

# International Journal of Occupational Safety and Ergonomics – rok 2023, ročník 29

## Číslo 1



### **Sohrab Amiri. *Longer working hours and musculoskeletal pain: a meta-analysis.* Pages: 1-16.**

*Objectives.* Musculoskeletal pain is the most common health problem in the workplace, and one of the most important risk factors for this pain is longer working hours. This study aimed to investigate the association between long working hours and musculoskeletal pain. *Methods.* Based on the keywords, two scientific sources – PubMed and Embase – were reviewed. The time limit search included articles that were published until May 2020 and only studies published in English were eligible. The results of the studies were combined based on random effects and pooled odds ratio (OR) reported. The degree of heterogeneity in all analyses was investigated and reported based on  $\chi^2$  and  $I^2$  tests. Publishing bias was also measured using statistical tests. *Results.* Longer working hours are associated with increased musculoskeletal pain with OR = 1.11 and 95% confidence interval (CI) [1.08, 1.14]. The result was OR = 1.52 and 95% CI [1.14, 2.03] in men and OR = 1.11 and 95% CI [1.00, 1.24] in women. *Conclusion.* Long working hours are an important and threatening factor for musculoskeletal health. Therefore, this issue should be considered in health policy as well as treatment and prevention.

- **Keywords:** working hours, musculoskeletal pain, meta-analysis

### **Khalil Taherzadeh Chenani, Reza Jafari Nodoushan, Mehdi Jahangiri, Farzan Madadzadeh & Hossein Fallah. *Adaptation of the standardized plant analysis–risk human reliability analysis technique for the surgical setting: expert judgment approach.* Pages: 17-24.**

*Objectives.* Application of human reliability analysis (HRA) techniques originally developed for industrial settings to the healthcare sector may be controversial in terms of reliability and methodological level. The aim of the present study was to adapt a standardized plant analysis risk–human reliability analysis (SPAR-H) technique for application in surgical settings through suggesting more context-specific definitions for performance shaping factors (PSFs), designing precise levels and elicitation of multipliers through a domain expert judgment approach. *Methods.* A ratio magnitude estimation approach was used for carrying out domain expert judgment for multiplier elicitation. Experts from four teaching hospitals participated in the present study. Intra-class correlation was used in order to examine the inter-rater reliability of the estimated

multipliers for each level of diagnosis and action task type. *Results.* Available time, threat stress, task complexity, experience/training, procedures, working conditions, human-machine interface, fatigue and teamwork were the nine suggested PSFs for the adapted SPAR-H technique. *Conclusion.* Context-specific definitions of the PSFs can enhance the reliability of human error probability assessments. Eventually, it could be concluded that multiplier elicitation through domain expert judgment is an efficient approach for adaptation of the HRA techniques for application in specific contexts.

- **Keywords:** human error, standardized plant analysis risk-human reliability analysis, performance shaping factors, surgery, expert judgment

**Rahul Jain, Vibhor Verma, Kunj Bihari Rana & Makkhan Lal Meena. *Effect of physical activity intervention on the musculoskeletal health of university student computer users during homestay.* Pages: 25-30.**

*Objectives.* The coronavirus outbreak delivered the condition of dying from infection and forced people (especially university student computer users) to perform all working and non-working activities during homestay. In this situation, device usage for a longer duration is mainly responsible for work-related health issues. This study aims to discover the effect of a physical activity intervention (PAI) on computer users' musculoskeletal health during homestay. *Methods.* The investigation was performed on 40 university student computer users. To measure body discomfort before and after using the PAI, the body part discomfort scale of Corlett and Bishop was applied. *Results.* After implementing the PAI, the musculoskeletal disorder (MSD) decrement in major body regions was reported as wrist/forearm (from  $8.17 \pm 1.45$  to  $4.57 \pm 1.10$ ), lower back (from  $8.01 \pm 1.42$  to  $4.40 \pm 1.14$ ), elbow (from  $7.57 \pm 1.71$  to  $3.49 \pm 1.13$ ) and neck (from  $7.40 \pm 1.71$  to  $4.02 \pm 0.81$ ). *Conclusions.* PAI significantly decreased the discomfort among users in various body regions. This research suggested that PAIs may reduce the risk of MSDs in the long term for different body regions.

- **Keywords:** Ergonomics and computers, physical activity, musculoskeletal disorders, work at home

**Kai Yao, Shengyuan Yan, Fengjiao Li, Yingying Wei & Cong Chi Tran. *Exploring the effects of road type on drivers' eye behavior and workload.* Pages: 31-35.**

The number of traffic accidents is increasing every year. This study researched the effect of road type on driver's workload and eye behavior. The results showed that the road type has an effect on workload, pupil diameter, fixation rate and number of fixations. The workload, pupil diameter, fixation rate and number of fixations have a positive correlation with the complexity of road conditions. The research on visual attention area found that the driver's attention area during driving includes the rear-view mirror, left mirror, right mirror and middle area of the interface. In addition, the search range in the horizontal direction is largest under the urban road condition. Drivers focus on the ahead situation in the expressway condition, and the driver focuses on the opposite and front road in the rural road condition. The research results can be used for drivers' training in the future.

- **Keywords:** traffic accidents, road type, workload, eye behavior

**Mohsen Mahdinia, Iraj Mohammadfam, Ahmad Soltanzadeh, Mostafa Mirzaei Aliabadi & Hamed Aghaei. *A fuzzy Bayesian network DEMATEL model for predicting safety behavior.* Pages: 36-43.**

*Objectives.* Safety behavior significantly affects safety performance in the workplace. This study aimed to develop a Bayesian network (BN) model for managing and improving

safety behavior. *Methods.* This study was carried out in the chemical industries in Iran. The data were gathered by a questionnaire consisting of 13 variables including organization safety priority, systems design, safety communication, safety education, work strategy, human–system interaction, mental workload, environmental distractions, work pressure, fatigue, sleepiness, safety knowledge and locus of control. The BN structure was created using the fuzzy decision-making trial, evaluation laboratory method and expert opinions. Belief updating was used to determine variables with the strongest effect on safety behavior. *Results.* Locus of control, organization safety priority and safety knowledge were the best predictors of safety behavior. Moreover, it was found that improving organization safety priority and safety knowledge is the best intervention strategy to improve safety behavior significantly. *Conclusions.* BN is a powerful tool that can model causal relationships among variables. Improving organization safety priority and safety knowledge can lead to the maximum possible level of safety behavior.

- **Keywords:** Bayesian network, fuzzy DEMATE, safety behavior, safety knowledge

**Cansın Medin-Ceylan, Merve Damla Korkmaz, Tugba Sahbaz & Basak Cigdem Karacay. *Risk factors of neck disability in computer-using office workers: a cross-sectional study.* Pages: 44-49.**

*Objectives.* This study aimed to determine the effect of risk factors associated with non-specific neck pain on neck disability among computer users. *Methods.* A cross-sectional observational study was conducted with 1028 office workers with neck pain. Data were collected using questionnaires, which included the Neck Disability Index, Numerical Pain Rating Scale, Four-Item Patient Health Questionnaire, demographic information, frequency of neck and head pain. Multinomial logistic regression analysis was performed. *Results.* Age (odds ratio[OR] 1.08, 95% confidence interval[CI] [1.05, 1.10]), female gender (OR 1.85, 95% CI [1.34, 2.56]), body mass index (OR 1.04, 95% CI [1.01, 1.07]), work experience 5–10 years (OR 3.29, 95% CI [2.19, 4.95]) or >10 years (OR 2.70, 95% CI [1.90, 3.83]), daily computer usage time >8 h (OR 2.40, 95% CI [1.41, 4.07]), monitor located outside the midline (OR 2.11, 95% CI [1.48, 3.01]) and stress level mild (OR 3.10, 95% CI [1.88, 5.11]), moderate (OR 7.81, 95% CI [4.50, 13.55]) or severe (OR 9.11, 95% CI [5.20, 15.94]) were identified as significant risk factors for neck disability. *Conclusion.* This information may enable designing appropriate workstations for preventing neck disability and prevent labour losses. Further research is needed to help us understand more about neck disability.

