the safety and health of employees. A systematic review of the literature was conducted to identify the research gaps in this area for future studies. *Methods.* The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology was followed. Related papers were searched on PubMed, Web of Science, ProQuest and Scopus electronic databases until September 2020. *Results.* A total of 300 papers were identified, of which 28 were selected for final review based on the respective criteria. The findings of these studies were classified and evaluated based on biomechanical, physiological and psychophysical approaches. No study was found for the epidemiological

approach. Only three papers mentioned the body physiological responses in team manual handling. The focus of the related studies found in this field was team lifting. No study was found on team pulling and pushing. Most studies were performed in a laboratory setting using young students who had no experience of team manual handling. *Conclusion.* The results of this study emphasize the need for further research, especially using the epidemiological and physiological approaches in different tasks of team manual handling in real work environments using experienced workers.

- **Keywords:** team manual handling, psychophysical, biomechanical, physiological

Mahnaz Saremi, Sajjad Rostamzadeh & Mahmoud Nasr Esfahani. *Hand functionality in dentists: the effect of anthropometric dimensions and specialty.* Pages: 1473-1481.

Objectives. This study aimed to investigate the relationship between dentists' hand functionality (handgrip, tip-to-tip pinch, key pinch and palmar pinch strengths) and dental specialty (maxillofacial surgery, endodontics, pediatric dentistry), socio-demographic factors and hand-forearm anthropometric dimensions. *Methods.* A cross-sectional study was designed in which 720 certified dentists (330 males and 390 females) voluntarily participated in the study. A tape measure (± 0.1 cm) and a digital caliper (± 0.1 mm) were used to measure anthropometric dimensions. A Jamar dynamometer and pinch gauge were used to measure hand strength variables. *Results.* Hand strengths decreased with age and clinical experience, and were always greater in male than female dentists. Maxillofacial surgeons aged 35–39 years attained the highest values of handgrip and key pinch strengths, while endodontists aged 30–34 years attained the peak values of tip-to-tip pinch strength. Among the measured hand dimensions, forearm circumference was significantly greater in maxillofacial surgeons compared with endodontists and pediatric dentists. *Conclusion.* Hand functionality is specialty-related among dentists because distinct dental specialties expose practitioners to different task demands. Like any other manual workers, dentists need more ergonomic and usable hand tools tailored not only to the intended application but also to the anthropometry of users.

- **Keywords:** hand strength, pinch strength, upper extremity, dentistry, anthropometry

Leila Omid, Saeid Mousavi, Gholamreza Moradi & Fereshteh Taheri. *Traffic climate, driver behaviour and dangerous driving among taxi drivers.* Pages: 1482-1489.

Traffic accidents are considered a major public health problem in many countries. The aim of this study was to explore the relationships between traffic climate factors (i.e., external affective demands, functionality and internal requirements), driver behaviours, dangerous driving behaviours and traffic accident involvement among taxi drivers. A total of 450 male taxi drivers participated in the study. The traffic climate scale (TCS), the driver behaviour questionnaire (DBQ), the positive driver behaviours scale (PDBS) and the Dula dangerous driving index (DDDI) were used to measure driving behaviours and traffic conditions. The results showed that there was a significant negative correlation between functionality (of the TCS) and the number of accident involvement. Further analysis demonstrated that the effect of risky driving (of the DDDI) on accident involvement was significant. Taken together, these findings suggest that functional traffic systems and driving environments play important roles in traffic accident involvement.

- **Keywords:** traffic climate scale, driver behaviours, dangerous driving behaviours, accident involvement

María Martínez-Rojas, José Manuel Soto-Hidalgo, María Dolores Martínez-Aires & Juan Carlos Rubio-Romero. *An analysis of occupational accidents involving national and international construction workers in Spain using the association rule technique.* Pages: 1490-1501.

Worker safety awareness on construction sites is a major concern due to the hazardous work conditions. Additionally, globalization is increasing the cultural diversity of the workforce and this influences workers' attitudes, beliefs and behaviour. The growing number of migrant workers in this sector has become a distinctive feature of the industry's labour market. The objective of this article is to analyse occupational accidents that occurred on Spanish construction sites while taking into consideration the nationality of the workers. Due to the large number of accidents and attributes associated with them, the use of association rules is proposed. Overall, results evince similar behaviour, although interesting differences can be observed regarding the occupation of workers. In addition, the results are in accordance with previous studies carried out in other countries. The analysis of these accidents will serve to establish initiatives that provide safer work environments.

- **Keywords:** health and safety, construction, association rules, accidents

M^a Jesús López-González, Eva González-Menéndez, Silvia González & Fermín Torrano. *Study of the interrelationships between musculoskeletal disorders and psychosocial risk factors in occupational health and safety technicians.* Pages: 1502-1510.

Objectives. The aim of this work is to examine the presence of musculoskeletal disorders (MSDs) and the exposure to psychosocial risk in a sample of 399 occupational health and safety technicians (OHSTs), deepening the associations between both aspects. *Methods.* The standardized Nordic questionnaire and the Decore questionnaire were used. Different descriptive and correlational analyses and a multivariate analysis model were carried out. *Results.* In total, 77.17% of the participants affirmed having suffered some muscle ailments. The most critical psychosocial risk factors are those related to the rewards that the worker obtains for their work, with 54.7% of the technicians in a situation of alert or emergency. It is highlighted that the fact of not feeling professionally valued, working outside working hours, having musculoskeletal discomfort and perceiving a state of poor or fair health increase the global risk index (GRI) score. *Conclusions.* The study highlights the high exposure of OHSTs to both physical and psychosocial risk factors as well as the significant relationship between these variables. Furthermore, the predictive model shows the variables that best predict the probability of MSDs: gender, training in emerging risks, perceived health and exposure to psychosocial risk.

- **Keywords:** stress, musculoskeletal disorders, psychosocial risk factors, occupational health and safety technicians, new ways of work

Çetin Yelgin & Nalan Ergün. *The effects of job demands and job resources on the safety behavior of cabin crew members: a qualitative study.* Pages: 1511-1521.

Job demands are viewed as the physical, psychological and social effects of the physical and mental efforts required by the job on the employee, while job resources refer to the gains and opportunities that reduce these effects, support employee development and help him/her achieve successful results. The aim of this study is to explain the effects of job demands and job resources perceived by cabin crew members on their safety behavior. To this end, using the qualitative research method, the data were obtained through semi-structured interviews with 14 cabin crew members in a medium-sized

airline business in Turkey. The findings were presented under four themes: 'working conditions', 'factors related to cabin crew members', 'passenger behaviors' and 'pursuer attitudes'. In conclusion, various recommendations are made for airline management by comparing the findings with those reported in the related literature.

- **Keywords:** airline companies, cabin crew, job demands, job resources, safety behavior

Zeynep F. Olcay, Ahmet E. Sakalli, Sertaç Temur & Ahmet Yazici. A study of the shift in fatal construction work-related accidents during 2012–2019 in Turkey. Pages: 1522-1532.

Objectives. The construction sector is one of the sectors with the highest number of occupational accidents and diseases in the world in terms of working conditions. According to the 'Communiqué on Occupational Hazard Classes on Occupational Health and Safety' related to Occupational Health and Safety Law No. 6331, the construction sector is considered a 'very dangerous works' class. *Methods.* Occupational accidents that occurred between 2012 and 2019 are examined according to occupational groups, working environments, etc. Feature importance and Kendall, Pearson and Spearman correlations were used for analysis. *Results.* From the studies, it is determined that fatal accidents in the construction sector in Turkey are caused by falling from height with a high rate. When the correlation values were examined, it was determined that the column 'accident type' had a negative relationship with the 'injured part of the body' and a positive relationship with the 'accident environment' column. *Conclusion.* A total 51% of 3517 fatal accidents examined occurred in the construction of buildings. Most deaths in the construction sector in Turkey are caused by falling from height, like many countries (41.6%). Statistics shows that despite the relevant regulations, the construction sector in Turkey is seen as a weak safety culture.

- **Keywords:** construction accidents, construction works, fatal work accidents, data mining, accident analysis

Yun Su, Miao Tian, Xianghui Zhang, Jun Li & Xiaoyu Han. Quantitative analysis of moisture distribution and transfer in firefighter protective clothing exposed to low-intensity radiation with/without hot steam. Pages: 1533-1542.

Objectives. This study aimed to examine moisture distribution and transfer in firefighter protective clothing when moisture from the atmosphere and skin sweat were considered simultaneously. *Methods.* A self-developed test apparatus was used to simulate moisture transfer through the protective clothing under exposure to thermal radiation. The weights of each layer of fabric before and after heat exposure were measured to analyze the moisture distribution and transfer. *Results.* The moisture level in each layer of fabric before the exposure presented an increase over the initial moisture content. After dry heat exposure, the moisture content in each layer of fabric reduced gradually. However, the existence of hot steam increased the moisture content stored in the fabric system and accelerated the moisture transmitting to the skin surface. In addition, the amount of outward water evaporation for dry heat exposure was moderately more than inward water evaporation, while the amount of inward water evaporation was greatly more than outward water evaporation for wet heat exposure. *Conclusion.* Moisture transfer in the firefighter protective clothing was a two-way transmission during both heat exposures. Understanding moisture transfer helps to provide proper guidance to improve the thermal protection of clothing and reduce steam burns.

