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## Číslo 1



**Monireh Hosseini, Laleh Farhang Matin, Mohammad Reza Monazzam & Hossein Khosroabadi. *Investigating the role of internal layout of magnetic field-generating equipment on workers' exposure at power substations.* Pages: 1-7.**

*Introduction.* This research is an attempt to show the role of interior layout of equipment in generating magnetic fields. *Materials and methods.* The levels of an extremely low-frequency magnetic field were measured in accordance with Standard No. IEEE 644:1994 in three substations and a control building in a petrochemical power plant in southern Iran. Then, workers' occupational exposure (time-weighted average [TWA]) was calculated and the sources of maximum magnetic field generation at each place were identified. Their interior design was changed to achieve the optimal layout of equipment subsequently; the workers' TWA was recalculated for the new situation. *Results.* The obtained results showed that electrical engineers and technicians were exposed to the maximum TWA of 10.14  $\mu\text{T}$ . The operators in the control room were exposed to the lowest TWA of 0.84  $\mu\text{T}$ . The results also showed that after the change of interior design and proper layout design of the equipment in the substations, the TWA was reduced by 0.73  $\mu\text{T}$ . *Conclusion.* The research findings revealed that the most harmonious arrangement of equipment in an industrial unit plays a major role in reducing the exposure of workers to magnetic fields and ultimately increases the level of their health in the workplace.

- **Keywords:** extremely low frequency, magnetic field, occupational exposure, interior design, substation

**Khadijeh Yaghoubi, Iraj Alimohammadi, Jamileh Abolghasemi, Mehdi Shirin Shandiz, Nahid Aboutaleb & Azadeh Ashtarinezhad. *The effect of occupational noise exposure on systolic blood pressure, diastolic blood pressure and salivary cortisol level among automotive assembly workers.* Pages: 8-13.**

*Introduction.* Both auditory and non-auditory health can be affected by exposure to occupational noise. The aim of this study was to evaluate the association of high occupational noise (at three levels) with systolic blood pressure (SBP), diastolic blood pressure (DBP) and salivary cortisol concentration in an automotive factory. *Methods.*

This study was carried out on 78 male workers from a factory who worked in the warehouse unit (control group: 60–70 dB(A)) and assembly units (two test groups: 75–85 and 85–95 dB(A)). Data were collected through questionnaires and measurement of SBP, DBP, saliva cortisol concentration and body mass index (BMI), prior to and post occupational noise exposure. The measurements were performed twice/day and repeated after 10 days. *Results.* For each occupational noise level group, there was no significant association between cortisol level with age and BMI. The SBP and DBP in all groups increased significantly. Also, the average cortisol levels were similar in different groups before noise exposure, but were statistically different after occupational noise exposure. *Conclusions.* High occupational noise exposure increases the cortisol level and blood pressure, which are the major risk factors of cardiovascular disease.

- **Keywords:** occupational noise exposure, systolic blood pressure, diastolic blood pressure, salivary cortisol level, automotive factory

**Mei Liu, Pin-Chao Liao, Xiao-Yun Wang, Sheng Li & Pei-Luen Patrick Rau.**  
***Influence of semantic cues on hazard-inspection performance: a case in construction safety. Pages: 14-28.***

Constant improvement in hazard identification is key to personnel safety in the workplace. Semantic cues have been proposed to simplify knowledge retrieval for site inspectors in building construction. However, the effectiveness of this approach and its internal mechanisms remain unexamined. This study assesses the influence of semantic cues on inspection performance from the perspective of visual behavior during elevator installation. Our results indicate that semantic cues drive selective attention toward goal-relevant information more effectively compared with when no such cues are provided. Second, semantic cues can improve performance regarding goal-relevant hazards and not diminish performance for incidental hazards. Third, the improvement of working memory and inspection performance is more pronounced in experienced workers than in novices. This research highlights the influence of semantic cues for hazard identification on visual behavior and inspection performance, and can serve as a foundation for the allocation of resources to aid inspection during construction.