**Mantana Vongsirinavarat, Sukhon Wangbunkhong, Prasert Sakulsriprasert & Haruthai Petviset. *Prevalence of scapular dyskinesia in office workers with neck and scapular pain.* Pages: 50-55.**

*Objectives.* This study aimed to investigate the presence of scapular dyskinesia (SD) in office workers with neck and scapular complaints. The postural malalignment and related muscle adaptations were also explored. *Methods.* SD and its subtypes were determined. Postural deviations and the length of commonly reported muscle tightness were evaluated. *Results.* Among 99 participants, 90% of them had SD. Considering both sides or 198 scapula, 90.4% were identified as having painful scapula and 19% as having painless scapula. There was a difference in the proportion of SD on painful (93%) and painless (69%) sides. Postural deviations including rounded shoulder (100%), forward head (43.3%) and thoracic hyperkyphosis (54.5%) were prevalent. Persons with type III SD had a higher percentage of forward head than other types. There was also tightness of the pectoralis minor (100%), levator scapulae (93.0%) and upper trapezius (98.3%) muscles without different proportions among types of SD. The greatest proportion of persons with SD had tightness of the levator scapulae. *Conclusions.* There was a high prevalence of SD among office workers with neck and scapular complaints. SD was also associated with abnormal posture and muscle tightness. The proper management of SD and working posture is warranted.

- **Keywords:** scapular dyskinesia, neck pain, office worker, posture, muscle length

**Farhad Solymanzadeh, Dariush Rokhafroz, Marziyeh Asadizaker & Maryam Dastoorpoor. Prediction of risk of coronary artery disease based on the Framingham risk score in association with shift work among nurses. Pages: 56-61.**

*Objectives.* This study aimed to determine the prediction of risk of coronary artery disease (CAD) based on the Framingham risk score (FRS) in association with shift work among nurses. *Methods.* This cross-sectional and descriptive-analytic study was conducted with nurses working in three hospitals located in Abadan, southwest Iran. The sample size was 120 participants, divided into 60 shift workers and 60 day workers (non-shift workers). Demographic data and medical and occupational history were collected through a checklist and interviews. CAD risk assessment tools used to estimate the 10-year cardiovascular disease (CVD) risk included the FRS. Data were analysed by Mann-Whitney *U* test,  $\chi^2$  test and one-way analysis of variance (ANOVA) using SPSS version 22.0. *Results.* There were statistically significant differences between blood pressure (BP), total cholesterol (TC), body mass index (BMI) and shift work ( $p \leq 0.001$ ). There was a statistically significant difference between prevalence of CAD risk and shift work based on the FRS ( $p = 0.04$ ). *Conclusion.* The study findings showed that shift work is a risk factor for CAD disturbances. Therefore, particular follow-up of shift workers should be recommended for screening and preventing CAD.

- **Keywords:** coronary artery disease, cardiovascular disease, nurse, shift work, Framingham risk score

**Marcia Ramos, Liszt Palmeira, Tainá Oliveira, Rogério Melo, Camila Lopes, Igor Carvalho, Daniel Chagas & Luiz Alberto Batista. Association of handgrip strength with anthropometry of a Brazilian healthy adolescent sample. Pages: 62-69.**

The importance of dynamometric and anthropometric information for industry is known; however, few studies have investigated the relationship between anthropometry and handgrip strength (HGS) in adolescents. The aim of the present study was to investigate the association of anthropometric variables with the level of HGS production in adolescents. Participants were 541 adolescents aged 12–16 years from a public school in the city of Rio de Janeiro. The behavior of the following variables was examined: the ability to generate HGS, age, total body mass, height and hand dimensions (hand width, hand span, hand length). The results showed an increase in the ability to generate HGS in adolescence and a significant difference between the genders from 13 years old, where boys generated higher HGS values. Correlations between HGS and total body mass and the hand width stood out in both genders, indicating a greater association.

- **Keywords:** handgrip, strength, hand anthropometry, adolescent

**Shibiao Su, Zhiming Liang, Sheng Zhang, Haijuan Xu, Jinru Chen, Zhuandi Zhao, Meibian Zhang & Tianjian Wang. Application of multiple occupational health risk assessment models in occupation health risk prediction of trichloroethylene in the electroplating and electronics industries. Pages: 70-76.**

*Objectives.* This study assessed the occupational health risks of work group exposure to trichloroethylene (TCE) in the electroplating and electronics industries in China. *Methods.* The UK Control of Substances Hazardous to Health (COSHH) Essential, the US Environmental Protection Agency (EPA) and the Singapore and the Chinese semiquantitative risk assessment models were used to assess the risks of TCE. Twenty

degreasing groups and 14 cleaning groups were recruited in the companies selected. *Results.* The concentrations of TCE in 66.7% of the cleaning groups and 35.0% of the degreasing groups exceeded the permissible concentration time-weighted average (PC-TWA) in China, and the concentrations of TCE in 100.0% of the cleaning groups and 70.0% of the degreasing groups exceeded the permissible concentration short-term exposure limit (PC-STEL) in China. Over 60.0% of the work groups were evaluated at high risk and over half of the work groups were evaluated at high cancer risk by the risk assessment models. *Conclusion.* Most work groups exposed to TCE in the electroplating and electronics industries in China are at high risk. The cleaning groups may have a higher risk for TCE exposure. The Chinese exposure index method and the synthesis index method are more practical than the other methods.

- **Keywords:** occupational health, risk assessment, trichloroethylene, electroplating industries, electronics industries

**Jian Li, Yunyi Wang, Rongfan Jiang & Jun Li. *Quantifying self-contained breathing apparatus on physiology and psychological responses during firefighting: a systematic review and meta-analysis.* Pages: 77-89.**

*Objectives.* There is no consensus regarding the efficacy of self-contained breathing apparatus (SCBA) on firefighters' physiological and psychological stress responses. This study synthesized and quantified the psycho-physiological demands placed on firefighters wearing SCBA compared to a control group. *Methods.* Five databases were searched with English-language restrictions from inception to January 2021. As dependent variables, physiological (rectal temperature [ $T_{re}$ ], mean skin temperature, heart rate [HR], maximal heart rate [ $HR_{max}$ ], maximum oxygen uptake [ $V_{O2max}$ ], total sweat rate [TSR]) and psychological (rating of perceived exertion [RPE] and thermal sensation [TS]) responses were continuously collected. This study is registered with PROSPERO (CRD42021228363). *Results.* Nine eligible studies with 289 participants met the inclusion criteria. The pooled estimates for  $V_{O2max}$  statistically significantly decreased, whereas, HR,  $HR_{max}$ , TSR and RPE increased significantly. Additionally, the  $T_{re}$  and TS parameters were elevated but not significant. Subgroup analysis revealed that, except for  $V_{O2max}$  and TSR, the SCBA weight did not differ significantly between groups on any outcome measure. *Conclusions.* Our meta-analysis indicates that wearing SCBA elicits thermoregulatory, metabolic and psychological stress. However, this is not primarily explained by the weight of SCBA, highlighting the value of ergonomic design and physiological monitoring.