- **Keywords:** moisture distribution, skin sweat, hot steam, firefighter protective clothing, flow direction

Jessica Stanhope, Dino Pisaniello & Philip Weinstein. *What do musicians think caused their musculoskeletal symptoms?* Pages: 1543-1551.

Objectives. The purpose of this study was to determine the factors that university music students and professional musicians believe caused their musculoskeletal symptoms (MSSs). *Methods.* Data were collected using a questionnaire distributed to university music students and professional musicians. Using a musician-driven data collection approach, musicians with MSSs were asked to nominate their top three perceived causes of their symptoms. Responses were categorized, and percentages reported for the main categories. *Results.* Of the 213 musicians, 37.6% reported biological factors, 21.1% reported external, physical factors, 93.9% reported behavioural factors, 18.8% reported psychosocial factors and 9.9% reported 'other' factors (e.g. accidents) as the perceived causes of their MSSs. *Conclusion.* This study is the first to investigate perceived causes of musicians' MSSs across a diverse range of musicians, using musician-driven methods. By using open response data collection strategies, a comprehensive, unbiased list of perceived causes of MSSs was compiled. Perceived causes not identified in previous research included manual handling, physical activity and sleep problems. Future research should consider the association between perceived causes and MSSs, and barriers and enablers of behaviour changes that may prevent MSSs. This research may guide the development of new strategies to reduce the burden of MSSs in musicians.

- **Keywords:** musculoskeletal, pain, occupational health, musicians, prevention, perceptions

Abdolhamid Tajvar, Hadi Daneshmandi, Elahe Dortaj, Mozghan Seif, Hossein Parsaei, Mahnaz Shakerian & Alireza Choobineh. *Common errors in selecting and implementing pen-paper observational methods by Iranian practitioners for assessing work-related musculoskeletal disorders risk: a systematic review.* Pages: 1552-1558.

Objectives. This study aimed to determine the types and frequency of pen-paper observational methods (OMs) used by Iranian practitioners and to identify their errors in selecting and implementing these methods. *Methods.* This was a systematic review and analytical study of papers in which the OMs had been used. Scientific databases were analyzed from September 1970 to September 2018. Errors were determined based on a list of wrong practices both in the selection and implementation of methods. Three ergonomists carried out the process of identifying errors independently. *Results.* The most frequently used methods were rapid upper limb assessment (RULA), quick exposure check (QEC) and rapid entire body assessment (REBA), respectively. Errors in selecting and implementing pen-paper OMs were 53.3 and 36.4%, respectively. *Conclusions.* Despite the abundant number of pen-paper OMs, Iranian practitioners use few of them. The high rate of errors can indicate a lack of knowledge and skills among practitioners for selecting and implementing OMs. The development of decision-making tools may help practitioners to select appropriate pen-paper OMs for assessing different types of tasks.

- **Keywords:** error, Iran, musculoskeletal disorders, observational methods, risk assessment

Farideh Hatami & Rayhane Kakavand. *The effect of educational intervention on promoting safe behaviors in textile workers.* Pages: 1559-1565.

Behavioral modification is an inseparable part of a comprehensive accident prevention strategy in a workplace. This study reports a behavior modification approach applied to evaluate the effectiveness of an occupational safety training educational intervention on industrial textile workers in Borujerd, Iran. This research is a quasi-experimental

Solomon four-group design participatory study conducted as a pre-test and post-test intervention. Totally, 85 workers participated in the study. The study was developed through a participatory approach, exclusively for the present research. In fact, we applied a combination concept of the PRECEDE-PROCEED model and the theory of planned behavior in planning and implementing the educational interventions. The results revealed significant improvements among all four groups within 1 and 3 months post intervention. The percentage of unsafe practices declined dramatically when the program was implemented. In conclusion, the appropriately developed educational intervention program led to improved safety practices among workers in the present study.

- **Keywords:** educational intervention package, PRECEDE-PROCEED model, theory of planned behavior

Patrice Marchal & James Baudoin. *Proposal for a method for analysing smart personal protective systems*. Pages: 1566-1576.

The emergence of 'smart' or 'intelligent' personal protective systems (SPPS) raises new questions with regard to occupational risk prevention. While manufacturers and standardization bodies are wondering about the safety requirements applicable when designing or assessing such equipment, the user companies wonder about the performance and the limits of such equipment and the risks associated with its use. This article first gives a definition for SPPS in order to clarify the exchanges between the stakeholders. It then proposes a four-stage approach to deal with the concepts of systems and intelligence applied to personal protective equipment. For the 'smart' parts, it is proposed, by analogy with the field of 'machinery', to define a safety level for the 'smart' parts which participate in the individual protection functions. In order to show its applicability, this approach is then applied to four examples of SPPS.

- **Keywords:** smart, personal protective equipment, system, definition, analysis approach

Patricia Tàpia-Caballero, María-José Serrano-Fernández, Joan Boada-Grau, Maria Boada-Cuerva, Luis Araya-Castillo & Andreu Vigil-Colet. *DF-8: a specific scale for assessing work fatigue in professional drivers*. Pages: 1577-1583.

The study objective is to create a scale specifically for measuring driver fatigue and to analyze the scale's psychometric properties. The participants were 518 Spanish drivers. We carried out an exploratory factor analysis (EFA) and the first subsample obtained a single-item solution (eight items). We then performed a confirmatory factor analysis (CFA) with a second subsample. The results were root mean square error of approximation (rmsea) = 0.05, comparative fit index (CFI) = 0.94 and Tucker-Lewis index (TLI) = 0.92, which corroborates the previous results and maintains the same number of elements. The resulting dimension shows good reliability. The scale scores were then related to several external correlates and other scales, and showed good convergence and criteria validity. The results indicate that the scale for assessing work fatigue specifically in professional drivers – driver fatigue (DF-8) – is a reliable and valid instrument.

- **Keywords:** fatigue, transportation, traffic safety, professional drivers, scale

Hu Shi & Siti Rohaida Mohamed Zainal. *Facilitating mindful safety practices among first-line workers in the Chinese petroleum industry through safety management practices and safety motivation. Pages: 1584-1591.*

The petroleum industry is a high-risk industry and operates under the social technical system. Therefore, the safety behavior of employees needs to be paid high attention. Thus, six dimensions of safety management practices are identified as independent variables to predict a special component of common safety behavior-mindful safety practices in the Chinese petroleum industry. High-reliability organization theory is adopted as the underpinning theory. A total 255 first-line workers from a Chinese petroleum company participated in this survey. The results reveal that safety training and safety communication and feedback are positively related to safety motivation. Moreover, workers' involvement and safety promotion policy have direct and positive impacts on mindful safety practices. Further, safety motivation is found to play a mediating role in the prediction of mindful safety practices in the Chinese petroleum industry. These findings give new insights for petroleum companies into how to promote mindful safety practices in the workplace.

- **Keywords:** safety management practices, safety motivation, high-reliability organization theory, mindful safety practices

Thomas Muth, Ingo Hansen, Clark Pepper & Jochen D Schipke. *Firefighters during training as divers: physiologic and psychomental stresses. Pages: 1592-1599.*

Objectives. Fire departments train divers for search, rescue and recovery in and under water. Their tasks likely exert major physical and psychological stress. This study hypothesizes that training is well balanced, following a learning spiral. *Methods.* Seven firefighters participated, performing 272 dives in different waters. Measurements included pulmonary function (body plethysmography); heart rate (HR) and air consumption during dives; personality variables with the state-trait anxiety inventory (STAI) and psychological stress with the task load index (NASA-TLX). *Results.* Pulmonary function was maintained at the end of training dives. During the dives, mean HR was 108 ± 23 bpm and mean air consumption 37 ± 15 L/min. Both values remained unchanged during training. The three highest STAI stanines (severe trait anxiety) were not considered, but median stanines and very low values were over-represented. Demands within the seven NASA-TLX areas were perceived differently. Sum of the scales 'very low', 'low' and 'mean' was $\geq 60\%$. In turn, the scale 'very high' was in none of the demands $>10\%$. *Conclusion.* Physiological values remained unaltered throughout training, i.e. workload and increase in competence properly matched. The moderate manifestation of psychomental stress speaks for a group of highly selected individuals. Both candidate selection and design of the learning spiral was successful.

