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Yazan Issa Abu Aisheh, Bassam A. Tayeh, Wesam Salah Alaloul & Ali Almalki. *Health and safety improvement in construction projects: a lean construction approach*. Pages: 1981-1993.

Objectives. Lean construction techniques have been considered an effective approach and strategy to reduce accidents in construction projects. This article aims to investigate the application of the lean construction principle and its impact on occupational health and safety. *Methods.* To achieve the aim, an analytical descriptive method was used. The data were collected through a questionnaire, with 70 respondents who were chosen using a random stratified sample method. The questionnaire evaluated the perception of contractors and consultants about the important lean construction factors and their impact on construction project safety. *Results.* There is an agreement that the application of lean construction techniques can be impeded by challenges like lack of lean construction knowledge, complexity, misconception about lean construction and difficulties in changing employees. *Conclusions.* The study identified strategies that could be used to address these challenges that will improve the safety of construction projects. These include enlightenment on benefits of the lean practice, publication of improvements realized from lean practice, training, workers' involvement and empowerment, persistence, robust planning and gradual implementation.

- **Keywords:** lean construction, health and safety, accidents, construction projects, strategies

Hajar Golbabaei Pasandi, Sepideh Mahdavi, Seyedeh Solmaz Talebi, Shayesteh Jahanfar, Mina Shayestefar & Mohammad Hossein Ebrahimi. *Investigating the prevalence of hearing loss and its related factors in professional drivers in Shahroud city, Iran*. Pages: 1994-1999.

Objectives. A cohort study was designed and implemented to determine the prevalence of hearing problems and their related factors in professional drivers in Shahroud city. *Methods.* In total, 1461 professional drivers were examined. Demographic information, work history, blood parameters, and anthropometric and audiometric test data were collected. Hearing thresholds were assessed at frequencies of 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz. *Results.* In total, 64.8% and 54.9% of hearing impairment degrees were observed in the left and right ears, respectively, and this difference was statistically significant. The hearing threshold in the left ear was higher at

all frequencies. The maximum hearing loss was at 6000 Hz, followed by 4000 Hz. There was a significant relationship between hearing loss with age groups for right and left ears and type of car for left ear. *Conclusion.* The prevalence and severity of hearing loss in Shahroud drivers are high, and most hearing loss is observed in the left ear. Given that noise-induced hearing loss is an incurable condition and has a significant impact on individuals' quality of life and employment, drivers should be regularly screened for ear damage under the variables affecting hearing loss, and noise prevention training should be provided.

- **Keywords:** hearing loss, professional drivers, noise, audiometry

Nilufer Kursunoglu & Maruf Gogebakan. *Prediction of spontaneous coal combustion tendency using multinomial logistic regression*. Pages: 2000-2009.

Spontaneous combustion of coal is a complex underground mining disaster, which mainly threats mine safety and efficiency. Several factors usually cause spontaneous combustion of coal, such as gas concentration, ventilation and coal properties. In this study, spontaneous combustion tendencies of coal mines were predicted considering the effective parameters for an underground coal mine in Turkey. Multinomial logistic regression, a multivariate statistical technique, was applied. Gas concentrations (CH4, CO, O2) and air velocity were defined as factors affecting spontaneous coal combustion. Fire hazard levels of the coal mines were determined as 'normal situation' and 'potential combustion'. It was observed that CH4 and CO variables and CH4 × CO interaction were effective in the formation of clusters. The results indicate that Mine I is more liable to spontaneous combustion than Mine II and Mine III. At the same time, the effects of variations in factors are examined in the study.

- **Keywords:** coal mine, hazard, spontaneous combustion, multinomial logistic regression, statistical technique

Akram Sadat Jafari Roodbandi, Alireza Choobineh, Niloofar Barahmand & Masoumeh Sadeghi. *Research outputs in ergonomics and human factors engineering: a bibliometric and co-word analysis of content and contributions*. Pages: 2010-2021.

This article analyzes research outputs in ergonomics and human factors engineering (EHFE), revealing its intellectual structure via bibliometric techniques, co-word analysis, network analysis and science visualization tools. The population comprises 23,472 records published during 2000–2018 in 19 core journals of the human factors and ergonomics subject category in Scopus. Findings showed that in EHFE fields 'the United States', 'University of Central Florida' and 'Stanton NA' were the most productive country, university and author, respectively. It was also found that 'ergonomics' was the most frequent keyword and 'ergonomics × human factor' the most frequent co-occurring keywords in EHFE documents. Hierarchical cluster analysis led to creation of eight topical clusters, including among others 'biomechanics ergonomics', 'work-related musculoskeletal disorders & work system design' and 'performance'. The results indicated that 'biomechanics ergonomics' was a well-matured cluster while 'human machine interaction', 'ergonomics design', 'macro-ergonomics' and 'cognitive ergonomics' were found to be emerging or declining clusters.

- **Keywords:** ergonomics, human factors engineering, knowledge structure, bibliometrics, co-word analysis

Yun Teng, Xinlin Chen & Li Ma. *Research on the influence of job embeddedness on individuals with different initiative*. Pages: 2022-2032.

'How to improve individual initiative' has become an important subject facing current researchers and practitioners. This study attempts to answer this question from the perspective of on-the-job embeddedness based on social cognitive theory, organization attachment theory and cognitive neural experiment. We revealed the differences in the effects of three dimensions of on-the-job embeddedness on individuals with different initiative by event-related potential (ERP) cognitive neural experiment. The experimental results showed that the effect on high-initiative individuals was in the descending order of organization fit, organization link, organization sacrifice; the effect on general-initiative individuals was in the descending order of organization link, organization fit, organization sacrifice; the effect on low-initiative individuals was in the descending order of organization sacrifice, organization link, organization fit. The ultimate goal is to put forward management strategies for individuals with different initiative from these three dimensions, to promote their initiative level and active participation in production activities.

- **Keywords:** on-the-job embeddedness, individuals with different initiative, event-related potential cognitive neural experiment, social cognitive theory, organizational attachment theory

Mahdi Malakoutikhah, Moslem Alimohammadlou, Hadiseh Rabiei, Seyed Aliakbar Faghihi, Mojtaba Kamalinia & Mehdi Jahangiri. *A scientometric study of unsafe behavior through Web of Science during 1991–2020*. Pages: 2033-2045.

Objectives. This scientometric study aimed to investigate research and hot topics on unsafe behavior. *Methods*. The study was performed using scientometric analysis mapping tools, such as CiteSpace, Gephi, MINITAB and VOSviewer, for statistical analysis. Studies published in Web of Science were included. *Results*. The first study was published in 1987. The results of the study showed that the *Safety Science* journal with 111 studies (10.45%) presented most of the published studies in this field. The USA and China were the two highest producing countries, with 289 and 229 published studies, respectively. The results of keywords and hot topics showed that between 1991 and 2000 safety climate, safety performance and modeling were ranked as the first to third most frequent words, and during 2001–2010 safety performance was removed from the list of top 10 keywords while safety climate and modeling were ranked, respectively, ninth and sixth most frequent. Finally, between 2011 and 2020, the keyword of organizational factors rose to first rank, indicating the significance of this keyword in the future. *Conclusions*. According to the results of the present study, it can be concluded that future studies on unsafe behavior can be conducted in the field of organizational factors.

- **Keywords:** unsafe behavior, scientometric, cooperative relationship, citation analysis, keyword frequency analysis

Melisew Mekie Yitayal, Sileshi Ayhualem, Berihu Fiseha, Gebresilassie Kahasay, Moges Gashaw & Hagazi Gebre. *Occupational lower back pain and associated factors among taxi drivers in Mekelle city, north Ethiopia: a cross-sectional study*. Pages: 2046-2051.

Objectives. This study aimed to assess the prevalence and associated factors of lower back pain (LBP) among taxi drivers working in Mekelle city, Tigray, Ethiopia in 2018. *Methods*. A community-based cross-sectional study was conducted from April to

May 2018 on a sample of 294 male taxi drivers in Mekelle city, Tigray, Ethiopia. A self-administered questionnaire adapted from the Nordic musculoskeletal questionnaire was used to collect data. Independent variables that had a significant association were identified using logistic regression models. Results were reported using texts and frequency distribution tables. *Results*. From a total sample of 304 male drivers, 294 taxi drivers participated; hence, the response rate was 96.7%. Prevalence of self-reported LBP in the past 12 months among taxi drivers was 27.9%. Average daily hours of driving (adjusted odds ratio [AOR] 2.296, 95% confidence interval [CI] [1.194, 4.416]), using lumbar support while driving (AOR 2.075, 95% CI [1.130, 3.808]) and lack of ergonomic awareness (AOR 2.478, 95% CI [1.343, 4.575]) were significantly associated ($p < 0.05$) with LBP among taxi drivers. *Conclusion*. Prevalence of LBP in this study was more than a quarter. Average daily hours driving, use of lumbar support and ergonomics awareness were significant determinants of LBP among taxi drivers.

- **Keywords:** prevalence, lower back pain, taxi drivers, Ethiopia

Kishor Bhagwat & Venkata Santosh Kumar Delhi. *Investigation of multi-level safety culture in the Indian construction industry: a multi-level employees' perception-based approach*. Pages: 2052-2065.

Inadequate compliance with safety practices is a major hurdle in the construction industry, and a single-level source of input to assess safety culture is a major limitation of the literature. Therefore, this study aimed to capture multi-level employees' (top management, middle management and workers) perceptions to assess multi-level safety culture (organizational level, project level and personnel level) in the construction industry. This study considered the Indian construction industry as the study area and used a questionnaire survey and interview technique as research instruments. In total, 184 responses were collected from multi-level employees. Data analysis was performed using a descriptive statistical method and hypothesis testing using the Mann–Whitney *U* test followed by the Kruskal–Wallis and post hoc tests. Findings highlighted inadequate safety compliances and significant ($p < 0.05$) perception differences among multi-level employees. Further, root cause analysis for observed perception differences was performed, and managerial implications were discussed from implementation perspectives.

- **Keywords:** safety culture, construction safety, safety management, perception-based study, building project

Qingwen Zhang, Dan Zhang & Pin-Chao Liao. *Leading indicators of mental representation in construction hazard recognition*. Pages: 2066-2079.

Hazard recognition is mainly a visual search and cognitive process. Mental representations of hazards may impact mental states of hazard recognition. We assessed the effects of critical indicators of mental presentations of construction hazards on prefrontal cortex activation, a proxy for the mental states of hazard recognition. Students participated in a hazard inspection experiment, with near-infrared spectroscopy (NIRS) used to record prefrontal cortex activation. The effects of critical indicators of the hazards' mental representations on prefrontal activation were analyzed. Results demonstrated that site familiarity, risk tolerance and safety knowledge have significant effects on medial prefrontal activation for hazards at a low visual clutter level. High levels of site familiarity and risk tolerance reduced medial prefrontal activation and saved cognitive resources. Theoretically, the findings supplement the knowledge of safety hazards' mental representations; and practically, the findings guide provision of individual-specific guidance for improving workers' hazard inspection performance.

- **Keywords:** hazard recognition, near-infrared spectroscopy, prefrontal cortex, oxygenated hemoglobin concentration change

Sohrab Amiri. *Unemployment associated with major depression disorder and depressive symptoms: a systematic review and meta-analysis*. Pages: 2080-2092.