- **Keywords:** firefighters, self-contained breathing apparatus, physiological response, psychological response, mechanisms, meta-analysis

**Jorge-Hernán Restrepo-Correa, Juan-Luis Hernández-Arellano, Carlos Alberto Ochoa-Ortiz & Aidé-Aracely Maldonado-Macías. *Influence of an armrest support on handgrip strength in different arm and shoulder flexion angles in overhead postures.* Pages: 90-98.**

A study was undertaken in which the handgrip strength in three arm positions above the shoulder was measured to compare handgrip strength when arm support is used and when it is not used. Grip forces were generated in pairs of flexion angles, corresponding to shoulder and elbow at 90°–90°, 135°–45° and 160°–20°. Thirty-two participants completed the present study; 23 men and nine women with a median age of 23.1 (SD  $\pm$ 3.6) years. A manual handgrip dynamometer (0–90 kg) and an adjustable angle arm support (AAAS) were used during the data collection. Two-way analysis of variance (ANOVA) for repeated measurements indicates a significant effect of the AAAS factor on the handgrip strength, as well as on the AAAS  $\times$  angle interaction. However, there is no significant effect of the angle factor on the AAAS  $\times$  angle interaction.

- **Keywords:** handgrip strength, elbow flexion angle, shoulder flexion angle, arm supportover, head postures

**Pegah Shafiei, Mousa Jabbari & Mahnaz Mirza Ebrahim Tehrani. Cause-responsibility analysis of occupational accidents in an automotive company. Pages: 99-108.**

The aim of this study was to determine the root causes of accidents and the responsibility rates of the parties involved in those accidents. For this purpose, 20 important accidents of an automotive company were selected and the root causes, the parties involved in the accidents and the respective responsibility rates were determined by 10 experts based on dividing into 11 Tripod Beta basic risk factors and using occupational accident tree analysis (OATA) and occupational accident component analysis (OACA) techniques. The results revealed that among the defects in the management system, the organizational system's defects had the greatest impact on the occurrence of occupational accidents. By modifying about half of the basic risk factors, 80% of occupational accidents can be controlled. Also, by focusing on monitoring and design units, the company's accidents can be reduced by up to 50%.

- **Keywords:** accident analysis, root causes, occupational accidents, responsibility rate, automotive company

**Hatice Karabuga Yakar, Sıdıka Oguz, Büşra Bulut, Canan Kapusuz, Pınar Abi & Reyhan Yavuz. Compassion fatigue in nurses caring for chronic diseases. Pages: 109-114.**

*Objectives.* The purpose of this study was to determine the level of compassion fatigue in nurses caring for chronic diseases and the factors that affect it. Nurses who provide continuous care for chronic diseases are under the risk of facing compassion fatigue. *Methods.* The descriptive and cross-sectional study took place during January–March 2019. The nurse identification form and the 'compassion fatigue' sub-dimension of the professional quality of life scale were used to determine compassion fatigue. *Results.* Nurses experience compassion fatigue at a moderate level. Female nurses, those who experience a decrease in their willingness to provide care and those who intend to leave work experience compassion fatigue more. Decrease in the willingness to provide care plays a determinant role on compassion fatigue. Nurses who experience compassion fatigue are unwilling to provide care to their patients. *Conclusion.* This study indicates the importance of the necessity for development of a compassion fatigue prevention program in the clinical area. Nurses should be trained on compassion fatigue within the scope of in-service training. This subject should be included in the school curriculum to increase the awareness of nursing students' about compassion fatigue.

- **Keywords:** caring", chronic disease, compassion, compassion fatigue, nurses

**Rui José Santiago, João Santos Baptista, André Magalhães & José Torres Costa. Impact of a 10-min typing task in the development of trapezius myalgia: a preliminary observational study. Pages: 115-120.**

*Objectives.* Computer use, as in typing, might contribute to trapezius myalgia (TM) development by increasing upper trapezius (UT) muscle fatigue. The purpose of this study is to investigate whether 10 min of performing a typing task by a population at risk would show significant changes in surface electromyography (sEMG) and pressure pain threshold (PPT) measurements. Supported and unsupported forearms postures are compared. *Methods.* Sixteen asymptomatic volunteers with minimum daily use of a computer of 5 h were randomized into two groups: fully supported forearms ( $n = 8$ ) and unsupported forearms ( $n = 8$ ). The protocol consisted of 10 min of a typing task, and the

workstation was set according to the usual participant profile. sEMG and PPT readings were collected from both UT muscles. *Results.* PPT and sEMG readings were not significantly different among the two groups. Supported forearms had less reduction of PPT and a smaller increase in electrical activity. *Conclusions.* Ten minutes of typing seems insufficient to observe any significant changes that could lead to TM development.

- **Keywords:** electromyography, myalgia, pain threshold, posture, computer

**Katarzyna Misiurek. *Methodology focused on the selection of construction operations for the standardization of work with an emphasis on the occupational safety criterion.* Pages: 121-128.**

This article indicates that work standardization is an effective tool for the improvement of occupational safety in any process performed by people. Work standardization has an impact on improving productivity, quality and engaging employees in improving current working methods. The article shows that in the construction industry there are problems concerning the selection of operations for work standardization due to the specificity of the operations performed there. As a result, work standardization is not a common methodology used in the construction industry, which may be one of the reasons for the greater number of accidents and near misses when compared to the manufacturing industry. The article presents the author's safety-complication-frequency (SCF) model for the selection of operations for work standardization, which is dedicated to the construction industry. The SCF model enables operations with the highest priority in terms of implementation for work standardization to be selected.

- **Keywords:** Training Within Industry, construction site, lean management, occupational safety

**Mohanad Kamil Buniya, Idris Othman, Riza Yosia Sunindijo, Ali Amer Karakhan, Ahmed Farouk Kineber & Serdar Durdyev. *Contributions of safety critical success factors and safety program elements to overall project success.* Pages: 129-140.**

Implementing a safety program is an essential step toward improving safety performance. This research aims to develop an overall project success (OPS) model for building projects through investigating the direct and indirect impact of safety critical success factors (CSFs) on OPS mediated by safety program elements. First, interviews were carried out with experts in the Iraqi construction industry, and then a questionnaire survey was utilized to obtain feedback from construction professionals. The results revealed that 20 elements are needed to confirm and improve effectiveness. These elements were categorized into four constructs: management commitment and employee involvement, worksite analysis, hazard and prevention control, and health and safety training. The analysis confirms that the relationship between safety CSFs and OPS are mediated by safety program elements. These findings offer a glimmer of hope for implementing safety programs in the Iraqi construction sector, and can also be used to enhance safety performance.

- **Keywords:** safety management, project success, construction, partial least squares, structural equation modeling

**Changquan He, Guangshe Jia, Brenda McCabe, Yuting Chen, Puwei Zhang & Jide Sun. *Psychological decision-making process of construction worker safety behavior: an agent-based simulation approach*. Pages: 141-153.**

Objectives. Relationships between safety behavior and its antecedents have been widely studied. However, the psychological decision-making process of construction worker safety behavior (CWSB) is rarely examined from the systematic perspective. Thus, this study constructed the theoretical framework for the decision-making process of CWSB and systematically explored effects of individual factors (education, age and safety knowledge), organizational factors (safety climate and leader-member exchange [LMX]) and psychological factors (psychological capital [PsyCap] and communication competence [CommComp]) on the dynamic performance of CWSB. Methods. Data were collected from the literature and 536 construction workers in China. The theoretical model was tested with the agent-based simulation (ABS) technique. Results. High level of education, safety knowledge, safety climate, LMX, PsyCap and CommComp help to reduce unsafe behavior at the cut-off point. However, the age-safety relationship might present a U-shape, which denotes that reasonable age structure of construction worker groups may be an option for bettering safety performance. The results indicate that the psychological decision-making process of CWSB is not only the result of individual rational decision, but also the product of organizational and psychological impacts. Findings of this study shed lights on safety behavior management practices based on the psychological decision-making process of CWSB.