- **Keywords:** learning spiral, scuba diving, professional diver, physical stress, psychomental stress

Ya. A. Korneeva & N. N. Simonova. *Psychological adaptation of shift staff for different activities in the Far North. Pages: 1600-1610.*

The objective of this study is a comparative analysis of the psychological adaptability of shift staff in oil and gas and diamond production in the Far North. In total, 227 shift workers took part in the study. Using the methods of psychophysiological and psychological testing, we studied the following parameters of the psychological adaptation of shift personnel: regulatory processes, subjective control, socio-psychological adaptation and personality characteristics. As a result of the study, some

differences were found in the parameters of the psychological adaptation of shift workers of various industries. In conclusion, the parameters of socio-psychological adaptation as a criterion of psychological adaptation for the workers of the southern shift are much higher than for the shift workers in the Far North. The shift workers with a favorable functional status have a higher dominance rate. The workers in the Far North also have a higher level of self-regulation.

- **Keywords:** shift fly-in-fly-out work method, psychological adaptability, regulatory processes, self-regulation, locus of control, socio-psychological adaptation, functional status

Monika Storman, Dawid Storman & Justyna Maciąg. *Quality of work-life among young medical doctors in Poland.* Pages: 1611-1617.

Objectives. Human resource management is the most important function in the management of organizations and significantly affects the quality of work-life (QWL). Recently, the health sector started to be interested in the QWL among doctors. The study aim was to assess the QWL among Polish medical residents. *Methods.* The questionnaire for the medical residents was prepared using data acquired from a review of the international literature. In October 2017, the questionnaires were completed twice by 10 residents with a 2-week interval to assess the inter-rater reliability. The online questionnaire was distributed between April and May 2018. *Results.* A total of 243 doctors responded, over one-third of whom were men. The QWL was very high for 2.06% of the participants, high for 23.87%, moderate for 27.16%, low for 38.27% and very low for 8.64%. Among the factors that significantly relate to the QWL are the number of working hours per week ($p=0.007$) and the general quality of life ($p=0.000$). *Conclusion.* Low QWL is the result of inadequate management in Polish hospitals and residents' QWL still needs to be improved. We propose to conduct such a survey periodically among all young medical doctors to systematically improve their QWL.

- **Keywords:** medical residents, quality of work-life, young doctors, quality of life

İshak Altinpinar & Ersan Başar. *Investigation of the effect of vessel type on seafarers' safety culture.* Pages: 1618-1623.

Maritime transportation is indispensable for world trade. Marine casualties have serious consequences. The majority of the accidents in the maritime industry are caused by human error. If necessary precautions are taken, human error can be prevented to a great extent. Safety culture is of tremendous importance in taking precautions and preventing accidents. The concept of safety culture emerged after the Chernobyl accident. Today, the importance of safety culture in preventing accidents is accepted by all international organizations. There are many elements affecting safety culture. In this study, the situation of the safety culture of 221 deck officers against many variables was examined. According to the analysis of variance test, it has been observed that the vessel type has a significant effect on safety culture even among the officers who graduated from the same college.

- **Keywords:** safety culture, occupational safety, seafarer, working conditions

Sohrab Amiri. *Prevalence of depression disorder in industrial workers: a meta-analysis.* Pages: 1624-1635.

Objectives. Depression is known to be associated with a variety of occupational factors. The aim of this study was to meta-analyze the prevalence of depressive disorder in industrial workers. *Methods.* Three databases indexing abstracts of articles were selected and searched until August 2020: PubMed, Web of Science and Scopus. For each study,

the sample size and number of depression events were extracted, and after extracting these data, the random effects method was used to assess the prevalence. I^2 and χ^2 values were used to investigate the heterogeneity. *Results.* The prevalence of depressive disorder in industrial workers is 21%. The prevalence of depressive disorder in men and women industrial workers is 23 and 28%, respectively. The prevalence of depressive disorder in Asia, Europe and America is equal to 22, 18 and 20%, respectively. The result of the heterogeneity test showed that the heterogeneity is high. *Conclusion.* The prevalence of depression in industrial workers is higher than in the general population. These differences can be due to the working conditions of industrial workers. Therefore, the work environment and the promotion of occupational health can play an important role in preventing depression.

- **Keywords:** depression disorder, meta-analysis, industrial workers, systematic review

Sara Karimi Zeverdegani, Maryam Yazdi & Amir Hossein MollaAghaBabae. *Latent class-derived patterns of musculoskeletal disorders in sedentary workers and chair ergonomic design.* Pages: 1636-1641.

Objectives. This study aimed to define specific patterns of multisite musculoskeletal disorders (MSDs) in office employees and to examine how derived patterns relate to ergonomic chair design. *Methods.* This cross-sectional study of 254 office employees extracted major patterns of MSDs using latent class analysis and investigated the association with ergonomic chair design. *Results.* Four major patterns of MSDs were extracted using latent class analysis: class 1 (12.1%), individuals with high probabilities of MSDs in the neck, shoulders, back and wrists; class 2 (35.6%), individuals with near-zero probabilities of MSDs across all sites; class 3 (14.1%), those with high probabilities of complaints in the back, hips and knees; class 4 (38.2%), those with high probabilities of MSDs across all sites. Considering class 2 as the reference, there was an inverse significant association between seat comfort and membership in class 3 (odds ratio [OR] 0.94, 95% confidence interval [CI] [0.89, 0.99]) and class 4 OR 0.94, 95% CI [0.91, 0.98], and a significant inverse relationship between body support and membership in class 4 OR 0.95, 95% CI [0.92, 0.99]. *Conclusion.* MSDs can be summarized with latent class-derived patterns among office workers. Ergonomic chair design was significantly associated with type of MSD patterns.

- **Keywords:** chair, ergonomic, latent class analysis, musculoskeletal disorders, office workers

Chizaram D. Nwankwo, Andrew O. Arewa, Stephen C. Theophilus & Victor N. Esenowo. *Analysis of accidents caused by human factors in the oil and gas industry using the HFACS-OGI framework.* Pages: 1642-1654.

Objectives. Human factors have been identified as the most common causes of catastrophic accidents in the oil and gas industry. Therefore, this study aims to analyze human causal factors of accidents in the oil and gas industry using the human factors analysis and classification system for the oil and gas industry (HFACS-OGI) framework. *Methods.* This study involved quantitative data collection for 184 accident cases in the oil and gas industry that occurred from 2013 to 2017 from the International Association of Oil and Gas Producers (IOGP) database. The causal factors of these accidents were coded using the HFACS-OGI framework. Accident data were analyzed using descriptive statistics and the χ^2 test. *Results.* Study findings reveal that 23% of all accidents were recorded in 2013. Thirty-two percent of accidents occurred in Asia, while 69% of accidents were recorded in onshore locations. Contractors were involved in 86%

of accidents, while 28% of accidents occurred during drilling, workover and well services. The contractor's work environment was the main human factor in 90% of accident cases. *Conclusion.* The HFACS-OGI framework proves to be a vital tool for robust accident analysis of human factors in the oil and gas industry.

- **Keywords:** human factors, accidents, HFACS-OGI, oil and gas industry

Ashwini Kumar Patel, Chavinor Banga & Baskaran Chandrasekaran. *Effect of an education-based workplace intervention (move in office with education) on sedentary behaviour and well-being in desk-based workers: a cluster randomized controlled trial. Pages: 1655-1663.*

This study aimed to assess the effectiveness of short-term workplace-based physical activity education on altering sitting outcomes, maximal oxygen consumption (VO₂max) and occupational well-being. Four office clusters (46 participants) of desk-based workers were randomized to either the move in office with education (MOWE) group or the control (CONT) group for 4 weeks. The outcomes were occupational sedentary time, VO₂max and workplace well-being. Data were analysed using non-parametric tests. Our study results did not show any significant change in sitting time or VO₂max. Nevertheless, workplace well-being of the MOWE group significantly improved when compared to the CONT group, especially in the domains of work satisfaction (odds ratio 11.67; p = 0.001) and employer care (odds ratio 0.167; p = 0.001). Workplace education (MOWE) improves well-being but may not alter sitting outcomes or VO₂max in office workers. Workplace education without policy change may not yield positive health outcomes.

- **Keywords:** workplace sedentary behaviour, breaking sitting, education, physical activity, maximal oxygen consumption, well-being

Mohammad Sadegh Sohrabi & Mohammad Babamiri. *Effectiveness of an ergonomics training program on musculoskeletal disorders, job stress, quality of work-life and productivity in office workers: a quasi-randomized control trial study. Pages: 1664-1671.*

Objectives. The increasing prevalence of musculoskeletal disorders (MSDs), especially in the neck and upper limbs, among office workers is an important issue related to health and job productivity. The present study aimed to evaluate the effect of an ergonomics training intervention on MSDs, quality of work-life and occupational psychosocial stresses among office workers. *Methods.* This quasi-randomized trial study was conducted in Isfahan, Iran in 2019. Outcome measures were measured in a follow-up period of 1, 3 and 6 months after the intervention. The results were analyzed using repeated-measures analysis of variance. *Results.* The interventions performed had a significant effect on neck, left shoulder, right wrist and left thigh discomfort. These interventions also had a significant effect on social support and physical job demands. Significant changes were detected in quality of work-life, chance of growth and security, social integration in organization and social relevance of work in life, although these changes decreased in quality of work-life. No significant differences were detected in the other measured outcomes. *Conclusion.* The implementation of ergonomic interventions was effective in reducing MSDs in the neck and upper limbs. It is recommended to conduct continuous training courses to control the risk of ergonomic factors affecting body discomfort.