Objectives. This study investigated the association between unemployment and depressive symptoms and major depression disorder worldwide using a systematic review and meta-analysis. *Methods*. Search time was limited to all articles published in English until December 2020. In the association between unemployment and depression, first, the results of qualified studies were extracted and, then, the results of each study were pooled with each other using the random effects method. *Results*. The prevalence of depression in the unemployed is 21%, 95% confidence interval (CI) [18, 24%]. This prevalence for depression symptoms is 24%, 95% CI [20, 28%] and for major depressive disorder is 16%, 95% CI [9–24%]. The association between unemployment and depressive symptoms was odds ratio (*OR*) 2.06, 95% CI [1.85, 2.30] and the association for major depressive disorder was *OR* 1.88, 95% CI [1.57, 2.25]. The association between unemployment and depression in men was *OR* 2.27, 95% CI [1.76, 2.93] and in women was *OR* 1.62, 95% CI [1.40, 1.87]. *Conclusions*. What is clear from the present study is that unemployment can lead to a higher prevalence of depressive symptoms and major depressive disorder, thereby undermining the mental health of the unemployed.

- **Keywords:** unemployment, major depression disorder, depression symptoms, meta-analysis, systematic review

Dušica Savić, Vladimir Mučenski, Trajče Velkovski, Jovana Topalić Marković, Miodrag Hadžistević & Miloš Šešlija. *Model for improvement of occupational health and safety in micro and small construction enterprises*. Pages: 2093-210.

This article presents research on qualitative parameters conducted in order to develop a model for the improvement of occupational health and safety (OHS) in micro and small construction enterprises (MSEs). Identification of factors and defining their significance enables improvements of OHS in the observed enterprises. The aim of the model is to assist MSEs in evaluating their qualities, pinpointing their deficiencies and ways to maximize the improvement of OHS performances. A panel of 20 experts defined the factors through an iterative process using the Delphi method. The research resulted in a model consisting of 42 OHS factors grouped into 10 categories. Model validation was carried out in the Republic of Serbia. The validation confirmed the applicability of the model as well as the relevance of factors that were determined by the panel of experts.

- **Keywords:** construction, Delphi method, evaluation, riskmodel

João Marcos Bernardes, Patricia Estela Monteiro-Pereira, Juan Gómez-Salgado, Carlos Ruiz-Frutos & Adriano Dias. *Healthcare workers' knowledge for safe handling and moving of the patient*. Pages: 2105-2111.

Objectives. Healthcare workers are at risk of injury during patient handling activities. There is a lack of research in safe patient handling. The objective of this study was to examine the knowledge level of safe patient handling among Brazilian healthcare workers and to analyze its associated factors. *Methods*. This cross-sectional study was performed in two hospitals and 47 outpatient facilities with 644 participants in Brazil. Healthcare workers completed a self-administered questionnaire about their working characteristics,

history of lower back pain and knowledge of safe patient handling. *Results.* The mean score of safe patient handling knowledge was 11.89 out of 22 maximum points. More than half (59%) of the participants did not see the risk of their activity. Educational level, type of healthcare facility and outpatient clinics were associated with safe patient handling knowledge in the logistic regression model. *Conclusion.* There was a substantial deficit in safe patient handling knowledge. There is a need for courses and textbooks to move beyond ineffective preventive strategies and minimize the risk of manual patient handling. Healthcare workers are at risk of injury during patient handling activities. Nursing schools in developing countries must focus on researching this topic to ensure safe patient handling.

- **Keywords:** moving and lifting patients, lower back pain, musculoskeletal pain, ergonomics, healthcare workers, preventive health, occupational health

Amani S. Ahmed & Ramadan Mohamed Eldahshan. *Occupational dermatoses: knowledge, attitudes and perceptions among motor vehicle repair workers*. Pages: 2112-2118.

Objectives. Motor vehicle repair workers are a vulnerable group for developing occupational dermatoses. They are exposed to a wide range of chemical, physical and mechanical hazards. This study aimed to assess the prevalence of occupational dermatoses among motor vehicle repair workers and their risk factors, and to evaluate the effect of a health educational program. *Methods*. The study was conducted among 106 motor vehicle repair workers. All participants were personally interviewed at their workshops and were subjected to the Nordic occupational skin questionnaire, dermal exposure knowledge, attitudes and perceptions questionnaire, dermatological examination and health educational program. Then, evaluation of the effects of health the program was done after 2 months. *Results.* Exclusively occupational dermatoses (18.9%) were followed by work-related dermatoses (17.9%). Chronic contact dermatitis was the most frequent exclusively occupational dermatoses (12.26%), followed by tar/oil acneform rash (3.77%) and mechanical injury (3.77%). Xerosis (6.6%) and hyperpigmentation (4.71%) were the most frequent work-related dermatoses. Lack of use of personal protective equipment, older age, longer duration of work, exposure to chemical hazards and car mechanics were the independent risk factors. *Conclusions.* A significant improvement occurred in the participants' knowledge about dermal exposure, behavioral action for prevention and overall belief (pre/post intervention) ($p < 0.01$).

- **Keywords:** motor vehicle repair workers, dermatoses, knowledge attitudes and perceptions

Tugba Yilmaz & Isil Isik Andsoy. *Musculoskeletal system disorders among surgical nurses related to the health industry in northwestern Turkey: a cross-sectional study*. Pages: 2119-2124.

Objectives. Nurses may encounter musculoskeletal disorders (MSDs) and pain episodes stemming from regular exposure to health industry risk factors. This study aimed to determine the prevalence of MSDs and associated factors among Turkish surgical nurses. *Methods*. A cross-sectional design using self-administered questionnaire surveys was employed with 169 surgical nurses. The survey included an individual data questionnaire and the Nordic musculoskeletal questionnaire – extended (NMQ-E). *Results*. In total, 88.8% of the surgical nurses had musculoskeletal system disorders, and most experienced these problems related to the health industry. The interventions causing physical strain in the participants were identified as constant standing up, patient care, carrying heavy loads, sudden movements, patient transfer and pulling–pushing practices. The nurses used coping methods including walking, exercising, receiving physiotherapist support, pilates and yoga. The most frequently encountered problems were in the back region. A significant relationship was found between musculoskeletal

system problems and the clinic of work, years of work, age and gender ($p < 0.05$). *Conclusions*. Nurses experience musculoskeletal problems related to the health industry. It is crucial to determine the real causes of musculoskeletal problems and take appropriate preventive measures to improve workplace ergonomics.

- **Keywords:** musculoskeletal system disorders, pain, causes, surgical nurses

Bezalel Orogun & Mohamed H. Issa. *Developing, validating and implementing performance metrics to evaluate the health and safety performance of sustainable building projects*. Pages: 2125-2137.

Objectives. This research aims to develop, validate and implement health and safety performance metrics to evaluate the health and safety performance of sustainable building projects throughout their design and construction in Manitoba. *Methods.* Thirty-four metrics were developed following a detailed literature review and validated by expert judgement based on analytic soundness, practicality and predictability. Only 25 metrics satisfied these criteria, of which five were implemented via data collected on seven sustainable buildings and seven non-sustainable buildings. *Results.* The results showed that sustainable building projects had 12.7% higher recordable injuries rates than non-sustainable projects, although the difference was statistically insignificant. Findings from this research showed that for sustainable and non-sustainable building, PM 19 'The percentage of workers with unsafe behaviour based on conducted safety observations' had a statistically significant and strong negative correlation with PM 8 'The percentage of workers who attended safety meetings' and with PM 21 'The percentage of the total workdays in which safety meetings were held'. *Conclusion.* The findings of this research can be used by general contractors and safety practitioners looking to enact evidence-based guidance to manage safety proactively on site and improve health and safety performance of their sustainable building projects.

- **Keywords:** sustainable building, construction safety, safety metrics, performance metrics, safety performance

Metin Bayram, Bulent Arpat & Yilmaz Ozkan. *Safety priority, safety rules, safety participation and safety behaviour: the mediating role of safety training*. Pages: 2138-2148.

Objectives. This study explores the effects of employee perception of the management's safety priority, safety rules and safety training on safety participation and safety behaviour decided by management, as well as the mediating role of safety training on the other four dimensions. *Methods*. The study covers employees working in 27 metal companies classed as hazardous/very hazardous in Turkey. The research data were collected by surveying 822 employees in the metal sector. Collected data were tested through explanatory and confirmatory factor analyses, in that order. *Results*. The findings of this analysis indicated statistically direct, positive effects of safety priority on safety rules and safety training, such an effect of safety rules on safety training, and again such effects of safety training on safety participation and safety behaviour. Besides, indirect relationships were detected between safety priority and safety rules and safety participation, and safety behaviour through the mediating role of safety training. *Conclusion*. Employee participation in health and safety issues as well as safe behaviour in the workplace depend on management prioritizing health and safety issues as much as production, formulating safe working rules, procedures and practices using comprehensive and regular training programmes.

- **Keywords:** safety training, safety participation, safety behaviour, safety rules, safety priority, safety climate, safety culture

Tiju Baby, G. Madhu & V. R. Renjith. *A path model approach to safety compliance and personal factors among electrical workers in India*. Pages: 2149-2160.

This article reports the findings from a safety research survey conducted among the employees of a large public-sector electrical utility in the state of Kerala, India. Responses from 3017 employees were collected by one-to-one interaction using the developed instrument. Personal factors like self-esteem, job stress, personal stress, social support and fatigue of the targeted population were measured. Personal safety climate factors of the utility were accessed by modifying the existing safety climate scales. Statistical analysis confirmed the reliability and validity of the factors in the study. A significant path model of personal and safety climate factors was developed. Seven research hypotheses were validated using statistical analysis. The results of the study highlighted the need for safety participation, safety knowledge, safety training and interventions to reduce personal issues in the workplace. These findings provide valuable insights for safety professionals for implementing novel methods to ensure workplace safety.

- **Keywords:** personal factors, safety climate, safety behaviour, factor analysis, mediation, path analysis

Bahman Baraei, Hassan Mahmoodi, Khaled Rahmani, Koen Ponnet & Tahereh Pashaei. *Predictors of safety behaviors among cement factory workers*. Pages: 2161-2167.

Objectives. Risk perception can affect safety behaviors. The purpose of this study was to determine the relationship between safety behaviors and risk perception among cement factory workers. *Methods.* The study was conducted on all 236 workers of a cement factory in Bijar, Iran. Three valid questionnaires were used: a sociodemographic and job-related questionnaire, a risk perception questionnaire and a safety behavior questionnaire. Data were analyzed using the χ^2 test and multiple linear regression analysis. *Results.* The mean age of participants was 38.1 (±8.4) years. The level of risk perception was high among 60.6% of participants and moderate among 33.1% of them. Additionally, 67.8% of participants had diligent engagement in safety behaviors. The results of the study revealed that job type, experience with workplace events and engagement in safety behaviors had a significant positive relationship with risk perception. *Conclusions.* This study shows that risk perception, safety training and supervision have a significant positive relationship with the engagement in safety behaviors. The findings of this study can be used in designing workplace interventions to reduce occupational dangers. Motivational strategies are suggested to encourage workers to use personal protection equipment.

- **Keywords:** cement factory, risk perception, safety behaviors, worker

Fadi Hamad, Nadine Marie Moacdieh, Rim Banat, Zavi Lakissian, Saif Al-Qaisi, George Zaytoun & Rana Sharara-Chami. *Perceptions on music and noise in the operating room: a cross-sectional study*. Pages: 2168-2172.

Objectives. Noise in operating rooms (ORs) during surgery may affect OR personnel and pose a threat to patient safety. The sources of noise vary depending on the operation. This study aimed to investigate how OR staff perceived noise, whether music was considered noise and what its perceived effects were. *Methods.* Surgeons, anaesthesiologists, residents and nurses were interviewed. iPads were placed in the ORs to gather noise-level data. *Results.* Ninety-one interviews were conducted. Most participants (60.5%) reported the presence of noise and 25% the presence of music in the OR. Noise data from iPads registered levels ranging between 59.52 and

85.60 dB(*A*). χ2χ2 analyses yielded significant results between participants' role and the perceived effects of noise ($p = 0.02$). Responses to open-ended questions were thematically categorized. *Conclusions*. Surgeons generally chose the music played in ORs and were likely positively inclined to its effects, while anaesthesiologists and nurses minded the lack of choice and were more likely to consider it as noise.