- **Keywords:** construction worker safety behavior, decision-making process, agent-based simulation, psychological utility

**Sohrab Amiri. *Sleep quality and sleep-related issues in industrial workers: a global meta-analysis*. Pages: 154-167.**

Objectives. Sleep-related issues are important health issues. This study aimed to investigate the global prevalence of sleep-related issues in industrial workers. Methods. A syntax of keywords was used to search the PubMed, Web of Science and Scopus databases. The search time was limited to articles published until September 2020, and the search range was in English. Events and samples were extracted for each study to calculate the prevalence. For all subgroups, events and samples were extracted to calculate the results of the subgroups. The random-effects method was used in the analysis. Heterogeneity was examined at the levels of all analyses. Results. Forty-eight articles were included in the analysis as eligible studies. Sleep-related issues have 30% prevalence in the 95% confidence interval (CI) [25, 35%]. The prevalence of sleep-related issues in men was 38%, 95% CI [31, 45%] and in women was 32%, 95% CI [14, 50%]. The prevalence of poor sleep quality, insomnia, sleep duration <7 h, snoring and sleepiness was 36, 22, 37, 29 and 10%, respectively. Conclusions. Sleep-related issues have a high prevalence in industrial workers, and the cause of these differences needs to be addressed and increasing insights provided to prevent and treat sleep disorders.

- **Keywords:** sleep-related issues, meta-analysis, industrial worker

**Na Xu, Guangju Liu, Yun Su, Miao Tian & Jun Li. *Modeling of heat transfer and thermal regulation for an electric heating glove against a cold environment*. Pages: 168-176.**

An electric heating glove can protect the health of workers without affecting flexibility of the hand in a cold environment. A heat transfer model of an electric heating glove with a function of intelligent temperature control was established. The model was verified by a test device for simulating cold-contact exposure. The results showed good agreement



between the simulated values and the experimental values. Based on the numerical model, the basic parameters of the electric heating glove were analyzed. It was found that the pressure, thickness and thermal conductivity of the outer fabric were the key factors affecting the thermal regulative performance of the electric heating glove. The power consumption of the electric heating glove was mainly determined by the thickness of the outer fabric. The developed model provides a theoretical basis for the design of an electric heating glove for a thermal regulative effect and energy saving.

- **Keywords:** numerical simulation, heat transfer, cold environment, electric heating glove, energy saving

**Andrew Shim, David Shannon, Mike Waller, Robert Townsend, Adebimpe Obembe & Monica Ross. *Tactical vests worn by law enforcement: is this improving stability for optimal job performance?* Pages: 177-180.**

*Objectives.* The purpose of this study was to determine whether equipped tactical vests would improve postural stability of law enforcement officers (LEOs) versus a duty belt or without either condition. *Methods.* Volunteers were police officers ( $n = 25$ , 22 males, three females; age  $42.4 \pm 3.2$  years; weight  $101.65 \pm 19.4$  kg; height  $178.92 \pm 8.2$  cm). The Institutional Review Board approved the investigation. A Bertec posturography plate (Bertec Inc., USA) determined four center of pressure (CoP) scores – eyes open stable surface (EOSS), eyes closed stable surface (ECSS), eyes open perturbed surface (EOPS), eyes closed perturbed surface (ECPS) – and four limit of stability (LoS) scores – frontal plane (LoSF), posterior plane (LoSP), left sagittal plane (LoSL), right sagittal plane (LoSR). *Results.* A repeated-measures multivariate analysis of variance (MANOVA) demonstrated no statistical difference within subject group CoP scores EOSS ( $p = 0.723$ ), ECSS ( $p = 0.252$ ), EOPS ( $p = 0.079$ ) and ECPS ( $p = 0.137$ ). Comparing between groups, the tactical vest demonstrated significance over the other CoP group conditions with ECPS ( $p = 0.001$ ). The duty belt group showed significance with ECSS ( $p = 0.001$ ). LoS variables indicated no significant results between groups. *Conclusion.* Tactical vests demonstrated improvements in ECPS scores ( $p = 0.001$ ) compared to either group.

- **Keywords:** police officer, tactical vest, duty belt, balance, stability

**Pei Wang, Bin Yang, Jie Wang, Jieqiong Zhou & Jianwu Chen. *Effect of ventilation mode and airflow rate on the flow field and particle mass concentration distribution of a high-speed rail carriage in the putty polishing workshop.* Pages: 181-191.**

*Objectives.* The putty polishing procedure usually produces a large number of micron-sized particles, which can lead to serious respiratory diseases as well as skin conditions. The diagonal ventilation system is widely used to decrease the particle concentration in different environments. However, it becomes less effective for a large empty factory workshop, such as the polishing workshop for high-speed rail carriages, in which the diagonal ventilation mode usually results in turbulence in the airflow. In this article we report that the situation can be improved by optimizing the number and locations of the air inlets and outlets in the carriage-polishing workshop. Three modified ventilation modes are proposed, whose efficiencies are evaluated by numerical simulations and compared to the diagonal mode. *Results.* The results show that the mode with two inlets close to the ceiling and two outlets close to the floor yields the best performance. Besides, the optimum airflow rate under this mode is further determined by both simulations and in-situ measurements. The results reported can serve as a reference for the design of the ventilation systems in the polishing workshops of similar sizes.

- **Keywords:** ventilation, high-speed rail carriage, putty polishing workshop, particle concentration, flow field

**Husain Nasaif, Maryam Alaradi, Ridha Hammam, Muna Bucheeri, Maroom Abdulla & Hameed Abdulla. *Prevalence of self-reported musculoskeletal symptoms among nurses: a multicenter cross-sectional study in Bahrain.* Pages: 192-198.**

*Objectives.* This study aimed to assess the prevalence of self-reported musculoskeletal symptoms among nurses in Bahrain and determine the factors that contribute to the occurrence of these symptoms. *Methods.* A cross-sectional study was conducted using data from a convenience sample of 550 nurses working in three hospitals in the Kingdom of Bahrain. The prevalence of self-reported musculoskeletal symptoms in the last 12 months was assessed using the self-administered Nordic musculoskeletal questionnaire (NMQ). *Results.* A total of 550 nurses participated in the study. Most were females ( $n = 488$ , 89.1%) between 31 and 40 years of age ( $n = 239$ , 43.8%). The overall self-reported prevalence of musculoskeletal complaints of all joints in the past 12 months was 88.1%. The highest prevalence was in the lower back (72.3%), followed by the shoulder (52.8%) and the neck (49%). The lowest prevalence was the elbow (12.1%). The prevalence of lower back symptoms was significantly associated with age ( $p < 0.001$ ), coexisting medical conditions ( $p < 0.001$ ), area of practice ( $p < 0.001$ ), number of tasks ( $p < 0.001$ ) and types of shifts ( $p < 0.001$ ). *Conclusion.* The findings indicate a high prevalence of symptoms among nurses. There is a need to implement strategies in healthcare facilities to improve working environment conditions and reduce the prevalence rate.

- **Keywords:** self-reported musculoskeletal symptoms, pain, nurses, prevalence rate

**Qiyue Li, Xiaomu Liao, Xing Huang, Xin'ao Wei & Xiang Zhang. *Impact resistance test system for the helmet based on a polyvinylidene fluoride piezoelectric sensor array.* Pages: 199-206.**

As the most commonly used personal protection equipment (PPE) in various production activities, the impact resistance of the helmet is of great importance. Referred to the conventional experimental method, this study constructs a helmet impact resistance test system with a polyvinylidene fluoride (PVDF) sensor array. Compared with the traditional test method, this study installed PVDF sensors on the contact surface between the headform and the helmet. The stress and its distribution on the headform are measured directly, which is helpful to evaluate the impact resistance of the helmet more accurately and comprehensively. Finally, the intra-group correlation coefficient (ICC) and the coefficient of variation (CV) of peak pressure of the repeated test results are calculated to evaluate the reliability of the test system, which shows high reliability. The test system is helpful for optimization of the helmet production design and further related research.