- **Keywords:** ergonomics, office worker, training, randomized controlled trial

Kayhan Ates, H. Feza Carlak & Sukru Ozen. *Dosimetry analysis of the magnetic field of underground power cables and magnetic field mitigation using an electromagnetic shielding technique*. Pages: 1672-1682.

Non-ionizing dosimetry investigations of extremely low frequency (ELF) magnetic fields that are generated by underground power cables as well as the minimization of their health effects are significant topics handled by numerous researchers. In this study, ELF magnetic fields and current densities caused by three-phased underground transmission lines induced in the human model were examined utilizing both analytical and numerical methods. Analyses were carried out using a two-dimensional problem scenario for the comprehensive head and body model. The results of the finite element method (FEM)-based simulation studies and the analytical calculations are consistent with each other. Moreover, a magnetic field shielding method utilizing conductive material was presented in the study. The shielding technique performed with copper material was carried out to mitigate the magnetic field and possible dosimetry hazards in the ELF region. The proposed shield was a 4-mm reverse U-shaped copper material.

- **Keywords:** extremely low frequency, magnetic field, electromagnetic shielding, non-ionizing dosimetry, electromagnetic safety

Mehdi Faraji Kujerdi, Hamidreza Mokarami, Vahid Keshtkar, Mansour Ziaei, Peyman Petramfar & Alireza Choobineh. *Improving working conditions in an Iranian hospital: a participatory ergonomics approach*. Pages: 1683-1689.

Objectives. The future workshop (FW), as a participatory ergonomics approach, is used to change the actual situation of a system into a preferable one. This study was conducted at a major hospital to identify ergonomic problems and provide appropriate solutions for improving working conditions using the FW technique. *Methods.* Twenty-five mid-level managers of the hospital participated in a 2-day FW. In the critique phase, the ergonomic problems were thoroughly discussed. After brainstorming followed by structuring and grouping of ideas, 75 ergonomic problems were identified and classified into four groups. Solutions and action plans were proposed to improve working conditions. *Results.* There were nine problems in the personnel-managerial group. Eighteen action plans were proposed to fix them. Stressful occupational factors were the worst problem in this group. Five problems were characterized in the physical space group and 10 action plans were presented. Seven problems were detected in the equipment group, for which 13 action plans were presented. In the welfare group, six problems and 12 action plans were presented. *Conclusion.* The results revealed that the FW was an appropriate method to find ergonomic bottlenecks in the hospital and a good basis for devising ergonomic interventions.

- **Keywords:** participatory ergonomics, future workshop, ergonomic intervention, hospital

Leticia Bentum, Lawrence Kwabena Brobbey, Rose Odotei Adjei & Paul Osei-Tutu. *Awareness of occupational hazards, and attitudes and practices towards the use of personal protective equipment among informal woodworkers: the case of the Sokoban Wood Village in Ghana*. Pages: 1690-1698.

We investigated the awareness of occupational hazards, and attitudes and practices towards the use of personal protective equipment (PPE) among informal woodworkers of the Sokoban Wood Village in Ghana. Structured questionnaires were used to collect primary data from 355 woodworkers and analysed using descriptive statistics and logistic

regression. The results showed that the workers are aware of PPE and knew about injuries they are exposed to. Most woodworkers had a positive attitude in terms of their perception on the necessity to use PPE but had a low frequency of PPE usage. Educational level, job type, length of service and marital status are the socio-demographic characteristics that significantly influence woodworkers' compliance with health and safety regulations. We recommend that institutions charged with enforcement of occupational health and safety regulations should extend their monitoring roles to informal workers and liaise with local companies to supply PPE to informal woodworkers at subsidized costs.

- **Keywords:** occupational accidents, diseases and injuries, safety culture, safety practices, small and medium-scale enterprises

Daltro Izaias Pelozato de Oliveira, Brunna Manuelle de Souza Teixeira, Osmair Gomes de Macedo, Vagner dos Santos, Luiz Guilherme Grossi Porto & Wagner Rodrigues Martins. *Prevalence of chronic lower back pain in Brazilian military firefighters. Pages: 1699-1704.*

Objectives. Lower back pain (LBP) is a common health problem worldwide, affecting an increasing number of individuals. Military firefighters (MFFs) face high levels of physical and psychological demands and are commonly exposed to different occupational risk factors. This study aimed to estimate the prevalence of chronic lower back pain (CLBP) in Brazilian enlisted MFFs. *Methods.* This cross-sectional study was carried out at the Military Firefighters Department of the Brazilian Federal District (Corpo de Bombeiros Militar do Distrito Federal [CBMDF]). The estimated sample size was 608 MFFs. *Results.* Of the 623 participants, 575 valid and complete questionnaires were analyzed. A total of 183 participants reported CLBP, indicating a point prevalence of 31.8% (95% confidence interval [CI] [28.2, 35.4]). The prevalence of acute and subacute LBP was 9.2% (95% CI [7.1, 11.9]), and 59% (95% CI [54.9, 62.9]) reported no back pain. CLBP was more common among men aged 40–49 years, who were insufficiently active and overweight. *Conclusion.* Around one-third of the study population reported CLPB. Prevalence estimates of CLPB were greater among men and those between 40 and 49 years old. Our data support the need for programs to prevent and treat CLBP among firefighters.

- **Keywords:** chronic lower back pain, firefighters, prevalence study

Hans Pettersson, Pål Graff, Louise Fornander, Jessica Westerlund, Bodil Björ & Fredrik Sjödin. *Introducing a new design of digital tool to increase vibration risk assessments: challenges with education-based interventions. Pages: 1705-1710.*

Objectives. This study aimed to investigate whether introducing a digital risk assessment tool, the Swedish National Vibration Database, would increase the number of risk assessments on hand–arm and whole-body vibration. Employer and safety representatives from companies where vibration exposure is common were invited. *Methods.* Of the 2953 invited companies, 1916 were selected for educational intervention and the remaining 1037 companies served as a control group with no intervention. For the educational intervention, participating companies were further divided into two groups (group A, $n = 26$; group B, $n = 47$) that both received information regarding risk assessment, but group B was also informed about the digital tool. Both groups answered a questionnaire on risk assessment before the intervention and at the follow-up, 6 months later; the control group received the same questionnaire but no education (group C, $n = 22$). *Results.* Of the invited companies, only 2% chose to participate and 7% at follow-up. Seventy-eight percent of the participants had made some kind of risk assessment of vibration at follow-up. *Conclusion.* Due to the low

participation rate among invited companies, this study is not able to draw any conclusions on whether the digital tool can be used to increase the number of risk assessments.

- **Keywords:** vibration, intervention, digital tool, risk assessment, questionnaire

R. Upadhyay, V. Jaiswal, A. Bhattacharjee & A. K. Patra. *Role of whole-body vibration exposure and posture of dumper operators in musculoskeletal disorders: a case study in metalliferous mines. Pages: 1711-1721.*

Objectives. The combined role of whole-body vibration (WBV) exposure and awkward posture on musculoskeletal disorders (MSDs) experienced by dumper operators in two metalliferous mines in India was evaluated through a cross-sectional study. *Methods.* Frequency-weighted root mean square (rms) acceleration was used for WBV exposure assessment. Anthropometry and rapid upper limb assessment (RULA) were used for static and dynamic posture assessment, respectively. Prevalence of MSDs was assessed using the Nordic musculoskeletal questionnaire (NMQ). Logistic regression was used to assess the factors contributing to MSD problems. *Results.* The rms values revealed that the operators exceeded the lower limit of Standard No. ISO 2631-1:1997. The dynamic posture study revealed that the majority of dumper operators were taking awkward postures and 58–74% of them were subjected to high and medium levels of MSD risk. The adjusted odds ratio (7.96, 95% confidence interval [1.24, 41.35]) for the most awkward postures revealed WBV exposure as the significant risk factor for MSD problems among the operators. *Conclusion.* WBV exposure and posture of operators should be regularly monitored and corrective actions implemented to reduce their MSD problems. Ergonomic seat design based on the anthropometry of the operators should be assessed at the time of procuring new equipment.