- **Keywords:** music, noise, surgery, perceptions of health, care workers, operating room

Hanna Barbara Rasmussen & Dewan Ahsan. *The safety programme as a tool of improvement for safety culture in the workplace: an exploratory follow-up study from the Danish offshore oil and gas sector*. Pages: 2173-2182.

Offshore industry has always been a risky working place, and therefore there has always been a strong focus on maintaining the highest safety standards. The present research aims to ascertain the effects of a new safety mindset from both individual employee and organizational angles, and is based on two surveys conducted in 2010 and 2014 on Danish oil production platforms in the North Sea and qualitative data from interviews, observations and documentary analysis. The participating offshore oil company introduced a new safety mindset at the beginning of 2010 to all of their employees and subcontractors. The results indicate that there were some significant, positive changes both in individual employee attitudes towards safety and in strong organizational commitment to work closely with employees to ensure the highest workplace safety status on oil platforms. However, the results also show that it is important to maintain a campaign to ensure these positive effects.

- **Keywords:** safety culture, safety climate, offshore oils, afety campaigns

Roger Barker, Xiaomeng Fang, Shawn Deaton, Emiel DenHartog, Huipu Gao, Robert Tutterow & Marni Schmid. *Identifying factors that contribute to structural firefighter heat strain in North America*. Pages: 2183-2192.

This article describes results from a survey of firefighters designed to identify conditions that contribute to heat strain in structural firefighting. Based on responses from about 3000 firefighters across the USA and Canada, the article provides invaluable information about how firefighters associate environmental conditions, work tasks and other factors with heat strain. One-half of firefighters surveyed have experienced heat stress during their service. They can wear fully deployed turnout gear for 2 h or more at the fire scene, reinforcing the importance of turnout suit breathability as a factor in heat strain. Survey results are useful in weighing the comparative value of total heat loss (THL) and evaporative heat resistance (Ref) for predicting turnout-related heat strain. Survey findings support the inclusion of a performance criterion in the National Fire Protection Association 1971 standard for firefighter personal protective equipment based on limiting Ref of turnout materials along with current THL requirement.

- **Keywords:** firefighters' heat strain, North America, survey, thermal environments, personal protective equipment, turnout gear, work load, time distribution

Efi Yuliati Yovi, Dalia Abbas & Takuya Takahashi. *Safety climate and risk perception of forestry workers: a case study of motor-manual tree felling in Indonesia*. Pages: 2193-2201.

Timber harvesting processes, especially motor-manual felling, are hazardous to forestry workers' health and safety. The purpose of this study is to examine forestry workers' mental safety models (at the supervisor and operator levels) using the Nordic safety climate questionnaire. This study also examines how operators and their families perceive workplace risks (dread and unknown risk factors). The safety climate analysis revealed that supervisors misunderstand management safety priority, competence, empowerment and justice. Additionally, this study found that operators do not yet prioritize safety. There was a lack of safety communication and operators' skepticism about the current safety system. These findings highlight the critical importance of implementing safety measures into operators' work environments. The risk perception analysis revealed that family members had a greater risk aversion to dread risk factors than operators. As a result, we see a possibility for family members to act as safety-net figures, bolstering the operators' safety values.

- **Keywords:** ergonomics, health support network, psychometric paradigm, safety behavior, workplace safety

Leonidas A. Zampetakis. *Occupational hazard perceptions as factors influencing students' intentions to engage in part-time jobs*. Pages: 2202-2209.

Purpose. The purpose of this study was to investigate the joined effects of students' perceived importance of occupational hazards and financial gains on intentions to engage in part-time jobs. The role of students' maturity value levels was also investigated. We used conservation of resources theory (COR) and job demands-resources (JD-R) theory as theoretical frameworks to test our hypotheses. *Method*. We conducted a factorial survey experiment using a sample of 858 students. Multilevel regression analyses with random effects were used to investigate effects of hazards perceptions and financial gains on intentions to engage in part-time jobs. The direct and moderating effects of students' maturity values were investigated. *Results*. Students considered financial gains more important in developing their intentions to take a part-time job, compared to occupational hazards. We also found interactions between occupational hazards and between occupational hazards and financial gains in predicting intentions. Students' maturity scores were negatively related to intentions and moderated the effects of financial gains and perceptions of psychological hazards on intentions. *Conclusion*. The study provided insights into students' perceptions of occupational hazards and financial benefits and their intention to take a part-time job. The results also indicate the direct and moderating effects of students' maturity values.

- **Keywords:** job hazards, part-time job, students, multilevel models, factorial survey experiment

Necmiye Yalcin Ocak, Murat Yesilaras, Yesim Eyler & Onur Hakoglu. *Occupational accidents of emergency medicine residents in Turkey*. Pages: 2210-2215.

Objectives. Healthcare workers face many biologic, chemical, physical and psychosocial hazards and risks in their work environment. Our research aimed to examine the types and frequency of occupational accidents, their notification status and predisposing factors to which emergency medicine residents (EMRs) were exposed in the last 12 months in Turkey. *Methods.* This research is a national, multicenter, online descriptive survey study. Participants' descriptive features, characteristics of occupational accidents they

were exposed to in the last 12 months and their use status of personal protective equipment (PPE) were examined. *Results*. We found that 215 EMRs were exposed to 1919 occupational accidents in the last 12 months, and only 287 of these accidents were reported. All participants had at least one occupational accident in the previous 12 months. PPE was not used in 37.9 and 44% of biologic and chemical transmission accidents, respectively. The PPE use frequency of the EMRs in necessary situations for examination gloves, surgical masks, respirators, goggles, gowns and face shields was 60, 19, 19, 8, 15 and 4%, respectively. *Conclusion*. The actual number of occupational accidents was determined to be considerably higher than those reported. PPE use habits of EMRs were less than they should be.

- **Keywords:** emergency medicine residents, occupational accident, personal protective equipment

Selçuk Alp, Fatih Yilmaz & Ebru Geçici. *Evaluation of the quality of health and safety services with SERVPERF and multi-attribute decision-making methods*. Pages: 2216-2226.

Evaluating the quality of occupational safety and health (OSH) services by experts is essential for both employee health and workplace productivity. In this study, first, the quality of OSH services is evaluated with a questionnaire using the SERVPERF method. Then, a questionnaire prepared according to the analytic hierarchy process (AHP) method is applied to OSH experts and the relative importance of the main dimensions and items in the SERVPERF method are determined. The weights of the items in the SERVPERF method are calculated with the AHP and fuzzy-analytic hierarchy process (FAHP). The quality scores obtained by the SERVPERF, AHP and FAHP methods are analyzed comparatively. The results show that the work environment-related measures and physical facilities in the workplaces are more inadequate, whereas assurance and empathy are better. Moreover, the items with the lowest value in the SERVPERF method get the highest score in the AHP and FAHP.

- **Keywords:** SERVPER, Fanalytic hierarchy process, fuzzy-analytic hierarchy process, safety, quality, multi-attribute decision-making

Haji Omid Kalteh & Hamidreza Mokarami. *A macroergonomics perspective for exploring safety culture factors: a qualitative content analysis approach*. Pages: 2227-2237.

Objective. Although assessing safety culture is a useful approach in reducing occupational accidents, there are no qualitative examinations of it based on a systems approach. This study was conducted with the aim of explaining the experiences of gas refinement personnel on safety issues and extending safety culture constructs using a macroergonomics approach. *Methods.* A directed qualitative content analysis was used. Data were collected by 18 semi-structured interviews based on a work subsystems model as a guiding framework. *Results*. From the interviews, 420 codes were extracted. By placing codes into subsystems, five categories in the organization subsystem, two categories in the job subsystem, one category in the human subsystem, two categories in the technology subsystem and two categories in the environment subsystem emerged. In addition to the common factors in assessment scales, factors such as work schedule, safety standards in new technologies and external factors of the organization like financial conditions were considered effective for workers' attitudes and safety behaviors. *Conclusion*. Investigating personnel perspectives about safety in the workplace based on a macroergonomics approach developed distinct factors in safety culture. It seems that industry features, environment and technology along with organizational factors are important in assessing safety culture.

- **Keywords:** macroergonomics, safety culture, organization ergonomics, sociotechnical system theory, qualitative content analysis

Iqra Javed, Siti Zawiah Md Dawal, Yusoff Nukman & Ashfaq Ahmad. *Prediction of work productivity outcomes by identifying critical risk factors among garment industry workers*. Pages: 2238-2249.

Work productivity is one of the most important economic measures in the manufacturing industry. However, the physical, psychosocial and individual risk factors of an industrial work environment affect workers' physical or mental health, resulting in work productivity loss, absenteeism and presenteeism. Therefore, this study aims to identify the most critical risk factors and develop statistical models for predicting work productivity loss, absenteeism and presenteeism of garment industry workers. A sample of 224 sewing machine operators was taken for data collection through observation and self-reported studies. The results indicated that the average work productivity loss, absenteeism and presenteeism was 38.21, 2.35 and 37.23%, respectively. Finally, the statistical models of work productivity loss, absenteeism and presenteeism was developed using multiple linear regression with precision of 69.9, 53.7 and 84.0%, respectively. Hence, this study will help garment industries to improve their work productivity by taking initiatives based on the developed models.

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

Gabriela Gracia, Alison Guzman & Linda Forst. *Design, implementation and evaluation of a participatory ergonomics program among home-based Mapuche weavers*. Pages: 2250-2261.

The Mapuche comprise 80% of the indigenous population of Chile. The Araucanía has the highest concentration of Mapuche peoples and is also the poorest region of the country. The region's proximity to a large tourist sector provides opportunities for weavers to work from home and sell their products as a primary or secondary income source. The adverse health effects related to craft production and home-based work are significant and not well described in the literature. Participatory ergonomics (PE), an approach that emphasizes the input and participation of individuals directly impacted by the work being studied, is a strong fit for this population. This article describes a PE project among 33 Mapuche weavers that characterizes the hazards, risks and perceived adverse health effects associated with home-based weaving and the identification, implementation and evaluation of three ergonomic interventions. This project can inform the development of sustainable ergonomics health programs for home-based artisans.

- **Keywords:** Indigenous, artisans, weaving, participatory ergonomics, hazards, community-based participatory research, interventions

Rahul Jain, Makkhan Lal Meena & Kunj Bihari Rana. *Risk factors of musculoskeletal symptoms among mobile device users during work from home*. Pages: 2262-2268.

Objectives. Coronavirus (COVID-19) is affecting people throughout the world. People are forced to conduct various activities at home using mobile devices (MDs) as a result of the outbreak. In this case, prolonged use of MDs is the major cause for work-related health problems. *Methods.* We used systematic cluster random sampling to sample a diverse group of Indians from India's various states. Subjects filled out a questionnaire with questions about their demographics, MD usage and musculoskeletal symptoms (MSSs) faced. The relationship between MSSs and various factors was investigated using χ^2 and binomial logistic regression analysis. *Results.* An online survey yielded 720 responses. More than half of employees registered MSSs in their upper body regions. Age, gender

and MD usage were correlated with MSSs in various body regions. According to the binomial logistic regression findings, gender was significantly linked to MSSs in each body region. *Conclusions.* Results show that MDs can be used effectively in intermediate leisure activities if they are used in accordance with their basic needs.