- **Keywords:** safety helmet, impact resistance, test system, polyvinylidene fluoride sensor

**Pin-Chao Liao, Xiaoshan Zhou, Heap-Yih Chong, Yinan Hu & Dan Zhang. *Exploring construction workers' brain connectivity during hazard recognition: a cognitive psychology perspective.* Pages: 207-215.**

Monitoring brain activity is a novel development for hazard recognition in the construction industry. However, very few empirical studies have investigated the causal connections within the brain. This study aimed to explore the brain connectivity of construction workers during hazard recognition. Electroencephalogram data were collected from construction workers to perform image-based hazard recognition tasks. The Granger causality-based adaptive directed transfer function was used to simulate directed and time-variant information flow across the observed brain activity from the

perspective of cognitive psychology. The results suggested a top-down modulation of behavioral goals originating from the dorsal attention network during hazard relocation. The sensory cortex predominantly serves as the information outlet center and interacts extensively with the frontal and visual cortices, reflecting a top-down attention reorientation mechanism for processing threatening stimuli. Our findings of brain effective connectivity supplement new evidence underpinning parallel distributed processing theory for workplace hazard recognition.

- **Keywords:** adaptive directed transfer function, effective connectivity, hazard recognition, time-varying brain networks, construction workplace

**Marcelo Fabiano Costella, Graciela Aparecida Pelegrini, Heleia Bortolosso, Paulo Vicari & Francieli Dalcanton. *Exploring the relationships between safety and maintenance in the cold generation process: insights from the functional resonance analysis method.* Pages: 216-223.**

Industrial refrigeration systems typically use ammonia as a refrigerant gas, which is a toxic gas so leaks can be catastrophic. This study aimed to identify how to improve robustness in a cold generation process using the functional resonance analysis method (FRAM). A case study was conducted through interviews and direct observations to develop three FRAM models: one focusing on operation and maintenance functions; another focusing on functions related to the provision of occupational health and safety (OHS) measures; and a third overlapping the first two models. Results revealed that the management of OHS is restricted to the legislation applied to piping under pressure, and the company did not consider a more comprehensive safety approach for the ammonia storage stage. This study also highlighted the need for action, such as non-destructive and penetrating liquid tests, in one of the process steps considered critical for operation and maintenance, but not for OHS.

- **Keywords:** functional resonance analysis method, safety, maintenance, cold generation process

**Emine Arici Parlak, Hatice Ayhan & Emine Iyigun. *Comparison of operating room nurses' satisfaction and preferences in using personal protective equipment for eye protection in the COVID-19 pandemic.* Pages: 224-229.**

*Objectives.* This study aimed to compare the problems, satisfaction and preferences of operating room nurses about the use of personal protective equipment (PPE) for eye protection during operations in the COVID-19 pandemic. *Methods.* This prospective quasi-experimental study was conducted in April 2021 in the operating room of a hospital in Turkey. The sample of this study consisted of 35 nurses who met the inclusion criteria. The evaluation of three types of eye protection equipment (goggles, goggle-type face shield and face shield) was repeated in the same group on consecutive days. *Results.* The comparison of the problems related to the use of PPE indicated that the highest rate of fogging (91.4%) was observed in goggles ( $p < 0.001$ ), and skin injuries (28.6%) were experienced in goggles and face shields ( $p = 0.002$ ). It was observed that operating room nurses were most satisfied ( $7.2 \pm 1.4$ ) with goggle-type face shields and ranked them in first place (80%) ( $p < 0.001$ ). *Conclusion.* According to the results of this research, it was found that the PPE for eye protection that was the least problematic, provided the most satisfaction and was ranked in first place during the pandemic was the goggle-type face shield.

- **Keywords:** COVID-19, operating room nurses, personal protective equipment, satisfaction

**Junshi Liu, Xingda Qu & Yipeng Liu. *Influence of load knowledge on lifting biomechanics*. Pages: 230-235.**

*Objectives.* Findings from previous studies implied that appropriately controlling load knowledge might help improve the biomechanical performance during lifting tasks. However, only load weight knowledge was often discussed in previous studies. The current study aimed to complement the existing studies and provide improved knowledge about the influence of load knowledge on lifting biomechanics. *Methods.* Twenty-four healthy male participants were recruited and instructed to perform symmetric lifting tasks with different load weights under different load knowledge conditions. Load weights were set at three levels (40, 80 and 120%) of each participant's maximum acceptable lifting capacity. The examined load knowledge conditions included 'no knowledge' condition, 'weight known' condition, 'fragile material known' condition and 'weight and fragile material known' condition. *Results.* We found that when knowing fragility information about lifting materials, workers tended to be more cautious by adopting a less dynamic motion pattern during the landing phase, as evidenced by decreases of 6–8% in elbow joint acceleration. The 'cautious' lifting pattern when fragility load knowledge was presented could contribute to reduced risk of lower back disorder. *Conclusion.* This finding could help to develop lower back disorder prevention interventions to improve occupational safety and health.

- **Keywords:** biomechanics, lifting, load knowledge, lower back disorder, work-related musculoskeletal disorders

**Akgün Yeşiltepe & Gülendām Karadağ. *The effect of occupational training provided to workers in a glass factory on their use of ear protectors*. Pages: 236-242.**

*Objectives.* This study aimed to determine the effect of occupational training applied to workers working in noisy parts of a glass factory on the use of ear protectors. *Methods.* The study was a semi-experimental pre-test and post-test design. It was carried out with 45 workers determined by purposeful sampling and working in a glass production factory who accepted to participate in the study. The data were collected with an information form and noise-related symptom chart, hearing health information questionnaire and observation. In the analysis of the study data, the number/percentage,  $\chi^2$  test, Cohen  $\kappa$  test and analysis of variance were used. *Results.* It was determined that workers pre training did not use ear protectors (100%) and there were some noise-related health complaints. There was an increase in using ear protectors (57.8%) and a decrease in their health complaints post training. It was also found that the workers' pre-training hearing health information questionnaire mean score was  $11.46 \pm 3.20$ , and post training was  $13.77 \pm 3.42$  in the first month and  $15.77 \pm 2.88$  in the fourth month. *Conclusions.* Occupational training provided to the workers increased the workers' awareness level and their rate of wearing ear protectors, and health problems caused by work-related noise started to recover.

- **Keywords:** occupational health, hearing, safety, risk factors, interventions

**Bo Liu, Quan Xu, Xiaoyang Xin, Xuyang Cui, Ming Ji & Xuqun You. *How can proactive personality affect cabin attendants' safety behaviors? The moderating roles of social support and safety climate*. Pages: 243-253.**

Cabin attendants are mainly responsible for maintaining in-flight safety, and they are crucial to enhance air travel safety and alleviate passenger concerns. The objective of this study is to explore relationships between proactive personality, social support, safety climate and safety behaviors among cabin attendants. A self-assessment questionnaire was used to investigate a sample of 560 cabin attendants from China Southern Airlines

Ltd. The results show that proactive personality and safety climate positively influence cabin attendants' safety behaviors. Social support was found to weaken the positive effect of proactive personality on safety behaviors. Furthermore, social support and safety climate jointly moderate the relationship between proactive personality and safety behaviors, suggesting that this relationship is the strongest when the levels of social support and safety climate are both high. Theoretical and practical implications for researchers and practitioners in designing interventions and strategies to promote safety behaviors in an airline context are discussed.