- **Keywords:** posture, heavy earth moving machinery, musculoskeletal disorder, rapid upper limb assessment, whole-body vibration

Sirinant Channak, Thaniya Klinsophon & Prawit Janwantanakul. *The effects of chair intervention on lower back pain, discomfort and trunk muscle activation in office workers: a systematic review. Pages: 1722-1731.*

Objectives. The chair is a standard piece of workstation equipment in an office. Previous studies showed that a suitable chair may reduce musculoskeletal symptoms. This review investigated the effect of chair intervention on lower back pain (LBP), discomfort and trunk muscle activation among office workers. *Methods.* Five electronic databases from 1980 to May 2020 were searched for relevant randomized and non-randomized controlled trials. The methodological quality of the included studies was assessed using the 13-item Cochrane risk of bias tool. Quality of evidence was assessed and rated according to Grading of Recommendations, Assessment, Development and Evaluations (GRADE) guidelines. *Results.* Two randomized controlled trials, 10 repeated-measures studies and two prospective cohort studies were included in this review. Nine studies were rated as high quality. The results indicated very low-quality to low-quality evidence for the conflicting effect of chair intervention on pain and discomfort reduction as well as trunk muscle activation among office workers. When stratified by chair type, the level of evidence for health benefits derived from any type of chair was still of very low to low quality. *Conclusion.* Unless supplementary high-quality studies provide different evidence, chair interventions are not recommended to reduce LBP or discomfort and activate trunk muscles.

- **Keywords:** chair, musculoskeletal disorder, spinal pain, sedentary worker

Mohammad Abri, Shahram Vosoughi, Jamileh Abolghasemi, Jamshid Rahimi & Hossein Ebrahimi. *The effect of job security on safety behavior with the moderating role of salary: a structural equation model. Pages: 1732-1737.*

This study aimed to model the relationship between job security and safety behavior with the moderating role of salary on the workers of the construction project of Qom (Iran) Subway. After determining the subjects of the study, the questionnaires on safety behavior and job security were completed by subjects. Also, the salary of the subjects was determined. Structural equation modeling used smart partial least squares software. The results revealed that job security had a direct and significant correlation with safety compliance, safety participation and safety behavior ($p < 0.001$). The salary as a moderator had a positive and significant effect on the relationship between job security and safety behavior ($p < 0.05$). Generally, it can be deduced that job security had a positive impact on safe behaviors, and the salary as a moderator enhanced this impact. To improve safety behavior in the workplace, employers should increase the job security of workers.

- **Keywords:** safety behavior, job security, salary, subway

Mehran Ghalenoeei, Seyed Bagher Mortazavi, Adel Mazloumi & Amir H. Pakpour. *Exploring individual factors influencing human reliability among control room operators: a qualitative study. Pages: 1738-1749.*

Identifying the individual factors is a major issue in determining the likelihood of human error and ultimately human reliability. In current human reliability assessment methods, this is determined based on a list of performance shaping factors and experts' judgment. This was a qualitative content analysis study, in which the participants were selected using purposive sampling from combined cycle power plant control rooms. Semi-structured interviews were performed and collected data were analyzed. A total of 32 operators (20 module controllers, eight head operators and four managers) were interviewed. Five categories were extracted, namely 'mental condition', 'consciousness at work', 'professional competence', 'communication skills' and 'quick reactions and decision-making capabilities'. Accordingly, it is suggested to taken into account such factors as professional competence and speed of reactions and to pay more attention to their important factors in the reliability of operators in combined cycle power plant control rooms.

- **Keywords:** individual influencing factor, qualitative content analysis, human reliability, control room operators

Derya Çınar & Ayfer Karadakovan. *Investigation of occupational safety in oncology nurses. Pages: 1750-1755.*

Objective. This study aimed to examine the occupational safety of oncology nurses. *Methods.* This cross-sectional study was conducted to examine the risks faced by oncology nurses in the units they work in and occupational safety. The data of the study were collected between April and October 2020 using an online questionnaire prepared by the researchers in line with the literature. The sample for the study consisted of 117 oncology nurses who voluntarily participated in the study and filled out the questionnaire completely. *Results.* More than half of the participants stated that they did not find occupational safety practices sufficient and were not given additional rights or psychological support given the risks of exposure. *Conclusions.* The study concluded that to improve occupational safety in oncology nurses, the physical conditions of the working environment should be improved, and up-to-date oncology and occupational safety training should be given regularly.

- **Keywords:** nurse, onkology, occupational exposure, occupational safety

Patricia Tàpia-Caballero, María-José Serrano-Fernández, Maria Boada-Cuerva, Luis Araya-Castillo & Joan Boada-Grau. *Variables that predict burnout in professional drivers*. Pages: 1756-1765.

Objectives. Stress maintained over time leads to a state of exhaustion known as burnout syndrome. This syndrome constitutes an occupational health problem, leading to high absenteeism. It can also mean that workers come to the workplace feeling unwell, which increases occupational collisions and injuries at work. In this study, we developed a predictive model of burnout in professional drivers using the following indicators: age, hours worked, seniority, educational level, fatigue, personality, attitudes toward driving, safety behaviors in the vehicle, and work characteristics and content. *Method.* A total of 523 professional drivers from different transport sectors, obtained through non-probability sampling, participated in the study. We used SPSS version 25.0 to analyze the data. *Results.* We determined the predictive capacity of certain variables that affect drivers and cause burnout. Exhaustion can be predicted with fatigue (48.8%), professional efficiency with emotional stability (39.8%) and cynicism with lack of motivation (28%) as the best predictors. *Conclusions.* The results contribute to a better knowledge of those factors that cause burnout in professional drivers. It is important to design individual interventions to reduce burnout, which would help reduce sick leave and possible collisions, in addition to providing greater well-being for drivers.

- **Keywords:** professionals drivers, burnout, personality, work characteristics, occupational healthlabor risks

Kohei Watanabe & Takahiro Yoshida. *Effect of arm position on spatial distribution of upper trapezius muscle activity during simulated car driving*. Pages: 1766-1772.

The present study aimed to investigate the upper trapezius muscle activity during simulated car driving while adopting three different arm positions. Ten participants were instructed to maintain the following positions: hands on the steering wheel (Hands-On), hands not on the steering wheel (Hands-Off) and hands not on the steering wheel but arms on armrests (Armrests). During the tasks, multi-channel surface electromyography (EMG) was recorded from the upper trapezius muscle with 64 two-dimensionally distributed electrodes. Amplitudes of surface EMG in Armrests were lower than in Hands-On ($p = 0.004$). The spatial distribution of surface EMG changed with time in Hands-Off and Armrests ($p < 0.05$), but not in Hands-On ($p > 0.05$). These findings suggest that being freed from steering leads to the recruitment of various muscle fibers/motor units within the upper trapezius muscle and the use of armrests may help reduce the physiological burden loaded on the muscle of drivers.

- **Keywords** automated driving system, steering, surface electromyography, car driving

Sepideh Abbaszadeh, Mehdi Jahangiri, Maryam Abbasi, Sean Banaee & Payam Farhadi. *Risk assessment of probable human errors in the scaffold erection and dismantling procedure: a fuzzy approach*. Pages: 1773-1778.

Objectives. Despite widespread use of scaffolds on construction sites, they are the most common causes of accidents, injuries and fatalities in this sector. About 80–90% of all occupational accidents occur as a result of human factors. On construction sites, proper erection/dismantling of scaffold is possibly the most essential factor in preventing accidents as it is one of the factors reported to be highly statistically significant in

correlation to a high overall scaffold safety rating. Therefore, analysis of human errors (HEs) caused by scaffolders is important to be implemented. The main objective of this study was to evaluate possible HEs during scaffold erection and dismantling (SE&D). *Methods.* Stages involved were identified using hierarchical task analysis (HTA). Risk values of HEs were then evaluated using the fuzzy analytical hierarchy process (FAHP). *Results.* Our findings indicate that the highest and lowest risk values were related to the errors of 'failure to reattach braces and connections prior to dismantling scaffolds' and 'insufficient preparation of the firm foundation', respectively. *Conclusion.* This study formulates a method to estimate the risk of potential HEs in SE&D.

- **Keywords:** human error, erection, scaffold, fuzzy analytical hierarchy process

Teerayut Sa-ngiamsak & Anamai Thetkathuek. *Short-distance versus long-distance deep-seaport container truck drivers' prevalence and perceived discomfort of musculoskeletal symptoms in the Thailand Eastern Economic Corridor.* Pages: 1779-1786.

Objectives. This research aimed to study the prevalence and perceived discomfort of musculoskeletal (MSK) symptoms among short-distance and long-distance deep-seaport truck drivers. *Methods.* Cross-sectional analysis using a standardized modified version of the Nordic musculoskeletal questionnaire (NMQ) was carried out using direct interviews with 25 male participants: 15 short-distance and 10 long-distance truck drivers. *Results.* As much as 88% was reported for the existence of MSK symptoms in the past 12 months. Considering all truck groups, regardless of short or long distance, the lower back was found with the highest prevalence (72%) followed by the neck (32%). The χ^2 test showed long-distance truck drivers had statistically significantly more prevalence in the neck ($p = 0.028$) than short-distance drivers. Perceived discomfort by the Borg CR10 scale confirmed the lower back had the highest score (2.4) followed by the neck (1.44). The Kruskal-Wallis test revealed that long-distance truck drivers had significantly higher scores on the lower back and neck ($p = 0.039$ and $p = 0.009$, respectively). *Conclusion.* Longer exposure to prolonged non-natural working postures, vibration, traffic conditions and working stress could be the judicial causes. To minimize this problem, integrated interventions need to be implemented with particular measures among short-distance and long-distance truck drivers.