- **Keywords:** semantic cues, safety inspection, working memory, eye tracking

**Ashish Kumar Singh, Makkhan Lal Meena & Himanshu Chaudhary.**  
***Measuring static muscular strength among female operatives: a cross-sectional comparison in different handicraft occupations. Pages: 29-40.***

*Purpose.* Loss of static muscular strength is the most common work-related problem among handicraft workers involved in hand-intensive jobs. A cross-sectional comparative assessment was carried out to determine the muscular strength among workers involved in the manufacturing of three different crafts: weaving, hand block printing and imitation jewelry. *Methods.* 120 female operatives were selected, and digital grip dynamometers were used to measure their maximum hand grip and pinch strength. *Results.* Static muscular strength varies significantly among the different occupational groups of workers. The difference in grip strength in the right and left hands shows that exposure to hand tools for a prolonged period plays a vital role in muscle strength. These findings indicate that static muscular strength varies significantly due to repetitive use of hand tools. The observed values of muscle strength in the dominant hand were significantly lower in jewelry workers while block printing workers had the highest strength. *Conclusion.* The decrement in pinch grip strength was evident due to long-cycle repetitive pinching movements of the distal phalanx during hand knotting and pearl drilling. This study proposes the need for ergonomically designed hand tool interventions that may reduce the accumulation of loss in static muscle strength.

- **Keywords:** static muscle strength, hand grip, pinch grip, carpal tunnel syndrome, ergonomics, handicrafts

**Haji Omid Kalteh, Seyyed Bagher Mortazavi, Eesa Mohammadi & Mahmood Salehi. *Psychometric properties of the Persian version of Neal and Griffin's safety performance scale.* Pages: 41-47.**

*Introduction.* Neal and Griffin's safety performance scale is an appropriate tool to evaluate safety performance. This article was validated and relied on the Persian version of Neal and Griffin's scale as the widely used tool to assess safety performance. *Methods.* Neal and Griffin's scale has eight questions and two dimensions – safety compliance and safety participation. A back-forward method was used to translate the original English version into Persian. A total of 161 employees of a petrochemical complex were selected for data collection. Content validity, Cronbach's  $\alpha$  and split-half methods, concurrent validity and confirmatory factor analysis were used for psychometric evaluation. *Results.* The content validity index and content validity ratio were 0.82 and 0.84, respectively. Cronbach's  $\alpha$  for total items was 0.9, indicating a high consistency. Additionally, Cronbach's  $\alpha$  values for safety compliance and safety participation were 0.87 and 0.83, respectively. Spearman's correlation coefficients indicated a positive correlation between safety performance and safety culture items ( $r = 0.182-0.852, p < 0.01$ ). Goodness-of-fit indexes in the default model had poor values. Thus, these values were improved in the modified model. *Conclusion.* The results demonstrated that Neal and Griffin's scale could be a reliable tool to evaluate preventive measures of safety performance among Iranian workers.

- **Keywords:** reliability validity safety performance safety compliance safety participation

**Ambusam Subramaniam & Devinder Kaur Ajit Singh. *Effects of using a document holder when typing on head excursion and neck muscle activity among computer users with and without neck pain.* Pages: 48-54.**

*Purpose.* The aim of this study was to examine the effects of using a document holder while typing on head excursion and neck muscle activity among computer users with and without neck pain. *Method.* An experimental study including 52 individuals with ( $n = 26$ ) and without ( $n = 26$ ) neck pain was conducted. Head excursion and neck muscle activity were measured using an accelerometer and surface electromyography, respectively. Two-way analysis of variance was conducted to examine the effects of using a document holder between computer users with and without neck pain. *Results.* The results demonstrated a decrease in head excursion ( $p < 0.001$ ) and muscle activity of both the right and left upper trapezius and the left lower trapezius and right anterior deltoid ( $p < 0.05$ ) with the use of a document holder. Computer users with neck pain had significantly ( $p < 0.001$ ) higher right lower trapezius muscle activity compared to the group without neck pain. *Conclusion.* The results of the study supported the use of a document holder to assist in decreasing head excursion and neck muscle activity. The use of a document holder while typing may be beneficial in preventing repetitive strain injuries among computer users.

- **Keywords:** Computer users, neck pain, muscle activity, head excursion, triaxial accelerometer, electromyography

**Marcin Jachowicz. *Properties of thin coatings deposited by physical vapour deposition on safety helmets.* Pages: 55-62.**

This article presents research on a new solution for industrial helmets improving mechanical and physical properties (temperature resistance and reflection of infrared radiation). The application of known technology in a new personal protective equipment area has been described in order to increase their level of safety and comfort of use. In this work we have studied the effect of a selected magnetron sputtering coating method onto polymer substrates, such as acrylonitrile-butadiene-styrene copolymer, polycarbonate, polyethylene, high-density polyethylene, polyamide, glass and silicon. Coatings made of copper, aluminium, TiN and TiAl were used. This work aims at identifying the best substrates for coating deposition improving the quality of protective helmets. On the basis of the obtained results, it can be stated that the TiN coating provides the best protection from infrared radiation and the best scratch resistance.