- **Keywords:** proactive personality, social support, safety climate, safety behaviors, cabin attendants

**Ming Zhu, Guohui Li, Qin Huang, Daiqiang Li & Junfeng Du. *Analysis of eye movements of workers in safe and unsafe behaviors using a video-based method.* Pages: 254-262.**

Analyzing eye movements of workers in safe and unsafe behaviors can reduce accidents. With a video-based method, the angular velocity of gaze direction (AVGD) represents micro-movements in gaze and angular velocity in saccade is used to analyze eye movements. A similar behavior simulation experiment is designed to collect operation videos, and an eye movement information extraction and processing framework is constructed to quantify and analyze eye movements. The results show that: the root mean square and movement frequency of AVGD can be used to recognize unsafe behavior; in operations with attention target fixation, compared with safe behavior, workers in unsafe behavior have higher angular velocity, movement frequency and turn frequency of eye movements; and in operations with attention target change, eye movement rules of workers in safe and unsafe behaviors depend on operation types. The results can provide features for unsafe behavior recognition and theoretical bases for safety training.

- **Keywords:** unsafe behavior, movement analysis, eye movement, video-base, dangular velocity

**Hang Thi Le, Hoa Thi Dinh & Tam Thi Ngo. *Asbestos dust concentrations and health conditions of workers at asbestos-cement corrugated sheet production manufacturers in Vietnam: a nationwide assessment.* Pages: 263-267.**

This study examined contemporary concentrations of asbestos dust during production and the health conditions of workers at asbestos-cement corrugated sheet production manufacturers in Vietnam. A nationwide survey was conducted on 28 factories (with 206 air samples) and 2459 workers. Asbestos fiber dust and the health status of workers were assessed. Results showed that 108/206 (52.4%) samples had asbestos fiber dust. The average concentration of asbestos fibers was  $0.19 \pm 0.14$  fibers/ml. The percentage of workers with thickened pleural lesions/pleural calcification nodules was low. More studies are needed to evaluate the effectiveness of biomarkers in preventing the onset of lung cancer and mesothelioma in workers.

- **Keywords:** environment, health, worker, asbestos, manufacturer

**Juan Xiong, Jian Lin Wen, Guang Shu Pei, Xu Han & Dan Qing He. *Effectiveness of Internet-based cognitive behavioural therapy for employees with depression: a systematic review and meta-analysis.* Pages: 268-281.**

*Objectives.* The effectiveness of Internet interventions for employees with depressive disorder remains controversial. We summarized all available evidence exploring the role of Internet interventions in reducing employees' depressive symptoms. *Methods.* This study was a comprehensive systematic review and meta-analysis that included acceptability and preliminary feasibility studies. We excluded programme descriptions, discussion articles and study protocols. We followed the PRISMA guidelines and searched MEDLINE, EMBASE, PsycINFO, the Cochrane Library and Web of Science from database inception to May 2021 for articles published in English. We extracted data concerning demographics, intervention format, including Internet interventions, control group conditions and outcome measures. We used a random-effects model and calculated Hedges' *g* values for the scores of employees receiving Internet interventions versus control conditions. This systematic review is registered as INPLASY202160082. *Results.* Data from 19 studies were included. These 19 studies included 5898 participants (2813 participants received Internet interventions, 3085 participants were in control groups). *Conclusions.* The findings suggest that Internet interventions can be effective in improving depression in employees. However, more randomized controlled trials are needed to provide better evidence regarding Internet interventions for employees with depression, and robust studies are needed to observe the effectiveness of Internet interventions.

- **Keywords:** Internet intervention, employees, depression, meta-analysis

**Prabhakar Shukla, C. R. Mehta, K. N. Agrawal, R. R. Potdar, Manoj Kumar & Karan Singh. *Approach for ergonomic assessment of self-propelled combine harvester seats based on anthropometric body dimensions.* Pages: 282-293.**

*Objectives.* The seat dimensions of self-propelled combine harvesters are designed without consideration of body dimensions of the user population and vary with make and models of combines. *Methods.* This research proposes a method to determine the percentage of seat match, upper mismatch and lower mismatch using the anthropometric body dimensions of Indian harvester operators. The seat dimensions of five popular combine harvester makes were measured and compared to the body dimensions of the operators. *Results.* The selected seats had 100, 44–70, 81–96, 98–100, 63–83, 59–94 and 55–97% mismatch for seat height, seat length, seat pan breadth, seat backrest height, upper backrest breadth, lower backrest breadth and steering wheel clearance, respectively. These data were used to recommend seat dimensions for combine harvesters. Seat height, seat length, seat pan breadth, seat backrest height, upper backrest breadth, lower backrest breadth and steering wheel clearance are recommended as 399, 362, 456, 400, 243, 386 and 190 mm, respectively. *Conclusions.* The recommended seat dimensions matched the user population anthropometric dimensions 94–100%. This approach will help to assess seat dimensions based on anthropometric data for a comfortable posture to prevent health risks such as musculoskeletal disorders (MSDs) among operators.

- **Keywords:** combine operator, seat design, seat dimensions, match and mismatch

**Sajjad Farhadi, Iraj Mohammadfam, Omid Kalatpour & Fakhradin Ghasemi. *Determining performance shaping factors to assess human error in the emergency response team in chemical process industries: a case study.* Pages: 294-305.**

*Objectives.* Human error (HE) plays a crucial role in the occurrence of accidents in chemical process industries (CPIs). Emergency response team (ERT) members are predisposed to HEs due to the nature of their work. The HE potential is influenced by the performance shaping factors (PSFs). Managing PSFs can diminish the human error probability (HEP) and consequently increase the emergency response success chance. This article aimed to determine the PSFs for ERT members in CPIs. *Methods.* First, an initial list of PSFs was searched and classified within human reliability analysis methods and studies. Then, an expert panel of the emergency management system was utilized to identify, classify and weight the initial PSFs. The fuzzy Delphi method and content analysis technique were applied to summarize and categorize the PSFs. *Results.* The results of the study showed that 11 PSFs had greater impacts on the ERT members' error potential. Findings revealed that stress and physiological stressors, competency, and team and organization were the three most important PSFs. *Conclusion.* The most important and relevant PSFs can be effectively used in accurate HE assessment of ERT members in CPIs.

- **Keywords:** performance shaping factor, human error, emergency response, chemical process industry, fuzzy Delphi method

**Long Chen & Ming Chen. *When work support does not work: investigating the joint moderating effect of challenge stressors and hindrance stressors on safety compliance.* Pages: 306-314.**

This study explores the within-person relationship between work support and safety compliance, as this has not been addressed by previous scholars. Drawing from the job demands–resources model, we argue for the positive impact of daily work support on daily safety compliance. We examined this hypothesis by collecting 221 daily diary data from 50 medical care personnel. The results show that the relationship between daily work support and daily safety compliance is positive and jointly moderated by challenge and hindrance stressors. Specifically, the positive relationship between daily work support and daily safety compliance is enhanced when there are high levels of challenge and hindrance stressors, and when there are high levels of challenge stressor and low levels of hindrance stressor. In addition, this positive relationship is not significant when there are low levels of challenge stressor and high levels of hindrance stressor.

- **Keywords:** work support, safety compliance, challenge stressor, hindrance stressor

**Rahul Jain, Kunj Bihari Rana & Makkhan Lal Meena. *Effect of work experience and upper-limb muscle activity on grip strength of manual workers.* Pages: 315-320.**

*Objectives.* The current study correlated grip strength (GS) measurements with upper-limb muscle activity (UMA) for three different experience levels of manual workers (beginner, intermediate and advanced). *Methods.* A total of 182 male and female manual workers were chosen, and GS was assessed in some contexts using a digital handgrip dynamometer. *Results.* The GS values change significantly depending on the amount of experience of the workers. The difference in GS for different UMA demonstrates that continuous exposure to hand tools in different conditions of the hands (twisting, bending, etc.) significantly impacts manual arm strength. *Conclusions.* These findings suggest that repetitive use of hand tools in various manual operations (cutting, digging, pruning, spading, etc.) causes GS to vary significantly. In addition, beginner experience-level individuals exhibited much lower GS values in the dominant hand, whereas advanced experience-level workers had the greatest strength. Thus, for generating higher forces, professionals (advanced and intermediate levels) choose to execute safer activity (i.e., more neutral positions) than beginners.