- **Keywords:** container truck drivers, musculoskeletal symptom prevalence, musculoskeletal perceived discomfort

Daniela Salinas-Toro, Cristian Cartes, Christian Segovia, Maria Jesus Alonso, Begoña Soberon, Maritza Sepulveda, Claudia Zapata, Patricio Yañez, Leonidas Traipe, Claudia Goya, Patricia Flores, Daniela Lopez & Remigio Lopez. *High frequency of digital eye strain and dry eye disease in teleworkers during the coronavirus disease (2019) pandemic.* Pages: 1787-1792.

Objectives. This study aimed to evaluate visual display terminal (VDT)-related digital eye strain (ES) and dry eye disease (DED) symptoms in subjects whose work was changed to teleworking (TW) during the coronavirus pandemic. *Methods.* A digital self-reported survey was conducted on subjects in TW, including demographics, medical history, VDT time and ES-related symptoms before and during the pandemic and DED (dry eye questionnaire 5 [DEQ-5] questionnaire). *Results.* A total of 1797 questionnaires were analyzed. Mean age was 40.5 (SD 11.1) years, and 69.9% were female. The mean number of TW weeks was 10.2 (SD 3.0). The total VDT total hours increased from 7.4 (SD 3.3) to 9.5 (SD 3.3) ($p < 0.001$). All ES symptoms presented a significant increase ($p < 0.001$). The mean DEQ-5 score was 8.3 (SD 4.9). The oldest group presented lower

values, and women had a higher score ($p < 0.001$). Additionally, 28.6% of the subjects were classified with severe DED, and the variables associated with a logistic regression model were total VDT hours, female gender, refractive surgery, rosacea, depression, previous DED, keratoconus and blepharitis. *Conclusions.* The number of VDT hours seemed to be a relevant factor for increase in ES symptoms and a high prevalence of DED during the pandemic period.

- **Keywords:** dry eye disease, digital eye strain, COVID-19, teleworking, visual display terminal

Tamara Golubović, Vesna Spasojević Brkić, Martina Perišić & Aleksandar Brkic. *Differences in attitudes of operators and managers on risk management of pressure equipment.* Pages: 1793-1801.

Objectives. Previous research indicates that models for risk assessment of pressure equipment have not sufficiently or adequately integrated indicators of human factors and organizational factors. *Methods.* The goal of this article is to check the differences in attitudes of operators and managers engaged in the area of pressure equipment risk management. A questionnaire was designed and data were then collected from 253 operators and managers working with the same pressure equipment in Serbia. By applying a paired t test, differences in their attitudes were checked for issues described by the constructs of communication (COM), potentially hazardous materials and equipment (PHME), process safety (PS), safety and health at work (SHW), organizational change management (OCM), maintenance/inspection (MI) procedures, human error (HE), trainings and competences of employees for crisis situations (TCECS) and conducting research after accidents (CRAA). *Results.* It is statistically evident that the coincidence of attitudes accounted for less than 20% of questions. The highest coincidence is shown for PHME and TCECS, where one-half of the dimensions of the given constructs indicate that there are no statistically significant differences. *Conclusions.* The differences found could be used as an explanation for high-risk levels of pressure equipment exploitation and how they influence it.

- **Keywords:** human and organizational factors, pressure equipment, questionnaire, managers, operators, differences

Chinnakannu Jayakumar, Steffy Isac & D. M. Reddy Prasad. *Emergency response plan for methane and chlorine with dispersion modelling using CAMEO.* Pages: 1802-1810.

There is a significant need in the current industrial scenario for methods to be formulated to treat dangerous chemicals most safely. Accidental release of toxic chemicals will result in emergencies. Hence, an emergency response plan (ERP) is inevitable. The most toxic chemicals in the water and wastewater sector are chlorine and hydrogen sulphide, whereas methane is a flammable gas. CAMEO software is used in this research to predict the region that toxic gas release impacts. This research deals with a sewage treatment plant ERP and control measures for methane and chlorine gases. The affected area of hazard will depend upon the weather conditions and the time of the accident. Comparing two different seasons, the impacted distance is more significant in summer than in winter. It is observed that the night and early morning is more dangerous than the afternoon and evening as it shows the larger impacted distance.

- **Keywords:** hazardous substances, emergency response plan, CAMEO (computer-aided management of emergency operations), toxic gases

Mostafa Soltaninejad, Mohammad Sadra Fardhosseini & Yong Woo Kim. *Safety climate and productivity improvement of construction workplaces through the 6S system: mixed-method analysis of 5S and safety integration.* Pages: 1811-1821.

The purpose of this study is to develop a framework for integrating essential safety practices (visualization, job safety analysis and plan-do-check-act) into 5S steps and validate it. First, 18 interviews with a snowball sample of construction workers, safety representatives, supervisors and site and project managers were conducted. A grounded theory method was utilized to code the interview data. The results revealed that the studied construction companies implement a systematic safety-based methodology to minimize construction work injuries. Second, to validate the proposed framework, a pre-test and post-test study was applied. The case and control groups (26 participants) answered a 6S questionnaire before the 6S system and 1 month after implementation. The results revealed that safety climate and productivity significantly increased for the case group but reduced for the control group during time.

- **Keywords:** 6S system, 5S method, grounded theory, safety climate, productivity, lean construction

Fakhradin Ghasemi, Hemn Zarei, Mohammad Babamiri & Omid Kalatpour. *Fatigue profile among petrochemical firefighters and its relationship with safety behavior: the moderating and mediating roles of perceived safety climate.* Pages: 1822-1828.

The present study aimed to investigate fatigue among firefighters and its relationship with their safety behavior. The moderation and mediation effects of perceived safety climate on this relationship were also investigated. Firefighters from 10 petrochemical companies in Iran were investigated. Moderation analysis was performed based on hierarchical regression analyses and mediation effects were studied using structural equation modeling. A total number of 261 firefighters participated in this study. The mean scores of general fatigue, physical fatigue, reduced activity, reduced motivation and mental fatigue were 10.5, 9.0, 8.2, 7.6 and 8.7, respectively. Fatigue had a negative significant effect on firefighters' safety behavior. Perceived safety climate had a mediation but not moderation effect on the relationship between fatigue and safety behavior of firefighters. Generally, the fatigue level among firefighters was fairly low, but had a significant negative effect on firefighter's safety behavior. Perceived safety climate can mediate such a negative effect.

- **Keywords:** safety behavior, management safety commitment, social support, firefighters

Kim Dunleavy, Mark Bishop, Ashleigh Coffman, Jacob Reidy & Andrew Kane. *Chronic lower back pain in aquaculture clam farmers: adoption and feasibility of self-management strategies introduced using a rapid prototype participatory ergonomic approach.* Pages: 1829-1839.

Objectives. Lower back pain (LBP) is extremely prevalent in seafood harvesters who often have limited or no access to ergonomic consultation, occupational health support and rehabilitation services. This pilot study aimed to describe a participatory ergonomic approach and determine the feasibility and extent of adoption of self-management strategies in clam farmers with LBP. *Methods.* A rapid prototype participatory ergonomic approach was used to develop context-specific self-management strategies. Options to adjust lifting and repetitive stress were introduced using video clips, demonstrations and discussions in the workplace. Workers chose and implemented three strategies for 8 weeks with weekly reminders. Survey and qualitative data from focus groups were

analyzed. *Results.* Team strategies were the most popular, but individual options were used more often. Strategies were considered feasible, acceptable and relatively easy to use. Strategies were implemented relatively consistently, and most improved productivity with decreased pain. Challenges for uptake included changing habit, culture and team dynamics. *Conclusions.* Participatory rapid prototyping provided a feasible and efficient option to introduce strategies for clam farmers with small teams, variable work processes and workloads, and time restrictions. Strategies were considered acceptable and easy to use, and most increased productivity. These methods show potential for future research.

- **Keywords:** lower back pain, participatory ergonomics, seafood harvesting, action research, feasibility, acceptability, clam farmers, aquaculture

Bo Rolander, Mikael Forsman, Bijar Ghafouri, Farhad Abtahi & Charlotte Wåhlin. *Measurements and observations of movements at work for warehouse forklift truck operators.* Pages: 1840-1848.