- **Keywords:** COVID-19 pandemic, device usage, musculoskeletal health, musculoskeletal symptoms, work from home

Prabhu Muniswamy, Irene Grace Peter, Varadayini Gorhe & Baskaran Chandrasekaran. *Association between physical and mental health variables among software professionals working at home: a secondary analysis*. Pages: 2269-2277.

The association of physical activity (PA) or sedentary behaviour (SB) with mental health in remotely working software professionals remains unclear. We administered a secondary analysis of physical health variables (PA and SB time during work and non-work days) and mental health variables (stress, anxiety, depression) from a primary study. Ninety-five per cent of the participants ($n = 76$) did not meet the global PA recommendations. Our study found daily PA time to be negatively associated with stress ($\beta = -1.57$; $p = 0.02$), anxiety ($\beta = -1.01$; $p = 0.04$) and depression ($\beta = -0.68$; $p = 0.47$). Furthermore, the average daily sitting time during the work day was found to be positively associated with stress ($\beta = 0.28$; $p = 0.00$), anxiety ($\beta = 0.01$; $p = 0.04$) and depression ($\beta = -0.68$; $p = 0.03$). Organizational policies should advocate the implementation of PA or SB strategies for improving mental health in remote workers.

- **Keywords:** sedentary work, physical health, mental health, Facebook, COVID-19, physical activity, mental health, sitting time, work from home

Ahmet Cigiloglu, Ercument Ozturk, Sencer Ganidagli & Zeynel Abidin Ozturk. *Different reflections of the face mask: sleepiness, headache and psychological symptoms*. Pages: 2278-2283.

Objectives. The COVID-19 pandemic has had significant physical and mental effects on healthcare workers. This study aims to evaluate the relationship between wearing face masks and headache, sleepiness, mood and anxiety symptoms in healthcare workers. *Methods.* A survey was administered to 365 healthcare workers working during the pandemic. The Beck depression inventory, the Beck anxiety inventory and the Epworth sleepiness scale were used to assess depressive symptoms, anxiety symptoms and daytime sleepiness, respectively. Participants were also asked about new-onset headaches. *Results.* Almost half of the participants (47.6%) reported new-onset headaches, and 23.2% reported excessive daytime sleepiness. The frequencies of depressive and anxiety symptoms were 43.7 and 59.2%, respectively. Sleepiness scores and new-onset headache frequency were higher in women and those using filtering facepiece respirators. A statistically significant positive correlation was found between mask-wearing duration, depressive and anxiety symptom scores, and sleepiness score. *Conclusions.* The present study has shown that many healthcare workers wearing face masks suffered from sleepiness, headaches and psychological symptoms during the COVID-19 pandemic. These findings indicate the importance of improving working conditions and planning psychological interventions for healthcare workers.

- **Keywords:** face mask, sleepiness, headache, healthcare workers, COVID-19

Aisah Timbang, Reddy Prasad D. M., Mohammad Hazwan bin Azri & Salwa Sofri. *Addressing process safety challenges in downstream industries in Brunei Darussalam*. Pages: 2284-2292.

International oil and gas corporations operating in Brunei may apply process safety management (PSM) and analysis techniques, resulting in varying approaches and measures to address process safety issues. Global corporations may have developed their own process safety standards while smaller firms employ established ones. This research compares the local PSM systems and standards with international ones to determine which employers face the most difficulties in implementing or increasing process safety inside their organizations. This study found that Occupational Safety and Health Administration (OSHA) regulations are used by 30% of local users in downstream operations. Common challenges encountered by local users are management/leadership commitment to process safety (11.9%), mechanical integrity and management of safety critical devices (5.3%), management review and intervention for continuous improvement (4.9%), communication amongst workers (3.8%), management of change (3.8%), operational control, permit to work and risk management (3.8%) and incident reporting (3.8%).

- **Keywords:** process safety management, process safety elements, hazardous chemical, downstream industries, Occupational Safety and Health Administration

Max Koschmann, Lewis Collins, Tom Spencer & Sungkon Moon. *Empirical investigation into underground utility strikes for supporting incident prevention: cases in Melbourne, Australia*. Pages: 2293-2301.

Underground utilities pose a hazard during excavation works. One-call services are available to prevent strikes by providing relevant drawings to contractors, such as Dial Before You Dig in Australia. Even with this service and many other technologies, incidents keep occurring at an alarming rate. The research team developed a plan to observe relevant incidents occurring at multiple sites in Melbourne. Thirty cases of service strikes were detected over a 2-year period and the data showed the existence of common causes related to proactiveness in operational management. This includes errors in the use of current tools such as geographic information systems, which need to correctly show the most up-to-date buried infrastructure to be effective. This research also highlighted the need for procedures to be followed that involved having assets marked out on site and proved through non-destructive digging prior to excavation. Two practical scenarios were used to verify the research findings.

- **Keywords:** underground utilities, construction safety, utility strikes, case study, Melbourne, protection procedures

Tarakant Bhagat, Ashish Shrestha, Santosh Kumari Agrawal & Ujwal Gautam. *Musculoskeletal complaints and associated factors among dental practitioners of Nepal: a nationwide survey*. Pages: 2302-2307.

Musculoskeletal disorders (MSDs) constitute a significant occupational hazard among dental practitioners. An online-based e-survey was conducted among 252 registered dentists of Nepal using the Nordic musculoskeletal questionnaire (NMQ) to assess musculoskeletal complaints and work-related characteristics. Musculoskeletal complaints in lower regions were found to be highly prevalent among dental practitioners with prevalence of 76, 27 and 28.2% in the last 12 months, 1 month and 7 days, respectively, followed by musculoskeletal complaints in the neck, wrist/hand and shoulder. Musculoskeletal complaint during the last 12 months was significantly associated with age, years in dental practice after graduation and leave from duty in the past 12 months. Similarly, educational qualification, medical comorbidities and leave from duty were

associated with complaints in the last 1 month. Musculoskeletal complaint during the last 7 days was associated with gender, working hours in a day, practice of four-handed dentistry and patients examined in a day.

- **Keywords:** dentistrye-survey, musculoskeletal complaint, occupational hazard

Vahideh Mohammadi Nezhad, Hamideh Razavi & Mahdi Mohammadi Nezhad. *Effects of mento-physical exercises on mental fatigue of shift work*. Pages: 2308-2314.

Objectives. This study aims to investigate whether mento-physical exercises can decrease mental fatigue during shift work. *Methods*. Research subjects including the control room staff of an urban train system were chosen randomly, for whom mental fatigue was assessed before and after rest breaks for control and experimental groups. A new protocol was applied in the experimental group, including breathing exercises, isometric and isotonic exercises, and progressive relaxation during the inter-shift break. A designed questionnaire and the Stroop test were used to evaluate fatigue and the reaction time, respectively. *Results*. Pre and post-test results showed that mental, visual and physical fatigue and reaction time decreased by 14.48, 49.22, 26.85 and 8.35% in the control group and 36.42, 48.48, 76.37 and 20.56% in the experimental group, respectively. *Conclusions*. At the 5% *a* level, Student's *t* test showed that mento-physical exercises effectively decreased mental and physical fatigue as well as reaction time in the experimental group compared to the control group.

- **Keywords:** mental fatigue, mento-physical exercises, mental recovery

Muhammet Cil & Tarik Gedik. *Research on factors affecting the risk-taking behavior of personnel working in the forest products sector*. Pages: 2315-2323.

Objectives. The fact that occupational accidents are a permanent problem in the forest products sector encouraged this research to be conducted on the factors affecting the risk-taking behavior (RTB) of employees in the sector. Understanding the RTB of employees in the sector would help managers to reduce occupational accidents and to develop effective safety interventions. Therefore, this study aimed to determine the effects of individual, organizational and workplace factors and sub-factors on the RTB of employees by using the structural equation model (SEM). *Methods.* A survey was conducted on 623 employees of the forest products sector in 64 enterprises in the provinces of Düzce, Bolu, Sakarya, Kocaeli and Yalova. *Results.* The results revealed that organizational and workplace factors had a significant effect on the RTB of the employees. However, no effect was found for individual factors, although the sub-factor of cognitive bias had a positive impact on RTB. In contrast, safety climate, safety training, use of personal protective equipment (PPE)-1 and working conditions negatively impacted the RTB of the employees. *Conclusions.* In terms of occupational health and safety, this study could serve to guide both sector managers and decision-makers on ways to improve the safety perception of their employees.

- **Keywords:** risk-taking behavior, forest products sector, structural equation model, enterprise

Rajat Kamble, Avinash Sahu & Sangeeta Pandit. *Occupational ergonomic assessment of hand pain symptoms among Bagh hand block print artisans of the handicraft textile industry in Madhya Pradesh, India*. Pages: 2324-2332.

Objectives. Hand block printing is a highly repetitive and precision job involving tasks such as hitting the wooden hand block with the hands as a hammer, causing chronic mechanical trauma to the ulnar side of the palm. This study aimed to determine the prevalence of work-related hand symptoms, to identify ergonomic risks and musculoskeletal disorders (MSDs) and evidence of mechanical trauma among artisans working in Bagh print of Madhya Pradesh. *Methods.* Occupational risk involved in the artisan's wrist area was identified using the modified Dutch musculoskeletal questionnaire (MDMQ) and modified Boston hand evaluation questionnaire. The Boston hand evaluation questionnaire helps in the measurement of the severity of the symptoms. A direct observation study was performed to identify the chronic effects of mechanical trauma (CEMT) on artisan's hands. *Results*. Symptoms like pain, weakness, numbness and tingling were highly prevalent among the artisans, those with experience <3 years were more likely to report pain during working hours ($p < 0.001$) and those with experience >13 years were more likely to report numbness ($p < 0.001$) and tingling ($p < 0.001$). *Conclusion*. This study supports the evidence that the new artisans are at higher risks of reporting pain and CEMT, including fever and body pain, ultimately causing job loss.

- **Keywords:** chronic mechanical traumahand block printingmusculoskeletal disorderskin dermatitiscallositywrist pain

Ali Raza & Zulfiqar Ali. *Assessment of obstructive and restrictive patterns of lung function among the workers of brick kilns*. Pages: 2333-2339.

This article aims to measure the obstructive and restrictive patterns of lung function of 506 consented workers aged between 18 and 60 years and having at least 1 year of work experience in brick kilns. A questionnaire was completed by workers and also lung functions were measured using a spirometer. It was observed that 81% of workers had abnormal lung function, with 33% obstructive and 67% restrictive impairments. Further severe obstructive impairment was seen in 56% of workers, 41% having moderate obstructive impairment and only 3% with mild obstructive impairment. Forced vital capacity (FVC) and forced expiratory volume in 1 s (FEV1) were significantly reduced ($p < 0.05$) for both restrictive and obstructive impairments while the FEV1/FVC ratio was non-significant for unhealthy workers with restrictive impairments as compared to obstructive impairments. The pulmonary abnormalities of workers were linked to increased occupational exposure to dust and smoke of brick kilns.

- **Keywords:** Kasur, obstructive, restrictive, respiratory problems, spirometry

Mahmut Akbolat, Mustafa Amarat, Yonca Yildirim, Kadir Yildirim & Yunus Taş. *Moderating effect of psychological well-being on the effect of workplace safety climate on job stress*. Pages: 2340-2345.