- **Keywords:** experience, gender, gripping, manual arm strength, unorganized sector, upper-limb muscle

**Harun İkiz & Emine Ergin. *Musculoskeletal system problems in office workers: relationship of physical activity levels and quality of life.* Pages: 321-328.**

*Objectives.* This study aimed to determine the relationship between musculoskeletal problems in office workers and their physical activity levels and quality of life. *Methods.* A questionnaire form, the quality of life scale (SF-36) and the international physical activity questionnaire (IPAQ) were used. Group differences were compared post hoc (Bonferroni) and non-parametrically (Mann–Whitney *U* test, etc.). *Results.* Among the participants, 81.7% experienced pain in at least one body area. Back pain was experienced most frequently at a rate of 54.8%, followed by neck and shoulder pain, respectively. According to the participants' physical activity levels, 58.5% ( $n = 141$ ) were active, 37.3% ( $n = 90$ ) were less active and 4.1% ( $n = 10$ ) were very active. There was a significant relationship between the prevalence of musculoskeletal disorders (MSDs) among the participants and the participants' age, educational status, income status, regular exercise status, duration of computer use, eye complaints, complaints in the wrists and ergonomic chair use. *Conclusion.* The prevalence of MSDs was determined to be high in the office workers, while their levels of physical activity were found low. Training and exercises are needed to prevent MSDs in office workers and improve their levels of physical activity and quality of life.

- **Keywords:** musculoskeletal, occupational health services, office worker, physical activity, quality of life

**Jennifer L. Garza, J. M. Cavallari & M. G. Cherniack. *Associations between observed time sitting at work and musculoskeletal symptoms: a repeated-measures study of manufacturing workers.* Pages: 329-334.**

Time sitting at work is known to affect health overall, but its specific effects on musculoskeletal symptoms are unclear. We evaluated the relationship between observed time sitting at work and self-reported musculoskeletal symptoms among 195 manufacturing workers. Longer time sitting at work was significantly associated with lower prevalence of neck/shoulder (prevalence ratio [PR] = 0.70, 95% confidence interval [CI] [0.68, 0.72];  $p < 0.001$ ) and arm/wrist/hand (PR = 0.46, 95% CI [0.31, 0.69];  $p < 0.001$ ) musculoskeletal symptoms. Associations remained largely unchanged after adjusting for job type or occupational postures and load. Time sitting at work was associated with musculoskeletal symptoms, and should be taken into consideration as part of interventions to prevent musculoskeletal disorders (MSDs) and promote health of manufacturing workers.

- **Keywords:** musculoskeletal symptoms, time sitting, occupational health

**Ahmad Soltanzadeh, Mohsen Mahdinia, Hamedeh Golmohammadpour, Reza Pourbabaki, Mostafa Mohammad-Ghasemi & Mohsen Sadeghi-Yarandi. *Evaluating the potential severity of biogas toxic release, fire and explosion: consequence modeling of biogas dispersion in a large urban treatment plant.* Pages: 335-346.**

*Objectives.* Biogas production in treatment plants for energy generation has increased in recent years. This study aimed to model the consequence of biogas release in a large urban treatment plant. *Methods.* The study modeled biogas storage tank consequences in a large urban treatment plant in Iran. Due to potential for biogas harmfulness, three consequences of toxic release, fire and explosion were evaluated. Scenarios were



evaluated in the worst-case situation. All modeling steps were performed using PHAST version 7.2. *Results.* In the case of catastrophic reservoir rupture in summer, distances of 3788.94, 128.86 and 91.72 m from the reservoir in the wind direction will be in the range of 100, 500 and 1000 ppm biogas, respectively. Study of pressure values due to explosion in the catastrophic rupture scenario revealed that distances of 57.19, 14.70 and 115.84 m from the biogas reservoir were in the range of 0.02, 0.13 and 0.2 bar pressure increase, respectively. *Conclusion.* Due to the treatment plant's location in a dense urban area, biogas dispersion could lead to exposure of many people to high-risk areas. Therefore, taking control measures comparable with the consequence modeling output can be a practical step toward reducing vulnerability against such incidents.

- **Keywords:** biogas, toxic release, fire, explosion, consequence modeling, treatment plant

**Sohrab Amiri. *Depression symptoms reducing return to work: a meta-analysis of prospective studies.* Pages: 347-357.**

*Objectives.* This study was conducted to estimate the risk of return to work for people who experience symptoms of depression based on the pool of prospective data. *Methods.* All online articles in PubMed and Scopus which were accessible before November 2019 were searched. The odds ratios of each of the studies were pooled together to obtain an overall odds ratio. The pool of studies was with random effects. The analysis was performed based on the depression symptoms scale, type of disease and duration of follow-up. Two other aspects were examined in the analysis, one being the bias in the publication of studies and the other being the level of heterogeneity that was examined. *Results.* Thirty-five studies were selected for the meta-analysis. The pooled odds ratio indicates that the odds of return to work in people with depressive symptoms is 31% lower than in those without depressive symptoms. The funnel plot shows that there is asymmetry. The Egger test result was significant ( $p < 0.001$ ) and there is publication bias. *Conclusion.* Depression symptoms after sick leave due to physical illness is a risk factor for not returning to work.

- **Keywords:** depression, return to work, meta-analysis, systematic review

**Saman Ahmad & Mohammad Muzammil. *Revised NIOSH lifting equation: a critical evaluation.* Pages: 358-365.**

The revised NIOSH lifting equation (RNLE) aims to manage lifting-related lower back pain (LBP), by determining safe load limits. Many researchers have studied the multiplier development criteria, the universal applicability of the equation and its ability to identify an increased risk of LBP in lifting tasks. Although a number of strengths of the equation have been highlighted, many limitations have also been identified. The need for new multipliers, such as worker and environmental characteristics, was highlighted in order to make the equation more adaptable. The RNLE was designed to protect 75% of female workers and is therefore inherently conservative. Additionally, as all multipliers have values less than or equal to 1, the recommended weight limits (RWLs) can be further reduced. Thus, new multipliers may be defined, by combining two or more existing multipliers, to make the RWLs more realistic.

- **Keywords:** revised NIOSH lifting equation, recommended weight limit, multipliers, lifting index, manual lifting

**Lei Wang, Shan Gao, Wei Tan & Jingyi Zhang. *Pilots' mental workload variation when taking a risk in a flight scenario: a study based on flight simulator experiments*. Pages: 366-375.**

Pilots' operation behavior in flight is associated with their mental state variables such as workload, situation awareness, stress, etc. The objective of this study was to investigate the dynamic process of mental workload for pilots who perform a risky flight task in simulated scenarios. Two empirical experiments were conducted to address this issue. In experiment one, 19 trainee pilots divided into high-risk and low-risk groups performed a target-search task in a low-altitude visual flight. The results showed a statistically significant interaction between groups and segments for heart rate variability (HRV). The same pattern of physiological results was replicated among participants in experiment two, in which 19 airline pilots completed an approach with low visibility. These findings highlighted the relationship between mental workload variation and risk-taking behavior, which could be considered in improving pilot selection and training to improve flight safety.