Inclinometry and video analyses can provide objective measures of physical workloads. The study aim was to measure and observe arm, back and head postures and movements among forklift truck operators (FLTOS) during a working day, analyzing differences between types of forklift trucks and to assess reported workload and health. Twenty-five male FLTOS in a high-level warehouse were randomly included. The data collected comprised technical measurements, video analyses of postures and movements, and a questionnaire measuring health, pain and workload. On average, the FLTOS rotated their head more than 45°, in total, 232 times/h. Video analysis revealed that FLTOS periodically drive the forklift truck sideways with the head rotated in the direction of travel, and in periods look upwards, in which the head is highly rotated and extended. Inclinometry and observations during the working day has the potential to be a valuable part of risk assessment promoting occupational safety and health.

- **Keywords:** neck/shoulder pain, inclinometry, inertia measurement unit, head posture, head rotation

Violeta Stefanović, Andrea Dobrosavljević, Snežana Urošević & Ivana Mladenović-Ranisavljević. *Modeling of occupational safety and health factors in production organizations and the formation of measuring scales of occupational safety climate.* Pages: 1849-1857.

This article explores the impact of the main occupational safety and health (OSH) factors in the overall OSH climate of production organizations in the territory of the Republic of Serbia, South Serbia, as an important segment of their strategic development. The article aims to validate and test the proposed conceptual model of OSH. Hence, the SmartPLS methodology was applied. Statistical analysis was performed using SPSS version 21.0. The hypothesized model was developed and tested on a sample of 871 participants employed in production companies. The results indicate that the development of an OSH climate in production organizations primarily depends on the commitment of the management to the OSH system. The results obtained indicate that the methods used in this research can be successfully used in order to identify the OSH factors in the work process, and thus to manage the quality of the work environment.

- **Keywords:** occupational safety and health factors, occupational safety climate, modeling, the commitment of the management, involvement of employees

Muzaffar Asad, Muhammad Kashif, Umaid A. Sheikh, Muhammad Uzair Asif, Shaju George & Ghas ul Hassan Khan. *Synergetic effect of safety culture and safety climate on safety performance in SMEs: does transformation leadership have a moderating role?* Pages: 1858-1864.

Objectives. In developing countries, health and safety is not given importance especially in small and medium-sized enterprises (SMEs). Incidents in health and safety are continuously increasing. The major reason is a lack of workplace safety culture. Secondly, enterprises lack resources, therefore it becomes hard for them to provide safety climate. Along with safety climate and safety culture, the behavior of leadership plays a significant role toward safety performance. Therefore, the purpose of this study is to analyze the moderating role of leadership for gaining safety performance through safety culture and safety climate. *Methods.* For the said purpose, the authors collected data from laborers and managers. A structured questionnaire was adopted and, after ensuring the reliability, structural equation modeling was applied. *Results.* The findings revealed that safety culture and safety climate both have a significant impact over safety performance; however, transformational leadership only moderates the relationship between safety culture and safety performance. *Conclusions.* Identification of the moderating role of transformational leadership is a significant contribution in social cognitive theory. Future researchers are also guided to identify the same link for large industries of developing countries.

- **Keywords:** small and medium-sized enterprises, leadership, safety culture, safety climate, safety performance

Oliver Brunner, Alexander Mertens, Verena Nitsch & Christopher Brandl. *Accuracy of a markerless motion capture system for postural ergonomic risk assessment in occupational practice.* Pages: 1865-1873.

Established methods for postural ergonomic risk assessment in occupational practice are mostly time-consuming and need to be conducted by experts. Use of technology could improve postural ergonomic risk assessments with regard to time efficiency and accuracy. A study was conducted to assess the accuracy of a markerless motion capture system (Microsoft Kinect V2) compared to a marker-based motion capture system (Vicon Bonita). Angles of different body segments were analysed. The results show major inaccuracies of the markerless motion capture system for capturing axial trunk rotation (mean angular deviation of 14.04°) indicating that potential health risks could be underestimated. Combined working postures of axial trunk rotation and arm anteversion show issues with self-occlusion. Based on the findings, it is discussed whether the detected inaccuracies for axial trunk rotation are likely to lead to overestimation or underestimation of potential health risks when conducting an ergonomic risk assessment.

- **Keywords:** motion capture, postural ergonomic risk assessment, axial trunk rotation, occlusion

Mekonnen Shiferaw, Hunachew Beyene, Wondwossen Abera Gitore & Adane Ermias Mangasha. *Occupational safety practices and associated factors among employees in Jinmao and Philip Van Heusen Textile Ethiopia, Hawassa Industrial Park, south Ethiopia.* Pages: 1874-1881.

Objectives. Occupational health and safety practice in the textile factory has been neglected and in Ethiopia there is little evidence on occupational safety practice and associated factors in a textile factory. This study aimed to assess the occupational safety practices and associated factors among employees in Jinmao and Philip Van Heusen Textile Ethiopia, Hawassa Industrial Park, south Ethiopia in 2019. *Methods.* An institutional cross-sectional study was conducted from January to February 2019. A total

of 345 participants were included in the study using a stratified random sampling method. Data were collected through face-to-face interviews and an observational checklist, and analyzed using SPSS version 20. Bivariate and multivariate analysis assessed the association between dependent and independent variables. *Results.* Among the 345 (96%) respondents recruited, more than four-fifths (82%) were single. Almost two-thirds (63.8%) were in the age range 21–24 years. Attending safety training (adjusted odds ratio [AOR]: 1.73, 95% confidence interval [CI] [1.05–2.81]), orientation on occupational safety practice (AOR: 2.18, 95% CI [1.15–4.14]) and working in the weaving section (AOR: 3.58, 95% CI [2.09–6.12]) were independent predictors of safety practice. *Conclusions.* The level of occupational safety practice was very low compared to studies in developing countries.

- **Keywords:** occupational safety practice, occupational hazard, weaving, dying, factory, Ethiopia

Ramtin Nazerian, Orhan Korhan & Ehsan Shakeri. A novel cost-effective postural tracking algorithm using marker-based video processing. Pages: 1882-1893.

Recently, many postural analysis techniques have been developed in order to reduce the risk of musculoskeletal problems. Methods such as rapid entire body assessment are capable of analyzing the most constant or awkward positions, but the selection of these postures is subjective. To make an objective postural analysis, devices such as electromagnetic trackers can be used continuously during the job task, but utilizing such devices is costly. Therefore, in this study a cost-effective marker-based video processing algorithm is developed for measuring three-dimensional (3D) information regarding both the location and the orientation of human posture. To investigate the precision of the measurements, an experiment was designed. With the average of 2.88 mm and 1.34° for location and orientation, respectively, the algorithm was able to measure six degrees of freedom information regarding 3D space. Furthermore, the precision of the algorithm is found to be significantly affected by the marker pattern.

- **Keywords:** 3D posture tracking, marker-based posture tracking, ergonomics, video processing, continuous posture analysis

Krzysztof Baszczyński. *Effect of safety harness design on the pressures exerted on the user's body in the state of its suspension.* Pages: 1894-1903.

The presented studies concern the pressure of safety harnesses on the user's body in a state of its suspension. An anthropomorphic dummy was used for simulation of human behaviour in suspension. The test objects included four models of harnesses of different designs, equipped with attachment elements placed at the back and front of the human body. Pressure mapping sensors of 56 × 56 mm² surface area and two-dimensional (2D) pressure mapping apparatus were used for the measurements. The parameters characterizing the pressures of the harness belts on the dummy surface were defined. The obtained results demonstrated in which position the pressures exerted on the dummy are the greatest and that they depend mainly on the design of the safety harnesses and their attachment point. The most sensitive points of action of the harness on the user's body have been identified. Guidelines for the construction of the safety harnesses have been formulated.

- **Keywords:** falls from a height, full body harnesses, anthropomorphic dummy, pressure measurements

Ryan Bakker, Mayank Kalra, Sebastian S. Tomescu, Robert Bahensky & Naveen Chandrashekar. *The effects of pistol grip power tools on median nerve pressure and tendon strains.* Pages: 1904-1910.

Objectives. Tendonitis and carpal tunnel syndrome are common cumulative trauma disorders that can occur with repetitive usage of pistol grip power tools. The role of reaction torque resulting in a forceful rotary displacement of the tool handle, as well as the role of applied grip force, is not clear in the development of these disorders. This study aimed to quantify the flexor tendon strains and median nerve pressure during a typical power tool operation securing a threaded fastener. *Methods.* Six fresh-frozen cadaver arms were made to grip a replica pistol grip power tool using static weights to apply muscle forces. A 5-Nm torque was applied to the replica power tool. The median nerve pressure and strains in the flexor digitorum profundus and superficialis tendons were measured using a catheter and strain gauges, at three wrist flexion angles. *Results.* The peak tendon strains were between 1.5 and 2% and were predominantly due to the grip force more than the transmitted torque. Median nerve pressure significantly increased with the wrist flexed versus extended. *Conclusion.* The results indicate that the contribution of the grip force to the tendon strain and median nerve pressure was greater than the contribution from the reaction torque.