Objectives. The main purpose of this study is to reveal the moderating effect of psychological well-being on the effect of workplace safety climate on job stress. *Methods.* The cross-sectional study design included the survey method. A total of 291 healthcare professionals returned the survey forms, among which 75.9% were women, and the mean age of the sample was 32.83 ± 6.03 years. Most of the participants (66.6%) had a bachelor's degree or higher. We analyzed the data using a structural equation modeling framework to test both direct and mediating effects. Hayes' Model 4

was used to identify the mediating role of psychological well-being on the effect of workplace safety climate on job stress. *Results*. According to the analysis results, the created model is significant, and psychological well-being plays a mediating role on the effect of workplace safety climate on job stress, reinforcing the negative effect of workplace safety climate on job stress. *Conclusion*. First, the safety environment perceived by employees reduces their stress. Second, psychological well-being plays a mediating role in relation to the effect of safety climate on job stress. This role contributes to the reduction of stress through the improvement of the safety climate.

- **Keywords:** psychological well-being, workplace safety climate, job stress, healthcare, safety, health

Somayeh Tahernejad, Alireza Choobineh, Mohsen Razeghi, Mohammad Abdoli-Eramaki, Hossein Parsaei, Hadi Daneshmandi & Mozhgan Seif. *Investigation of office workers' sitting behaviors in an ergonomically adjusted workstation*. Pages: 2346-2354.

Objectives. Common ergonomic office workstations are designed for a few optimum postures. Nonetheless, sitting is a dynamic activity and the ideal sitting posture is rarely maintained in practice. Therefore, the present study aimed to investigate the sitting behavior of office workers in an actual working environment using ergonomically adjusted workstations to examine whether they promote maintaining appropriate sitting postures. *Methods*. Sitting behaviors (frequency of postures and position changes in different body parts) were explored among 26 office workers during a 60-min sitting duration, using the posture recording and classification method developed by Graf et al. The rapid upper limb assessment (RULA) method was also used to assess postural load. Then, the results of the RULA method were compared with the results from investigating the sitting behavior of office workers. *Results*. Common ergonomic workstations were effective in eliminating some awkward postures. However, some important risk factors such as holding postures with an inappropriate lumbar spine curve (86% of the observations) and maintaining a posture for a long time (for 7–12 min) were observed in the participants' sitting behaviors, while they were neglected in the RULA method. *Conclusions*. The common ergonomic workstations could not guarantee the users' appropriate sitting behaviors.

- **Keywords:** office workers, sitting behavior, dynamic sitting, posture, prolonged sitting, rapid upper limb assessment

Rajitha Kawshalya Mailan Arachchige Don & Seung-Cheol Hong. *Sri Lankan migrant worker perceptions of workplace hazard and safety awareness: case of the manufacturing industry in Korea*. Pages: 2355-2361.

This study was carried out to understand the perspective of unskilled Sri Lankan employees in the manufacturing industry to gain a deeper understanding to learn how to utilize expatriate labor meaningfully in a host country workplace. The structural questionnaire was developed according to previous studies and international labor standards and was validated with an expert in the field. The questionnaire included three parts covering the basic information, perception of workplace hazards, and health and safety awareness of workers. Unfamiliar work practices and processes due to lack of safety and work training have become an impediment. Further investigation of this study shows that language is one of the main barriers to living and working in Korea, the findings of this study indicate where employment permit system (EPS) workers appear to be fervent and our research exhibits the unrevealed image of EPS workers in the Republic of Korea.

- **Keywords:** employment permit system, occupational health, workplace safety, migrant workers, Sri Lankan labor

Niyazi Bilim & Atiye Bilim. *Estimation of the risk of work-related accidents for underground hard coal mine workers by logistic regression*. Pages: 2362-2369.

Coal mining has the most risk in all of the mining sectors. Hence, in this sector, most work accidents encountered are intensive. The demographic characteristics of workers affect the occurrence of occupational accidents. This study aims to develop an equation that predicts workday loss by analyzing the relationship between workers' demographic characteristics and having an accident with workday loss. In this study, work-related accidents between 2014 and 2019 in underground hard coal mines in Turkey were analyzed using logistic regression analysis. An equation is derived that estimates the workday loss with the characteristics of workers in hard coal mines. With the equation derived in this study, employers can determine the potential for work accidents according to the demographic characteristics of the workers and serious work accidents will be prevented. Therefore, proactive solutions can be produced by applying the methods used in this study to different industries.

- **Keywords:** logistic regression, work safety, work accident, coal mine accident, accident analyses

Christian Pilat, Christopher Weyh, Torsten Frech, Karsten Krüger, Emil Schubert & Frank-Christoph Mooren. *An ergonomic welding torch reduces physical load response and improves welding quality in novices: a pilot study*. Pages: 2370-2376.

Objectives. This crossover pilot study aimed to compare the physical load response of an ergonomically improved welding torch versus a conventional torch. *Methods*. Ten inexperienced volunteers performed an experimental augmented virtual welding trial at chest height (ASME code 1G) and overhead (ASME code 4G) with both welding torches in random order. Skeletal muscle load and fatigue were assessed by surface electromyography and changes in isometric peak force. The sensation of pain, perceived exertion and welding execution quality were defined as further outcome parameters. *Results*. The muscle load response in three out of eight muscles was lower in favour of the ergonomic welding torch, which went along with a lower sensation of pain and a higher working accuracy. *Conclusions*. An ergonomically improved welding torch reduces the acute physical load response and sensation of pain, which ultimately allows performing better, and might contribute to prevention of musculoskeletal diseases in the long term.

- **Keywords:** occupation, welding, health, musculoskeletal system, ergonomics

Unai Latorre Erezuma, Ander Espin, Jon Torres-Unda, Izaro Esain, Jon Irazusta & Ana Rodriguez-Larrad. *Use of a passive lumbar back exoskeleton during a repetitive lifting task: effects on physiologic parameters and intersubject variability*. Pages: 2377-2384.

Objectives. This study evaluated the effects of wearing the Laevo v2.56 exoskeleton (Laevo, The Netherlands) on physiological parameters related to working load and metabolic cost (MC) during a lifting task, explored the variability in exoskeleton performance among users and determined whether perceived discomfort negatively correlates with a reduction in MC. *Methods.* Twenty participants completed a 4-min repetitive lifting task with/without the exoskeleton. Respiratory gases, heart rate, blood lactate and ratings of perceived exertion and experienced discomfort were collected, and

MC was calculated. *Results*. Wearing the exoskeleton significantly reduced MC and oxygen uptake during the lifting task by 4.8 and 3.8%, respectively. Workload reduction occurred in 65% of the participants. *Conclusion*. The Laevo v2.56 exoskeleton reduced MC and workload in a repetitive lifting task in a subject-dependent manner. Future studies should focus on identifying factors that could cause performance variability such as user–robot interaction forces.

- **Keywords:** passive back exoskeleton, lower back pain, lifting, metabolic costinter, subject variability

Jean-Pierre Arz, Nicolas Grimault & Ossen El Sawaf. *Experimental assessment of the effect of wearing hearing protectors on the audibility of railway warning signals for normal hearing and hearing impaired listeners*. Pages: 2385-2395.

The influence of wearing hearing protectors on the detection of seven railway warning signals in noise was evaluated by comparisons of the masked thresholds measured with and without hearing protectors, out of a total of 80 listeners. The results show that wearing hearing protection devices (HPDs) improves the audibility for normal hearing listeners whereas it tends to impede the audibility for hearing impaired listeners. Moreover, the impediments greatly depend on the warning signal acoustical characteristics. Statistical analyses were performed in order to propose a criterion for hearing impaired listeners that guarantees their security when wearing hearing protectors. If we do not consider one given high-pitched signal that is not suitable as a warning signal, the conclusion is that security is assured when the average absolute hearing threshold (average at 500, 1000 and 2000 Hz for the best ear) of the listeners remains lower than a hearing level of 30 dB.

- **Keywords:** hearing protector devices, warning signals, audibility, masked threshold, hearing impaired

Patricia Tàpia-Caballero, María-José Serrano-Fernández, Maria Boada-Cuerva, Joan Boada-Grau, Jordi Assens-Serra & Lluís Robert-Sentís. *Age, gender, personality, burnout, job characteristics and job content as predictors of driver fatigue*. Pages: 2396-2402.

Objectives. Several studies have shown that one of the most common causes of collision is driver fatigue since fatigue causes drowsiness while driving and this decreases the driver's ability to maneuver the vehicle and increases the probability of their nodding off and falling asleep at the wheel. This may be due to a variety of personal reasons and specific factors connected to working conditions. In the present work we therefore intend to develop a predictive model for fatigue in professional drivers using the following indicators: age, gender, personality, burnout, characteristics and job content. *Method.* The participants were 516 professional drivers from different transport sectors, obtained through non-probabilistic sampling. SPSS version 25.0 was used for data analysis. *Results.* The predictive capacity of a number of variables that affect drivers by causing fatigue is determined. Fatigue can be predicted through certain variables, with the best predictor being exhaustion (48.8%). *Conclusions.* This research contributes to a greater knowledge of the factors that produce fatigue in professional drivers. It highlights the importance of designing interventions to reduce the incidence of fatigue, resulting in greater well-being for the driver and a lower incidence of collisions.

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

Sonia González-Recio, Maria Boada-Cuerva, María-José Serrano-Fernández, Jordi Assens-Serra, Luis Araya-Castillo & Joan Boada-Grau. *Personality and impulsivity as antecedents of occupational health in the construction industry*. Pages: 2403-2410.

Objectives. In health and safety at work, two main groups of causes of occupational accidents have been identified: unsafe conditions or technical factors; and the causes related to safe behavior or the human factor. The objective of this study is to analyze the predictive variables (emotional intelligence, personality, impulsivity and safety of the work environment) for three factors of the CONS-32 scale (criterion variables: use of protections, personal risk behavior and personal physical workload) in the construction sector. *Methods.* Using a sample of 256 Spanish workers from this sector, we analyzed the significant correlations between the three criterion variables and a set of variables extracted from various instruments, as well as the regression models that explain most of the variance. *Results.* The results show that the main predictive variables that explain the three factors are those related to responsibility as a personality trait, impulsivity and safety of the work environment. *Conclusions.* Based on the empirical evidence found, the most explanatory factor in all cases is safety climate in the work environment.

- **Keywords:** safety, work environment, personality, impulsivity, construction sector, predictive study

Jing Dai, Hang Wang, Lin Yang, Xinsheng Cao, Chunchen Wang, Zhijun Gao, Wendong Hu & Zhihong Wen. *The effects of emotional trait factors on simulated flight performance under an acute psychological stress situation*. Pages: 2411-2418.

Objective. Pilots are commonly exposed to some sources of emotional and cognitive stressors, especially for flight cadets, which have an important influence on flight safety. The present study aimed to study the relationship between emotional trait factors, emotional state, mental workload and simulated flight performance (SFP) under an acute psychological stress situation. *Methods*. Fifty-five undergraduates were included in the study. The Wong and Law emotional intelligence scale (WLEIS), state-trait anxiety inventory (STAI), stress rating questionnaire (SRQ) and National Aeronautics and Space Administration task load index (NASA-TLX) were used as data collection tools. Nine hours of simulated flight training were conducted in a simulator of the Type-6 Primary Trainer (Aviation University Air Force, China). The simulated flight assessment was taken as the acute psychological stressor. *Results*. SFP was negatively correlated with tensity and state anxiety. Emotional intelligence (EI) indirectly affected the SFP mediated by emotional state and workload, and emotional state had a mediating effect on the relationship between trait anxiety and SFP. *Conclusions*. The findings indicated that emotional trait factors (EI and trait anxiety) may indirectly affect SFP under an acute psychological stress situation, and emotional state (tensity and state anxiety) and mental workload played an important mediating role.