- **Keywords:** magnetron sputtering, thin coatings, safety helmets, radiant heat

**Suprakash Gupta, Pramod Kumar & Gunda Yuga Raju. A fuzzy causal relational mapping and rough set-based model for context-specific human error rate estimation. Pages: 63-78.**

Safety is of paramount importance in high-risk systems. Safe and reliable operation of a system depends mainly on its key component, 'the human'. Human error is pivotal in an accident sequence and the rate of error is instrumental in the analysis of accidents which focuses on the development of interventions. However, assessing the rate of human error is a big challenge. Human performance and the rate of error are governed by the context of work. This study discusses a fuzzy rule-based causal relational mapping approach to investigate the variability of the human error rate with context. Different contexts are mapped onto the human error rate estimated from the reported accident cases. This mapping develops a causal relational diagram which can be used for predicting the human error rate in any context. Such information is useful to identify problems of areas and to develop safety countermeasures.

- **Keywords:** human error rate, context describing factor, human reliability analysis, fuzzy relational mapping, rough set, underground coal mining

**Bhakti Jamdade, Apurv Shimpi, Savita Rairikar, Ashok Shyam & Parag Sancheti. Factors predisposing to work-related lower back pain in automobile industry workers. Pages: 79-85.**

*Objective.* This study aimed to assess the presence of lower back pain (LBP) in automobile industrial workers and correlate it with the factors known to be contributing to the development of work-related LBP. *Method.* Post ethical approval, an analytical cross-sectional assessment was conducted for a correlation study on 317 workers from different automobile industries, garages and service centres, who were then assessed by Nordic musculoskeletal questionnaire for the presence of LBP. Their pain intensity was assessed using a numerical rating scale, their core strength with a pressure biofeedback unit, their flexibility via the sitting and reach test and their work posture with the rapid entire body assessment tool. Pain intensity was correlated with core strength, flexibility and posture in all of the workers using Spearman's correlation coefficient  $r$  with  $\alpha$  set at  $p \leq 0.05$  at a 95% confidence interval. *Results.* There was no significant correlation of the pain intensity with the core strength ( $r = 0.052, p = 0.424$ ), flexibility ( $r = 0.020, p = 0.755$ ) or posture ( $r = 0.002, p = 0.974$ ). *Conclusion.* The present study indicates that internal factors like core strength and flexibility, and work postures have no correlation with intensity and severity of LBP in automobile industry workers.

- **Keywords:** core strength, rapid entire body assessment, flexibility, posture

**Lijun Wang, Jiazhen He, Yehu Lu, Shumin Jiang & Min Wang. *Interaction effects of washing and abrasion on thermal protective performance of flame-retardant fabrics.* Pages: 86-94**

In this study, common flame-retardant fabrics were treated with single washing or abrasion and their interactions to simulate wearing away during use. The changes in thickness, mass/m<sup>2</sup> and protective performance of the fabrics under both flame and radiation environments were evaluated. Results demonstrated that the protective performance was firstly increased after washing or abrasion, and then decreased with further increasing washing or abrasion cycles. After certain treatment cycles, the combined effect of washing and abrasion was significantly greater than the single effect of washing or abrasion alone. The interaction modes of washing and abrasion also showed significant differences in protective performance under a flame test. Under radiation exposure, the effect of combined washing and abrasion was more obvious. There was a positive correlation between the fabric weight and its protective performance with different treatments. The findings provide useful guidance for the actual use and maintenance of protective clothing.

- **Keywords:** flame-retardant fabric washing and abrasion interaction effect thermal protective performance

**Dipayan Das, Awadhesh Kumar & Monica Sharma. *Risk factors associated with musculoskeletal disorders among gemstone polishers in Jaipur, India.* Pages: 95-105.**

*Purpose.* Gemstone polishing is a highly repetitive and strenuous job which may lead to musculoskeletal disorders (MSDs) among workers. This study aimed to determine the prevalence of MSDs and their contributing factors among gemstone polishers in Jaipur, India. *Materials and methods.* A self-reported questionnaire study was conducted among 388 male gemstone polishers. Current working postures of the participants were evaluated using rapid upper limb assessment. Results were considered significant at  $p \leq 0.05$ . *Results.* MSDs were highly prevalent among gemstone polishers, primarily in the lower back, neck, wrists/forearms and shoulders. Work-related factors including prolonged daily working hours, little recovery time, sustaining a non-neutral working posture, repetitive movements of upper limbs and individual factors including age and job tenure were significantly associated with MSDs in different body regions. Higher education led to a reduction in the occurrence of MSDs. Evaluation of working posture recommended further investigations and immediate changes in working habits of gemstone polishers to avoid serious harm and physical damage. *Conclusion.* Gemstone polishers in Jaipur are at high risk of developing MSDs in different body regions. Sustaining a non-neutral working posture for a long duration is a major risk factor in the current work setting.