- **Keywords:** tendonitis, cumulative trauma disorder, power tools, carpal tunnel syndrome, grip force, median nerve pressure

Neda Mahdavi, Javad Faradmal, Iman Dianat, Rashid Heidarimoghadam & Hassan Khotanlou. *Investigation of hand muscle fatigue and its influential factors in manual tasks.* Pages: 1911-1923.

Muscle fatigue (MF) can lead to musculoskeletal disorders (MSDs) in the long term; however, it can be managed if the causes are well known. This study aimed to examine the grip force (GF) and grip fatigue (GFa) of employees with light, moderate and heavy manual tasks using a dynamometer and find their possible relationship with other factors. The nature of heavy manual tasks led to more experience of GFa and GF of the right hand. Moreover, the equal need for both hands in occupations with light and moderate manual tasks is the reason for more GFa in the left hand. In this primary study, the height, weight and age of subjects and their exposure to vibration had a decisive effect on GF. In order to determine the accurate effects of the aforementioned risk factors on MF, it is recommended for future studies to be performed on larger populations.

- **Keywords:** hand muscle fatigue, force change index, manual tasks, ergonomics

Busisiwe Shezi, Angela Mathee, Laura Alferts, Richard Dobson, Patrick Ndlovu, Tarylee Reddy & Renee A. Street. *Respiratory outcomes among plant processing workers in Durban, South Africa.* Pages: 1924-1928.

Plant products used by informal traditional medicine traders go through various methods of manual processing to yield a final single or multi-concoction product; however, the prevalence of potentially associated respiratory outcomes has yet to be established. The aim of this study was to describe respiratory outcomes associated with processing plants among informal traditional medicine traders. Questionnaires related to the preparation of plant products and respiratory outcomes were administered to study participants by trained researchers. Of the 216 traders, nocturnal cough, nasal allergies and waking with a feeling of tightness in the chest were the most frequently cited respiratory outcomes (43, 35 and 22%, respectively). The study highlighted the burden of respiratory outcomes among traders who process plant products and the need for targeted workplace interventions.

- **Keywords:** plant products, informal traders, traditional medicine, respiratory symptoms, asthma, health

Hu Shi. *The effects of safety-specific transformational leadership and active transactional leadership on mindful safety practice adoption in the Chinese petroleum industry.* Pages: 1929-1936.

Previous studies have concentrated on the value of managerial leadership for safety behavior conduct by employees in the workplace. However, safety leadership styles concerning mindful safety practices have rarely been examined. The goal of this study is therefore to investigate the relationships between safety-specific leaderships (transformational and active transactional leadership) and the adoption of mindful safety practices among first-line workers mediated by safety climate in the Chinese petroleum industry. Data were obtained from first-line workers in two Chinese petroleum companies. PLS-SEM results show that transformational and active transactional leadership are positively related to safety climate, which in turn affects mindful safety practice adoption in the Chinese petroleum industry. The results of the current study indicate that transformational and active transactional leadership in a safety-specific view offer a comprehensive leadership model for mindful safety practices conduct in the Chinese petroleum industry.

- **Keywords:** safety-specific transformational leadership, safety-specific active transactional leadership, safety climate, mindful safety practices

Imran Aslan. *Ranking and comparing occupational health and safety system performance indicators in hospitals by the analytic hierarchy process.* Pages: 1937-1947.

The main goal of this study was to identify whether changes and new applications were positively or negatively influencing safety performance among health-sector workers. The research is based on the opinion of 16 selected occupational health and safety (OHS) experts who evaluated five main groups of questions by the analytic hierarchy process (AHP). The results were compared to the same questionnaire's results applied previously at three main hospitals in Bingöl, Turkey. The results presented are predictable, such as that of private hospitals having better control and pressure on applying the OHS system; experts gave higher priority to OHS training; and staff considered that working according to OHS criteria was the most important problem. Caring about others' safety and protecting one's own life, being knowledgeable about risks, having practical OHS training and cooperation are other important criteria according to the experts.

- **Keywords:** analytic hierarchy process, occupational health and safety, hospitals, performance criteria

Antti Karjalainen, Maija Leppänen, Joonas Ruokolainen, Marko Hyttinen, Mirella Miettinen, Arto Säämänen & Pertti Pasanen. *Controlling flour dust exposure by an intervention focused on working methods in Finnish bakeries: a case study in two bakeries.* Pages: 1948-1957.

Objectives. The purpose of this study was to examine the effectiveness of intervention strategies to control mass concentrations and peak exposures of flour dust in two Finnish bakeries. The effect of the intervention on the proportion of various particle size fractions of the total particulate matter was also investigated. *Methods.* Mass concentrations of flour dust were measured during three working days in a pre-intervention and post-intervention study in both an industrial and a traditional bakery. Gravimetric sampling and real-time measurements were performed. Relevant intervention strategies focused on working methods were planned in collaboration with the managers of the

bakeries. *Results.* The average mass concentration of inhalable flour dust reduced in most of the stationary locations post intervention. The reductions in exposure levels were between 39 and 45%. However, the exposure levels increased 28–55% in the breathing zone. Real-time measurements showed reductions in the peak mass concentrations in the traditional bakery post intervention. In both bakeries, the total particulate matter size fraction consisted predominantly of particles with an aerodynamic diameter lower than 1 µm and greater than 10 µm. *Conclusion.* Further studies are needed to plan more effective intervention measures supplemented by technical control methods in both bakeries.

- **Keywords:** baker, fine particles, indoor air quality, mass concentration, occupational

Mohsen Mahdinia, Iraj Mohammadfam, Mostafa Mirzaei Aliabadi, Hamed Aghaei, Ali Reza Soltanian & Ahmad Soltanzadeh. *The mediating effect of workers' situation awareness on the relationship between work-related factors and human error: a path analysis approach.* Pages: 1958-1966.

Situation awareness is the main reason behind different patterns of unsafe behavior among workers and can play a mediating role in the relationship between predictive situational variables and human error. This questionnaire-based study carried out with Iranian workers investigated the direct and indirect effects of work pressure, mental workload, human–systems interaction and environmental distractions on three types of human error (i.e., slips, lapses and mistakes). The results of path analysis showed that, based on model fit indexes, the model is appropriately fit ($\chi^2/df = 3$, comparative fit index = 0.99, Tucker–Lewis index = 0.99, root mean square error of approximation = 0.26). It was also observed that the effects of four independent variables on all three types of human error are indirect and mediated by situation awareness. Consequently, it is confirmed that situation awareness plays a key role in the occurrence of human error and is a sharp-end causal factor for human error in industrial workplaces.

- **Keywords:** situation awareness, human error, work pressure, mental workload, human-systems interaction, environmental distractions

Martin Holzer. *Protect the protectors: a qualitative study on OSH in conjunction with unwanted side effects for the work performance of frontline police officers.* Pages: 1967-1972.

Objectives. Occupational safety and health (OSH) measures for frontline police officers are developing rapidly in many western societies. Various organizations, such as police forces and unions, view this development as necessary in the face of increasing numbers of assaults, knife crime, rampages and terrorist attacks. Also, current research seems to promote a progressive aggregation of OSH focusing on frontline officers on the beat. This article aims to explore possible side effects of the current development, based on a recent qualitative small-scale research project with the participation of 12 highly experienced frontline police constables in Hampshire, England, all having around 24 years of service. *Methods.* As a clearly explorative study, semi-structured interviews were deployed. While using inductive theorizing and understanding the participating police constables as humans at work, the identification and collection of inner context components such as the participants' perceptions, motivations, emotions, beliefs, values or attitudes have been intentionally put at front. *Conclusions.* Particularly, emphasizing individual risk assessment and risk perception, current research has identified that an organizational over-reliance on standardized risk management processes might trigger police officers' risk averseness, overall leading to a habitual over-worrying about things and bringing safety culture and occupational cop culture into disagreement.

- **Keywords:** frontline police officers, occupational safety and health, risk assessment, risk adverseness, risk perception

Xiang Ji, Hanjing Huang, Zhihao Li, Zhi Guo & Pei-Luen Patrick Rau.
***Comparing interventions to reduce boredom in a low mental workload environment.* Pages: 1973-1979.**

Boredom is a common workplace problem. Previous research has suggested that repetitive and monotonous work tasks may lead to boredom. However, these tasks have been reduced due to increased workplace automation. Thus, the current cause of boredom may be due to low mental workload. This research developed a general boredom model and compared the effects of feedback type (performance and ranking) and intervention method (game and quiz) on boredom and task performance. Results revealed that the secondary task interventions can reduce boredom and feedback could shorten the response time. Gender also had a significant influence on response time. Notably, results revealed a 4% probability of task failure during the experiment, indicating other interventions are also required. This research indicates that interventions to reduce boredom caused by low mental workload should be designed differently from tasks that have been designed to combat the boredom caused by repetitive and monotonous work.

- **Keywords:** boredom, low mental workload, feedback, intervention, gender