- **Keywords:** emotional intelligence, trait anxiety, state anxiety, mental workload, emotional state, simulated flight training

Martin Argus & Mati Paasuke. *Musculoskeletal disorders and associated factors among office workers in an activity-based work environment*. Pages: 2419-2425.

Objectives. This study aimed to evaluate the prevalence of musculoskeletal disorders (MSDs) and associated factors among office workers working in the activity-based workplace (ABW). *Methods.* Forty-two office workers with an ABW and 68 office workers as controls participated. The Nordic musculoskeletal questionnaire, the Baecke physical

activity questionnaire, the Copenhagen psychosocial questionnaire III and the fear-avoidance beliefs questionnaire were used and the pain pressure threshold (PPT) was measured. *Results.* There were no significant differences in the prevalence of MSDs in most body areas between the ABW and control groups. The ABW group experienced significantly ($p < 0.05$) more right wrist, hand and finger (WHF) pain in the past 6 months when compared with the control group. The ABW group demonstrated significantly ($p < 0.05$) more work-related physical activity and daily time spent standing. There were no significant differences in other pain-related factors measured. *Conclusions.* Office workers with an ABW had a similar prevalence of MSDs to office workers with a designated workplace and no differences in associated factors.

- **Keywords:** activity-based workplace, musculoskeletal disorders, physical activity, flex-office, office work

Su-Xia Liu, Hua-Zhong Chen, Qiang Mei, Ying Zhou & Nkrumah Nana Kwame Edmund. *Impact analysis of behavior of front-line managers on employee safety behavior by integrating interpretive structural modeling and Bayesian network*. Pages: 2426-2438.

Employee safety behavior is a basic element of enterprise work safety. The results of accident investigations and risk assessments in enterprises indicate that management factors are some of the most important factors that affect employee safety behavior. The purpose of this study is to explore the relationship between the behavior of front-line managers (FLMs) and employee safety behavior by integrating a qualitative method, i.e., the interpretive structural model (ISM), and a quantitative method, i.e., the Bayesian network (BN). The results of the BN analysis showed that safety incentives and safety communication were the best predictors of safety participation, while safety supervision and safety control were the best predictors of safety compliance. Moreover, the results revealed that an instantaneous improvement of safety communication, safety incentives, safety supervision and safety guidance was the most effective joint measure to reach a high-level of safety behavior of employees in the workplace.

- **Keywords:** front-line managers' behavior, safety behavior, Bayesian network, interpretative structural model

Blessing Chinweobo-Onuoha, Elif Asude Tunca, Felix Olajide Talabi, Ayodeji Boluwatife Aiyesimoju, Victor Oluwole Adefemi & Verlumun Celestine Gever. *Modelling journalists' coping strategies for occupational hazards in their coverage of protests against police brutality (ENDSARS protests) in Nigeria*. Pages: 2439-2446.

Although journalism practice exposes media workers to different levels of occupational hazards, research on the coping strategies is limited. This study made an effort to extend literature in this direction by providing a model that explains the coping strategies of Nigerian journalists who covered the 2020 ENDSARS protests in Nigeria. The researchers surveyed a total of 470 journalists who were sampled through a respondent-driven chain referral sampling technique. It was found that journalists who covered the protests faced occupational hazards such as physical attacks, disgrace, threats, trauma, anxiety as well as fear. The coping strategies were found to include seeking social support, selective appearance, self-censorship as well as self-motivation. It was further found that perceived behavioural control significantly moderates the implementation of coping strategies. The researchers explored the implications of these results on theory, practice and scholarship.

- **Keywords:** ENDSARS protests, occupational hazard, scoping strategy, journalism

Rasoul Yarahmadi, Somayeh Soleimani-Alyar & Mohammad Reza Vafa. *Improving healthy work culture measures using participatory ergonomic interventions*. Pages: 2447-2454.

Objectives. The productivity outcomes from proper implementation of participatory ergonomic interventions in industrial developing countries (IDCs) are important to have management support. However, the role of awareness promotion in engaged groups of intervention has been overlooked. This article explains the health effects of some ergonomic interventions including nutrition awareness, training and workstation redesign on the labor productivity indices of an industry using participatory ergonomics. *Methods.* The study design was a semi-experimental study. After the field study, the proper model of participatory ergonomics was presented to implement the interventions. The International Labour Organization (ILO) checkpoint, quick exposure check (QEC) checklist and Nordic questionnaire were applied to assess ergonomic risk factors. Labor productivity was measured using some indicators of health and production. Statistical tests including paired-sample *t* tests were performed for data analysis using SPSS version 22.0. *Results.* The ergonomic interventions with a focus on awareness promotion resulted in positive outcomes ($p < 0.05$) including a decrease of blood pressure (equally 3.1%), improvement in optimum monthly performance of labors, better QEC number and also time saving of about 18.93% in doing tasks. *Conclusion.* Awareness promotion and productivity outcomes were found to be important in management commitment and support to persuade participatory ergonomic interventions.

- **Keywords:** participatory ergonomics, awareness, training, redesign, nutrition, productivity

Vendy Hendrawan Suprapto, I. Nyoman Pujawan & Ratna Sari Dewi. *Effects of human performance improvement and operational learning on organizational safety culture and occupational safety and health management performance*. Pages: 2455-2467.

Human performance improvement (HPI) is a strategic approach for reducing and controlling human errors, while operational learning (OL) is part of the organization's knowledge management system focusing on day-to-day operations. This study explores the influence of HPI and OL on the development of organizational safety culture, occupational safety and health (OSH) management performance in one of Indonesia's largest oil producers. First, we conducted a focus group discussion with top management and then surveyed 260 workers. The data were then analysed using partial least squares structural equation modelling, finding that HPI has a positive significant influence on OL. Furthermore, HPI and OL have positive significant influences on OSH management performance, such that OL mediates the effects of HPI on organizational safety culture, OSH management performance. These findings imply the need to prioritize and implement measures to improve organizational safety culture, OSH management performance.

- **Keywords:** human performance improvement, operational learning, organizational safety culture, occupational safety and health management performance

Mousa Jabbari, Yousef Yousefpour, Mohtasham Ghaffari & Alireza Shokuhian. *Evaluation of effectiveness of risk-based comprehensive safety training planning in the gas pipeline construction industry*. Pages: 2468-2481.

Safety training programs play an effective role in reducing diseases and accidents during working. The purpose of this study was comprehensive safety training planning for the

gas pipeline construction industry, and investigation of its effectiveness in a pilot project. For this purpose, in an interventional research study (before and after), a risk-based training needs assessment was performed. Afterwards, a comprehensive training program was developed and implemented based on this assessment. After 6 months of implementing this training program, its effectiveness was assessed using three questionnaires and 19 checklists. Comparison of scores before and after the training showed that the changes made in all cases were significant. Therefore, comprehensive training planning and its implementation based on the hazards of the workplace and the level of risk in the construction of pipelines play an effective role in increasing safety knowledge, perceptions, attitude and behavior of workers.

- **Keywords:** hazard identification, risk assessment, job hazard analysis, checklist, safety culture

Viviane de Freitas Cardoso, Claudia Aparecida Stefane, Fernanda Cabegi de Barros, Josiane Sotrate Gonçalves, Leandro Corrêa Figueiredo & Tatiana de Oliveira Sato. *Influence of gender and age on musculoskeletal symptoms in white-collar and blue-collar workers: a cross-sectional study*. Pages: 2482-2491.

Objectives. This study aimed to identify the prevalence of musculoskeletal symptoms among blue-collar and white-collar workers stratified by gender and age. *Methods*. The sample was composed of 390 blue-collar and 510 white-collar workers. Musculoskeletal symptoms were evaluated using the Nordic musculoskeletal questionnaire. An independent *t* test or Mann–Whitney test was used for inter-group comparisons. The χ^2 association test was applied for categorical variables. Logistic regression analysis was used to determine the influence of gender and age on musculoskeletal symptoms. *Results*. The prevalence of shoulder, lower back and ankle/foot symptoms was higher among blue-collar workers compared to white-collar workers. In the analysis stratified by gender, female blue-collar workers had a higher frequency of shoulder symptoms and male blue-collar workers had a higher frequency of lower back symptoms. In the analysis stratified by age, younger blue collar-workers had a higher frequency of shoulder, lower back and ankle/foot symptoms compared to young white-collar workers, and older white-collar workers had a higher frequency of neck symptoms compared to older blue-collar workers. *Conclusions*. Gender and age exerted an influence on self-reported symptoms in blue-collar and white-collar workers.

- **Keywords:** work-related musculoskeletal disorders, occupational health, aging, gender, physiotherapy

Mostafa Mohammadian, Alireza Choobineh, Mohsen Razeghi, Naser Hashemi Nejad, M. R. Karamooz-Ravari, Morteza Sheykhshoaei, Reza Kazemi & Hadi Daneshmandi. *Designing and usability testing of a new prototype active footrest for knee extension exercise among office workers*. Pages: 2492-2500.

Objectives. The active factor along with light exercise can reduce static muscle work and increase muscle flexibility and endurance. Accordingly, this study aimed to design and prototype a new active footrest, implemented in conventional sitting workstations, and to test its usability among office workers. *Methods.* The steps taken to design and prototype the active footrest were: selection of an exercise appropriate for goals of ergonomic interventions; idea development; selection of the best conceptual design; design with SOLIDWORKS version 2016; and fabrication of a prototype. Afterward, usability of the active footrest prototype was assessed among 20 office workers (10 females) using field data by the system usability scale. *Results.* Upon completion of the design steps, the active footrest prototype was prototyped by taking into account design criteria (e.g.,

functionality, inclusive design, easy application and reduction of additional body movement), anthropometric data and mechanical properties. The participants rated the usability of the active workstation as 89 ± 8.21 (out of 100), indicating good usability results. *Conclusion.* In this study, an active footrest was designed and prototyped to perform knee extension exercise with the capability of being implemented in conventional sitting workstations.

- **Keywords:** active workstation, sedentary behavior, physical activity, knee extension, system usability scale

Hanna Al-Makhamreh, Farah Al-bitar, Aseel Saadeh, Abdallah Al-Ani, Muayad Azzam, Dana Alkhulaifat, Asim Khanfar, Yousef Toubah, Lujain Aburaddad, Kamal Hassan & Hashim Al-Ani. Evaluating the physical, psychosocial and ergonomic burden of lead aprons among Jordanian interventionists: a nationwide study. Pages: 2501-2508.

Objectives. This study assessed the physical and psychological burden of lead apron use on Jordanian interventionists and investigated the attitudes and knowledge of interventional personnel toward ergonomic guidelines and practices. *Methods*. A cross-sectional investigation of a randomly sampled Jordanian cohort of interventional personnel was conducted using a self-administered questionnaire. *Results*. A nationwide sample of 130 practitioners with a mean 9.3 ± 8.1 years of experience in interventional procedures participated. Practitioners were aware of their apron's weight but not of its lead equivalence (71.5%). More than 60% of respondents complained of back pain. While 66.9% did not develop musculoskeletal pathologies, 64.3% of those with already established musculoskeletal pathologies experienced worse pain due to apron usage. Despite believing in the effect of lead aprons on muscular strain and work performance, 78.5% adhere to its usage. In terms of ergonomics, only 39.2% were aware of ergonomic guidelines; however, 90.0% believe that ergonomic practices are essential as 49.2% have experienced discomfort due to bad ergonomics. In terms of psychological burden, anxiety and depression were suggested in 16.4 and 21.6% of the sample. *Conclusion*. Jordanian interventionists portray positive attitudes toward lead aprons; nevertheless, their awareness of ergonomic practices warrants the implementation of evidenced-based interventions.