- **Keywords:** mental workload, risk-taking behavior, heart rate variability, risk perception, flight safety

**Francisco Salguero-Caparrós, María Martínez-Rojas, María del Carmen Pardo-Ferreira & Juan Carlos Rubio-Romero. *Performance of barrier systems and functions in the construction industry*. Pages: 376-385.**

*Objectives.* Improving knowledge about the mechanism of accident occurrence in the construction industry provides important information to help design and implement appropriate barriers to stop the spread of unexpected events. This study characterizes the sequence of accidents in the construction industry by linking the most commonly identified circumstances, the barriers and barrier functions infringed and the specific way in which each of these functioned. *Methods.* In order to achieve the proposed objective, an analysis was made of 241 investigations of work accidents that occurred in the construction sector in Spain between 2009 and 2014. The statistical difference between the groups of variables was determined using contingency tables in which the value of the  $\chi^2$  statistic was calculated. *Results.* The results obtained show that behavioural factors are fundamentally identified, such as the worker's non-observance of ensuring their own safety or the deficient interpretation of rules. *Conclusions.* This study illustrates that to understand the performance of barrier systems and functions, efforts must be focused not only on the things that go wrong, i.e., accidents, but also on the things that go right within the variability of daily performance in systems as complex as the construction industry.

- **Keywords:** occupational accidents, construction industry, barrier systems and functions, variable deviation, occupational health and safety

**Lee J. Winchester, Alison L. Hooper & Cailin J. Kerch. *Ease of restroom access influences fluid consumption habits and health in classroom teachers*. Pages: 386-391.**

*Objectives.* There are rising concerns about the health of classroom teachers in the USA, including stress, hypertension and frequent urinary tract infections. Teacher working conditions are likely a contributor to their health concerns. Many teachers report that they cannot easily take a restroom break at work, and therefore they consume minimal water or other fluids. This study investigated the relationship between restroom access and fluid consumption and the prevalence of renal and cardiovascular health complications in classroom teachers. *Methods.* The responses of 844 teachers (92% women, 8% men; 65.1% between age 26 and 45 years) to an online survey about

restroom accessibility, fluid consumption and health were analyzed using descriptive statistics,  $\chi^2$  analyses and logistic regression. *Results.* Fifty-nine percent of teachers could not easily take a restroom break, and 54.7% consumed fewer than 2 cups of water per workday. Furthermore, 44.8% reported being pre-hypertensive and 4.9% reported being hypertensive. Teachers with insufficient restroom access were significantly more likely to report frequent urinary tract infections. *Conclusions.* This study demonstrates a relationship between restroom access, fluid consumption and renal/cardiovascular health in classroom teachers. Future research should directly investigate how teacher work environment impacts renal and cardiovascular health.

- **Keywords:** teacher wellness, renal health, fluid intake, cardiovascular health, restroom access

**Prabhjot Singh Viridi & Gulab Pamnani. *Human error identification and risk prioritization in LPG unloading operations.* Pages: 392-406.**

*Objectives.* Errors due to human activities in any operation are analyzed using human reliability analysis in which the principal step is to identify potential human errors followed by quantification and analysis of the error. This work intends to apply a methodology for identifying human errors and to prioritize the risk associated with them in a liquefied petroleum gas (LPG) unloading operation. *Methods.* The methodology uses hierarchical task analysis which provides the basic framework, along with a systematic human error reduction and prediction approach which aids in identification and categorization of the errors associated with each task with the help of predefined error taxonomy. Also, in order to quantify the risk associated with each identified error, fuzzy failure mode and effect analysis has been adopted. To rank and prioritize the risk associated with each identified error where the individual constituent components are non-commensurable in nature, the VIseKriterijumska Optimizacija I Kompromisno Resenje method has been incorporated. *Results and conclusions.* Applicability of the methodology presented will help comprehend the severity of risk corresponding to each error at different levels, and the ranking mechanism thus developed in this work aids to prioritize the action to minimize the likelihood of errors.

- **Keywords:** human error risk prioritization, hierarchical task analysis, systematic human error reduction and prediction approach, fuzzy failure mode and effect analysis, VIseKriterijumska Optimizacija I Kompromisno Resenje

**Hülya Yüksek, Mazlum Çelik & Ahmet Keser. *The mediator role of well-being in the effect of COVID-19 anxiety on occupational commitment: research in the aviation sector.* Pages: 407-423.**

The coronavirus (COVID-19) pandemic, which emerged in China in December 2019, has severely affected many industries across the world and created substantial psychological, social and economic impact on individuals. With the coronavirus outbreak labelled as a pandemic by the World Health Organization, the first measures have been taken for the aviation industry. The crisis environment created by the pandemic had a negative impact on aviation personnel. The main purpose of this research is to investigate the mediator role of employee well-being in the effect of COVID-19 anxiety on occupational commitment. The data were collected through a survey of cabin and cockpit staff (n = 3862). After the analyses, it was found that the effect of COVID-19 anxiety on well-being, and occupational affective and normative commitment was significant. Moreover, it is among the findings that well-being has a partial mediator role in the effect of COVID-19 anxiety on occupational affective and normative commitment.

- **Keywords:** aviation sector, COVID-19 anxiety, flight personnel, occupational commitment, well-being

**Praphatson Sengsoon & Kanruethai Siriworakunsak. *A comparison of muscle activity, posture and body discomfort during the use of different computer screen sizes.* Pages: 424-430.**

This study aims to compare changes in neck angles, muscle activities, ergonomic risk and body discomfort caused by use of two different computer screen sizes. The 36 female users who participated used displays with 46.99 and 58.42-cm screen sizes and were assessed for craniocervical angle (CCA), craniovertebral angle (CVA), upper trapezius (UT) and sternocleidomastoid (SCM) muscle activity, ergonomic risk and body discomfort for a duration of 1 h. The results showed there were no significant differences when comparing usage between both computer screen sizes ( $p > 0.05$ ). However, there were significant differences in the CCA, UT muscle activity and body discomfort when comparing before and after usage for both computer screen sizes ( $p < 0.05$ ). The results indicate that computer users can select different screen sizes for working but should be concerned with neck angle, muscle activity and body discomfort when using for long periods of time.

- **Keywords:** electromyography, neck angle, ergonomic assessment, computer screen size, computer use

**Faisal M. Alessa & Eduardo M. Sosa. *Experimental evaluation of impact-resistant gloves using surrogate hands.* Pages: 431-443.**

Injuries to the hand and fingers with varying degrees of severity are widespread in industries such as mining and oil and gas production. This study presents the results of tests carried out to measure the impact performance for commonly used impact-resistant gloves (metacarpal gloves). Sets of surrogate hands made out of a 3D-printed skeletal structure and soft tissues represented by synthetic gel were manufactured and subjected to controlled impact tests. The calibration and validation of the surrogates were based on impact response data reported previously for cadaveric specimens. Calibrated surrogate hand specimens were tested to assess the impact protection of typical metacarpal gloves. Each type of metacarpal glove provided different levels of protection measured by the decrease in the peak impact reaction force and the fractures detected after the impacts. Results indicated that surrogate specimens suffered fractures in 77% and 33% of the impacts for unprotected and protected hands, respectively.

- **Keywords:** glove, impact, surrogate hand, 3D printing, synthetic gel

**Karina Nielsen, Kara Ng, Dina Guglielmi, Laura Lorente, Luminita Pătraș & Michela Vignoli. *The importance of training transfer of non-technical skills safety training of construction workers.* Pages: 444-452.**

Safety training of migrant workers in construction has focused on technical skills with limited attention to non-technical skills, which support safety training transfer to the worksite, both immediately after training and in the long term. Using realist evaluation as our theoretical framework, this study explores the transfer of two key non-technical skills to construction sites: communication and decision-making. Trained workers completed questionnaires post-training and after six months. A moderated mediation model found an indirect link through training transfer between communication and decision-making skills immediately post-training and six months later. The results also revealed that high levels of safety self-efficacy moderated the relationship between communication, but not decision-making, safety skills post-training and the extent to which trained workers reported transferring these skills. The study has important practical implications, showing the significance of training transfer of non-technical skills, such as communication and decision-making, to the worksite.

- **Keywords:** safety, training, realist evaluation, non-technical skills, training transfer