- **Keywords:** musculoskeletal disorders gemstone polishers risk factors ergonomics

**Nabiollah Bakhtiari, Iman Dianat & Moein Nedaei. *Electromyographic evaluation of different handle shapes of masons' trowels.* Pages: 106-111.**

The effects of five different handle shapes of masons' trowels on muscle activity of the arm and forearm muscles (through electromyographic measurements of the biceps brachii [BB], flexor digitorum superficialis [FDS], pronator teres [PT] and extensor carpi ulnaris [ECU]) were evaluated in a simulated masonry task. The results showed a significant effect of handle shape on the muscle activity of the BB, PT and ECU. The muscle activity of the extensor (ECU) and flexor (FDS) were generally larger than those of the supinator (BB) and pronator (PT). Some improvements were found in terms of

muscular exertions with prototype designs C, D and E, which had either handles with variable diameter (designs C and E) or a slightly bent handle (design D). These findings have practical implications for the design of single-handle hand tools but may need further validation for specific contexts of use.

- **Keywords:** electromyography, hand tool handle, handle shape, muscular effort, hand tool design, construction work

**Mustafa Onder, Burcu Demir Iroz & Seyhan Onder. *Using categorical data analyses in determination of dust-related occupational diseases in mining.* Pages: 112-120.**

Dust-related occupational diseases are common in the mining sector. It is important to identify employees who have high potential for these diseases and to investigate the factors affecting disease formation. For this reason, dust and dust-related occupational diseases should be carefully investigated in mining operations. In this study, dust-related occupational diseases in an open-pit lignite mine were investigated. Firstly, dust measurements were performed and then a health check of all employees was implemented. The obtained data set was categorized by taking into account the occupation, age, experience and level of dust exposure of the employees. While the logistic regression analysis was performed to determine the probability of the diseases, a hierarchical loglinear model was established to investigate the factors in the occurrence of these diseases for those employees with the diseases. Therefore, the most important factors for the development of the diseases were determined by the hierarchical loglinear model.

- **Keywords:** respirable dust, dust-related occupational diseases, categorical data analyses, mining, occupational health

**Revanth R. Konda, Ji-Chul Ryu & Jeong Ho Kim. *Three-dimensional global acceleration estimation in the presence of rotation using an inertial measurement unit for whole-body vibration studies.* Pages: 121-127.**

Off-road vehicle operators are likely exposed to not only a high level but also different types of whole-body vibration (WBV) such as significant non-vertical and/or rotational accelerations. To evaluate the effects of these different WBV exposures, it is necessary to first correctly estimate the acceleration of the vehicle considering not only translational but also rotational motion. The main objective of this study was to propose and evaluate an algorithm to accurately estimate global acceleration of a vehicle using magnitude-based filtering and inertial navigation with an inertial measurement unit. In a laboratory experiment where a 6-df robotic arm generated three-dimensional motion at three different frequencies (2.3, 4.5 and 8.5 Hz), local acceleration data were collected in the presence of rotational movements. The comparison of the calculated global acceleration to the reference data show that the algorithm provides a good estimation of global acceleration even when rotational movement is not negligible.

- **Keywords:** whole-body vibration, off-road vehicles, acceleration estimation, rotational motion, inertial measurement unit

**France Ncube, Artwell Kanda & Tatenda Sanyanga. *Standing working posture and musculoskeletal pain among Citrus sinensis workers in a low-income country.* Pages: 128-135.**

*Background.* Work-related musculoskeletal pain (WRMP) among *Citrus sinensis* farm workers has barely been studied. Yet most work tasks in such farms are manually

performed using awkward standing postures that can contribute to WRMP. *Aim.* This study assessed the standing working posture in relation to WRMP among *C. sinensis* workers. *Methods.* Ninety-two workers engaged in manual tasks participated in this cross-sectional study. Postures at the upper limbs were analysed using the rapid upper limb assessment (RULA) method. Data were analysed using SPSS version 20. *Results.* Analyses generally showed statistically significant associations ( $p < 0.05$ ) between a body part RULA score and WRMP at the concerned body part. The upper arm score was  $>1$  in 77.2% of the workers and caused upper arm pain in 66.3%; the association between the upper score and upper pain was statistically significant ( $\chi^2 = 20.57$ ;  $p < 0.05$ ). Similarly, significant associations were found between: (a) wrist score and wrist pain; (b) neck score and neck pain; (c) trunk score and back pain. *Conclusions.* *C. sinensis* workers use unsafe postures which contribute to WRMP at the upper arm, trunk, neck and wrists. Ergonomics measures are required to improve their working posture.