- **Keywords:** ergonomics, interventionists, Jordan, lead aprons, psychological burden

Mostafa Pouyakian, Fereydoon Laal, Mohammad Javad Jafari, Farshad Nourai & Sohag Kabir. *Fuzzy Bayesian estimation and consequence modeling of the domino effects of methanol storage tanks*. Pages: 2509-2519.

In this study, a fuzzy Bayesian network (FBN) approach was proposed to analyze the domino effects of pool fire. Failure probabilities were calculated using triangular fuzzy numbers, the combined center of area (CoA)/sum-product method and the BN approach. Consequence modeling, probit equations and leaky–noisy-OR (L-NOR) gates were used to analyze the domino effects, and modify conditional probability tables (CPTs). Methanol storage tanks were selected to confirm the practical feasibility of the suggested method. The domino probability using bow-tie analysis (BTA) and FBN in the first and second levels was compared, and the ratio of variation was used for sensitivity analysis. Probability of the domino effect in the first and second levels (FBN) was 0.0071472631 and 0.0090630640, respectively. The results confirm this method is a suitable tool for analyzing the domino effects and that using FBN and L-NOR gate is a good way to assess the reliability of tanks.

- **Keywords:** fuzzy Bayesian network, domino effect, atmospheric storage tanks, L-NOR, methanol, pool fire

Charlotte Wåhlin, Kjerstin Stigmar & Emma Nilsing Strid. *A systematic review of work interventions to promote safe patient handling and movement in the healthcare sector*. Pages: 2520-2532.

Objectives. The aim of this systematic review was to describe interventions which promote safe patient handling and movement (PHM) among workers in healthcare by reviewing the literature on their effectiveness for work and health-related outcomes. *Methods.* Databases were searched for studies published during 1997–2018. Measures were operationalized broadly, capturing outcomes of work and health. Only randomized controlled trials (RCTs) and cohort studies with a control group were included. Quality was assessed using evidence-based checklists by the Swedish Agency for Health Technology Assessment and Assessment of Social Services. *Results.* The systematic review included 10 RCTs and 19 cohort studies. Providing work equipment and training workers is effective: it can increase usage. Training workers to be peer coaches is associated with fewer injuries. Other effective strategies are participatory ergonomics and management engagement in collaboration with workers, facilitating safe PHM. *Conclusions.* This systematic review suggests that interventions for safe PHM with an impact of health-related outcomes should include access to work equipment, training as well as employer and employee engagement. The additional impact of multifaceted interventions is inconclusive.

- **Keywords:** occupational health, patient handling and movement, healthcare

Rahul Rajak, Aparajita Chattopadhyay & Priya Maurya. *Accidents and injuries in workers of iron and steel industry in West Bengal, India: Prevalence and associated risk factors*. Pages: 2533-2540.

This study estimates the prevalence and risk factors of accidents and injuries among iron and steel industry workers. A cross-sectional study (N = 505) was conducted from November 2019 to March 2020 in the Indian Iron and Steel Company (IISCO), Burnpur, West Bengal, India. The result shows that about 28% of workers experienced accidents and injuries in the last 12 months. The most frequent injuries reported were cuts from sharp objects (37.32%), followed by fractures and dislocation (30.28%) and burns (19.01%), upper head injury (23.24%) and arm/shoulder injury (14.08%). Non-technical education (adjusted odds ratio [AOR]: 2.52), higher exposure in risky and polluted areas (AOR: 2.85), alcohol consumption (AOR: 2.47), poor occupational health and safety knowledge (AOR: 0.65) were significantly associated with work-related injuries. Occupational health and safety knowledge and usage of safety measures must be propagated and monitored to curb accidents and injuries among iron and steel industry workers in India.

- **Keywords:** accidents and injuries, iron and steel industry, personal protective equipment, safety knowledge

Soqrat Omari Shekaftik, Zhaleh Sedghi Noushabadi & Azadeh Ashtarinezhad. *Nanosafety: a knowledge, attitude and practice (KAP) study among Iranian researchers working in nanotechnology laboratories*. Pages: 2541-2545.

Objectives. There is a set of evidence about the adverse effects of engineered nanomaterials (ENMs) on humans and the environment. People working with nanomaterials (NMs) (in nanotechnology laboratories and workplaces) are often exposed to these materials. Following nanosafety principals can reduce exposure to ENMs. This

study aimed to investigate the knowledge, attitude and practice (KAP) of Iranian researchers toward nanosafety. *Methods*. This descriptive cross-sectional study was conducted via a questionnaire designed using the results of a literature review and validated by a panel of experts. After completion of questionnaires by Iranian researchers, data were analyzed using SPSS version 20.0. *Results*. Investigation into the knowledge of study participants showed that 61.38% of them answered the questions correctly. Although 74.34% of the study participants had a proper attitude to nanosafety, only 27.3% of them considered ENMs to be harmful to humans and the environment. Examination of researchers' performance in laboratories showed that 24.25% of them 'always' have good performance. *Conclusions*. It seems that increasing awareness by teaching the principles of working safely with NMs can help to create a positive attitude toward the principles of nanosafety. Positive attitude can finally lead to the optimal performance of researchers in laboratories involved with NMs.

- **Keywords:** nanomaterials, knowledge, attitude and practice (KAP) study, nanosafety, good practices, nanotechnology laboratories

Tracy Le, Andrew L. Shim & David Newman. *Does a relationship between handgrip strength and coincidence anticipation timing exist among young adults: a pilot study*. Pages: 2546-2550.

The purpose of this investigation was to observe whether a strong to moderate relationship exists between maximal handgrip strength best score and best coincidence anticipation timing (CAT) score in young adults. Handgrip strength has demonstrated a strong relationship with high levels of activities of daily living (ADLs) and reduced injury potential. A one-shot case-study design was selected for this investigation. Twenty-three females and one male volunteered for this investigation (age 22.29 ± 4.71 years, height 63.78 ± 6.22 cm, mass 56.66 ± 8.25 kg) from a local higher education institution. Participants ($n = 24$) utilized the Bassin anticipation timing device (Lafayette Instruments, USA) and a Camry digital hand dynamometer (Model EH101, Camry LLC, El Monte, CA, USA) during the same time and recorded all scores. The Pearson correlation coefficient ($r = -0.413$; $p = 0.04$) indicated a medium effect relationship between best maximal handgrip strength and best CAT score.

- **Keywords:** handgrip strength, coincidence anticipation time, ergonomics, activities of daily livinghand injuries

Maryam Shaygan & Maryam Yazdanpanah. *Depression and work–family conflict mediating the effects of job stress on chronic pain: a structural equation modelling approach*. Pages: 2551-2558.

Objectives. Most research studying the relationship between job stress and chronic pain has relied on physiological responses. This study aims to determine psychosocial mechanisms by which job stress can influence chronic pain in workers. *Methods.* This cross-sectional study was carried out among 793 workers in gas and oil platforms or petroleum refinery plants in southern Iran. Structural equation modelling was applied to evaluate direct, indirect and total effects of job stress on chronic pain in the presence of mediating variables (work–family conflict and depression). *Results.* Job stress ($B = 0.024$, $\beta = 0.477$), 95% confidence interval (CI) [0.016, 0.032], work–family conflict ($B = 0.031$, $\beta = 0.446$), 95% CI [0.023, 0.038], depression ($B = 0.046$, $\beta = 0.224$), 95% CI [0.028, 0.064] and work experience ($B = 0.083$, $\beta = 0.380$), 95% CI [0.065, 0.101] had significant direct effects on chronic pain. Indirect paths from job stress to chronic pain via depression ($B = 0.002$, $\beta = 0.042$), 95% CI [0.001, 0.003] and work–family conflict ($B = 0.004$, $\beta = 0.085$), 95% CI [0.003, 0.006] were significant. *Conclusions*. Given that depression and work–family conflict mediate the effects of job stress on pain, stress management programmes for workers might include various strategies to reduce

negative thoughts as well as cognitive biases and minimize role conflicts between work and private life.

- **Keywords:** chronic pain, depression, job stress, work–family conflict

Ilknur Yalcin & Ayse Ergun. *Effects on Turkish ice cream employees' musculoskeletal pain of a physical activity and ergonomics improvement program in the workplace.* Pages: 2559-2565.

Objectives. This study aimed to investigate the effects of a physical activity and ergonomics improvement program (PAEIP) on employees' musculoskeletal pain. *Methods.* The sampling group included 120 employees who met the criteria and were randomly assigned to the intervention group ($n = 57$) and the control group ($n = 63$). The visual analog scale, the Nordic musculoskeletal survey and rapid upper limb assessment (RULA) were used for collecting data. *Results.* When pre-test and post-test pain scores of the intervention group were compared, the average post-test scores were significantly lower in the neck, shoulder, wrist and lower back regions than the pre-test scores. When the intervention and control group RULA scores were compared, in the intervention group the proportion of employees found in an 'acceptable posture' level was 0% in the pre-test and 5.3% in the post-test, and in the same group the proportion of employees in the 'further investigation and change may be needed' level was 31.6% in the pre-test and increased to 61.4% in the post-test. *Conclusion.* As a result, the PAEIP has been found effective in reducing the ergonomic risks associated with upper extremities and rate or intensity of musculoskeletal pain.

- **Keywords:** Neck pain, hand/wrist pain, foot pain

Shuwen Deng, Honglei Zhu, Rui Peng & Yonggang Pan. *Development and validation of a cognitive model-based novel questionnaire for measuring potential unsafe behaviors of construction workers*. Pages: 2566-2573.

The accident death rate in the construction industry is one of the highest among all occupational accidents. In order to identify the most common and direct causes of accidents, the unsafe behaviors of construction workers must be investigated, which necessities a questionnaire. Considering that safety climate research and behavior safety research barely explained the causes of unsafe behavior, this research was conducted from a cognitive model-based perspective. A new questionnaire was designed to evaluate the potentially unsafe behaviors, and a cognitive model with 11 factors was adopted. After verification by exploratory factor analysis, confirmatory factor analysis and reliability analysis, the new questionnaire showed good validity (content validity index < 0.79 and content validity ratio aaaa 0.42, average variance extracted > 0.5) and reliability (Cronbach's $\alpha > 0.7$, composite reliability > 0.7), and the cognitive model fitted well. Therefore, the new questionnaire is effective and reliable in assessing the causes of unsafe behaviors of construction workers.

- **Keywords:** cognitive model, unsafe behavior, construction worker, questionnaire development

Süleyman Kocatepe & Zeki Parlak. *The effects of psychosocial factors on occupational accidents: a cross-sectional study in the manufacturing industry in Turkey*. Pages: 2574-2581.

Objectives. Looking at death statistics in workplaces, occupational health and safety (OHS) is indisputably one of the most important problems of society. Considering that the existing measures are insufficient to reduce deaths, it is essential to look at the prevention of occupational accidents/diseases with an interdisciplinary approach and to

employ new perspectives in order to develop new methods. The aim of this study is to determine whether psychosocial risks are perceived as an accident factor by employees and to bring the concept of psychosocial accident factors into a discussion. *Methods*. The survey technique is used as a data collection tool for this study. The questionnaire has 33 questions. SPSS version 25.0 was used to analyze the data. *Results*. The study showed that employees who had an accident perceived psychosocial factors as an important accident factor. *Conclusions*. Studies on causes of accidents at work are generally based on a single dimension, such as environmental conditions and/or faults of employees. There is almost no focus on the reasons for the misbehaviors of employees. Psychosocial factors are not taken into account or neglected, but results show that providing psychosocial support and/or psychological counseling services in workplaces may be effective in reducing accidents.

- **Keywords:** accident factors, occupational accident, occupational health and safety, psychosocial risk factors, stress

Sara Rawdeng, Rattaporn Sihawong & Prawit Janwantanakul. *Work ability in aging office workers with musculoskeletal disorders and non-communicable diseases and its associated factors: a cross-sectional study.* Pages: 2582-2587.

Objectives. The prevalence of musculoskeletal disorders (MSDs) and non-communicable diseases (NCDs) increases with age. This study examined the impact of MSDs and NCDs on work ability, using the work ability index (WAI), among aging office workers (between 45 and 60 years old) and determined factors associated with WAI scores. *Methods.* A cross-sectional study was conducted in office workers from 27 government offices in Bangkok and nearby provinces using an online questionnaire. Analyses were conducted using the Mann–Whitney *U* test and a multivariable logistic regression model. *Results.* Of 689 workers (452 females and 237 males), 34, 13, 12 and 41% reported MSDs, NCDs, MSDs + NCDs and no MSDs/NCDs, respectively, in the past year. Median scores (interquartile range) of WAI were 37.0 (6) for MSDs, 37.0 (4) for NCDs, 34.5 (6) for MSDs + NCDs and 40.0 (4) for no MSDs/NCDs. Significant difference in WAI scores was found between the MSDs and MSDs + NCDs groups ($p = 0.005$); and between the NCDs and MSDs + NCDs groups ($p < 0.001$). Female, high work experience and low job control were significantly associated with reduced WAI scores (WAI ≤ 36). *Conclusion.* The presence of MSDs or NCDs reduced work ability among aging office workers compared to their healthy counterparts. Having MSDs + NCDs further reduced work ability.

- **Keywords:** musculoskeletal pain, non-communicable diseases, aging, occupational groups

Shengyuan Yan, Kai Yao, Fengjiao Li, Yingying Wei & Cong Chi Tran. *Application of a Bayesian network to quantify human reliability in nuclear power plants based on the SPAR-H method*. Pages: 2588-2598.

Human error is an important factor leading to nuclear power plant (NPP) accidents. Human reliability analysis (HRA) is considered an effective method to reduce human error. Therefore, this article proposes a method to quantify human reliability based on the standardized plant analysis risk–human reliability analysis (SPAR-H) method. Firstly, the method used the performance shaping factors of SPAR-H to build a human reliability model. Secondly, the triangular fuzzy number was used to quantify the qualitative information of root nodes, and the fuzzy IF–THEN rule was used to determine the prior probability distribution of intermediate nodes. Finally, Bayesian reasoning was used to quantify human reliability based on the human reliability model. The result of the developed method is consistent with the result of cognitive reliability and error analysis

methods (CREAM). The developed method can be used as a tool to quantify human reliability in the NPP system.

- **Keywords:** human error, nuclear power plants, human reliability analysis, Bayesian reasoning

Gizem Serin Atis, Aygen Beste Ozic, Tolga Bukruk, Ece Ozkaya & Ozge Kantas Yorulmazlar. *The association between commuting, mood and job performance: the structural equation modelling approach*. Pages: 2599-2605.

Commuting demands a considerable amount of time from a worker's daytime. Numerous studies have shown the relationship between commuting and mood, and even job performance. Contradictory findings are also present in the literature regarding the association between commuting, mood and job performance. Therefore, the aim of the present study is to examine the association between commuting, negative upon arrival at work and individual job performance, given the special focus on the mediating role of negative mood. Two hundred and twenty-six participants were recruited via snowball sampling. Participants were asked to answer questions about commute duration and distance, to rate their mood upon arrival at work and to fill in the individual work performance questionnaire. Results showed that commute duration and distance was associated with job performance through mood upon arrival at work. It is believed that this study provides valuable information regarding the mediating role of mood upon arrival at work.

- **Keywords:** commute distance, commute duration, negative mood, individual job performance, structural equation modelling

Gökçe Güney & Bayram Kahraman. *Implementation of the analytic hierarchy process (AHP) and Fine–Kinney method (FKM) against risk factors to determine the total cost of occupational health and safety precautions in environmental research laboratories*. Pages: 2606-2622.

A risk assessment method provides the definition of the risks that may be encountered in a laboratory. In order to take safety precautions regarding the in environmental research laboratories, risk assessment studies using Analytic Hierarchy Process (AHP) and Fine-Kinney Method (FKM) were carried out in this study. The environmental research laboratories were selected for the occupational health and safety assessment studies which analyze environmental samples such as wastewater, biological sludge, soil/sediment, and solid waste. Potential risks, accident rates and damages that may arise in an environmental research laboratory could be minimized with the occupational health and safety precautions decided to be taken in the light of this modeling study. Finally, the cost of the safety precautions to be taken on the basis of each risk was calculated according to the used models (AHP and FKM) in environmental research laboratories and determined approximately as 10,000.00 EUR in this study.

- **Keywords:** analytic hierarchy process, cost analysis, Fine–Kinney method, occupational accidents, occupational health and safety, safety precautions

Rasoul Ahmadpour-Geshlagi, Neda Gilani, Saber Azami-Aghdash, Mostafa Javanmardi, Seyed Shamsaledin Alizadeh & Saeid Jalilpour. *Investigating barriers to accident precursor reporting in East Azerbaijan Province Gas Company from the perspective of HSE officers: a qualitative study*. Pages: 2623-2630.

Objectives. Investigating the root causes of under-reporting near misses is very important. The aim of this study was investigating barriers to near-miss reporting in East Azerbaijan Province Gas Company from the perspective of health, safety and environment (HSE) officers. *Methods.* Semi-structured individual interviews were used and 21 interviews were conducted with HSE officers. Inductive content analysis was used for analyzing interviews. After analyzing the interviews, the codes in the interviews were categorized. *Results.* In general, two categories of code were created: reasons for non-reporting of accident precursors; and suggested solutions to improve the reporting system of accident precursors. However, two main categories were found for not reporting: individual reasons such as lack of commitment to the job, lack of attention to social responsibility, forgetfulness and laches in reporting, etc.; and organizational reasons such as job instability among employees, lack of sufficient training, failure of the organization to provide feedback, etc. *Conclusion.* This study found that the opinions of people working in the organization can be very effective in promoting reporting, so any organization can choose the appropriate strategy to increase the number and quality of reports by examining the opinions of managers, HSE officers and workers in the organization.

- **Keywords:** near misses, health, safety and environment officers, individual reasons, organization reasons

S. A. Alhammadi, Bassam A. Tayeh, Wesam Salah Alaloul & Amro Fareed Jouda. *Occupational health and safety practice in infrastructure projects*. Pages: 2631-2644.

Objectives. This research intends to investigate the responsibilities of the parties engaged in the implementation phase of the infrastructure projects in occupational health and safety, i.e., the consultant and contractor. *Methods*. A questionnaire was developed through the selection and modification of the responsibilities from the literature review. *Results*. The statistical analysis results show that the consultants and contractors both ranked the item 'The owner requires the contractor to implement the occupational safety standards within the bid' first in the owner responsibilities, having 0.67 relative importance index (RII). In the responsibilities of the consultant, the first ranked item was 'The consultant has a role in adopting occupational safety plans and contingency plans', having 0.66 RII. In the responsibilities of the contractor, the first ranked item was 'The contractor shall provide the insurance cover for all project crews', having 0.71 RII. In the responsibilities of the workers, the first ranked item was 'Workers know the handling of tools and equipment within the project', having 0.59 RII. *Conclusion*. Overall, there was general agreement between consultants and contractors to classify and arrange items because both face the same conditions and have the same working environment.

- **Keywords:** health and safety, infrastructure projects, consultant, contractor

Kishor Bhagwat, Venkata Santosh Kumar Delhi & Prakash Nanthagopalan. *Construction safety performance measurement using a leading indicator-based jobsite safety inspection method: case study of a building construction project*. Pages: 2645-2656.

The construction industry is one of the hazardous industries all over the world. There have been continuous safety efforts on post-facto safety investigations and related

corrective actions. However, to prevent future accidents, post-facto reports may not be able to provide comprehensive insights. Also, past literature pointed at limited proactive efforts to measure the current level of safety at the project. Therefore, this study introduced a leading indicator-based jobsite safety inspection (JSI) method to measure the project's safety performance. A total of 781 observations were reported in baseline and follow-up JSI on a real construction site. The study's findings highlighted an increase in safe behavior and conditions (SB&C) by reducing unsafe behavior (UB) and unsafe conditions (UC). Results confirmed a significant improvement in the safety performance index (SPI) of the case study from 39.07 to 67.47%. This study also investigated hazardous locations and weak safety dimensions for further SPI improvement.

- **Keywords:** construction industry, safety performance, leading indicators, jobsite safety inspection

Harun Kınalı, Umut Yıldırım & Arda Toygar. *A quantitative study on the mental health of Turkish seafarers*. Pages: 2657-2667.

Physically and mentally healthy seafarers with professional knowledge and skills are needed for maritime transportation to be safe and sustainable. Mental problems experienced by seafarers can lead to negative consequences, such as bullying, substance dependency, assault, murder and suicide. Accordingly, this study examined the effects of differences between the socio-demographic characteristics of Turkish seafarers on their depression, which is an important criterion for determining mental disorders. Data collected from 403 participants through quantitative research methods were analyzed using SPSS version 25.0 and AMOS version 23.0. Although periodic physical and mental health checks are performed on seafarers, it was found from the analysis results that 33.2% of Turkish seafarers experience mental issues. Moreover, the study determined that the socio-demographic characteristics of seafarers made some differences in their depression levels.

- **Keywords:** seafarer, mental health, depression, seagoing life

Agnieszka Adamus-Włodarczyk & Emilia Irzmańska. *Preliminary end-of-service-life study of the soles of protective footwear resistant to selected mechanical factors and mineral oil*. Pages: 2668-2675.

This work aimed to study the end of service life of soles of protective footwear resistant to selected mechanical factors and mineral oil. Three sole variants were examined; made from poly(ethylene-co-vinyl acetate) (EVA), poly(vinyl chloride) (PVC) and polyurethane (PU), currently widely used in all-rubber protective footwear. The preliminary study focused on the abrasion resistance and bending strength of the three sole materials after different times of exposure to mineral oil. Changes in density and hardness of the examined materials were evaluated following exposure to cyclical factors. Statistical analysis was performed to identify significant differences between the three types of polymers in terms of abrasion resistance, density and hardness following exposure to mineral oil for three different periods. Surface morphology of the sole materials was examined by means of scanning electron microscopy. The presented studies elucidate the effects of mineral oil on the basic mechanical parameters of all-rubber footwear soles.

- **Keywords:** protective footwear, selfhealing materials

Yun Teng, Yu Sun, Huihui Yang, Xiangyu Guo & Xinlin Chen. *Research on the relationship between enterprise safety production management mode and employees' safety behavior based on social cognition and behavior incentive theory*. Pages: 2676-2685.

The realization of high-performance production safety needs not only a scientific and reasonable production safety management mode, but also active participation of employees with safety initiative (SI). Based on social cognition theory and behavior motivation theory, this study establishes a research model of the production safety management mode and safety behavior. Based on the survey data of 467 employees from 91 enterprises, the structural equation model is used for empirical verification. The findings show that three safety production management modes of punishment, regulation and guidance will affect the level of employees' SI, and then affect safety behavior. SI acts as an intermediary variable between the safety production management mode and safety behavior. Transformation of the enterprise safety production management mode from punishment to regulation, and then to guidance, is conducive to encouraging employees to implement initiative safety behavior (ISB), reducing passive safety behavior (PSB) and improving enterprise safety management performance.

- **Keywords:** production safety, management mode, safety behavior, safety initiative