- **Keywords:** Citrus sinensis, musculoskeletal pain, injury, risk, rapid upper limb assessment

**Melanie J. Hayes, Adam A. Rogers, Janet Chuanon, Thomas Tan, Ivan Lai & Elisha Yong. *Dental and oral health students' perceptions of loupes.* Pages: 136-143.**

*Objectives.* The dental industry has embraced the usage of loupes, with recent literature identifying numerous clinical and ergonomic benefits. Despite the growing usage of loupes among Australian dental professionals and dental students, few data regarding the perceived benefits and limitations of their use in clinical practice are available. The aim of this study was to examine the experiences and opinions of loupe usage among Australian dental and oral health students. *Methods.* A self-reporting questionnaire was distributed to all dental and oral health students across Australia during 2016. *Results.* A total of 223 students responded to the questionnaire. Of these responses, 45.7% reported they wear loupes during their clinical training, with the majority (32%) purchasing them due to recommendation by a demonstrator. Primary benefits reported included ergonomics/posture (89%), restoration evaluation/detection (72%) and quality of care/improved patient care (63%). Primary limitations reported included infection control (53%), decreased awareness of patients' non-verbal communications (44%) and vision dependency (30%). *Conclusions.* Overall, the students in this study identified both benefits and limitations to wearing loupes in clinical practice. Despite this, an overwhelming majority (96%) of those who used loupes would recommend them to other dental and/or oral health students.

- **Keywords:** dental student, oral health student, magnification, loupes, musculoskeletal disorders

**Serdar Korkmaz & Dal Jae Park. *The effect of safety communication network characteristics on safety awareness and behavior in a liquefied natural gas terminal.* Pages: 144-159.**

Relatively few studies have investigated the safety awareness and behavior that are substantially influenced by the characteristics of safety communication. It is very important to comprehend what kind of attributes play a role in adequate safety information flow in a communication network. For these reasons, the current study aimed to explore the effectiveness of safety communication on safety awareness and behavior. The data were collected by performing interviews with employees of teams at a liquefied natural gas terminal located in Pyeongtaek, South Korea. A social network analysis (SNA) was applied to visualize the pattern of the safety communication network and calculate the typical SNA metrics such as density, tie strength, betweenness and degree centrality. In addition, the number of communication channels was also considered as a crucial

differentiator between teams. Then, a correlation analysis was applied to investigate the impact of calculated SNA metrics on safety awareness and behavior. As a result, density, tie strength, degree centrality and the channel variety showed a direct influence on safety awareness and behavior. Conversely, betweenness centrality was not an active metric. This study demonstrated that raising the level of SNA metrics such as density, tie strength and degree centrality, and using various channels to communicate safety information within teams, could support better safety awareness and behavior.

- **Keywords:** social network analysis, safety communication, safety awareness, safety behavior, liquefied natural gas terminal, petrochemical

**Ismail W. R. Taifa, Darshak A. Desai & Niravkumar Mukesh Bulsara. *The development of an ergonomically designed product through an integrated product team approach.* Pages: 160-178.**

*Purpose.* This article discusses the process of developing an ergonomic desk for students through an integrated product team approach. *Methodology.* Using an integrated product team approach, numerous quality tools, customization techniques, strategic tools and techniques including quality function deployment, ergonomic principles, Kano model, SCAMPER (substitute, combine, adapt, modify, put, eliminate, reverse), brainstorming, Pareto's principle and cause-and-effect diagrams were systematically applied. In addition, for detailed designs, anthropometric measurements were considered. *Results.* Having identified various health problems associated with use of unergonomic furniture by students, this study developed an ergonomic desk using SolidWorks version 2016. The ergonomic student desk considered the design for adjustability principle which accommodates 90% of all students (5th percentile female to 95th percentile male). *Conclusions.* Data obtained from three colleges were systematically verified, validated and evaluated and a design for an ergonomic student desk was the result. Adoption of these systematic processes gives the design practical validity, and once the ergonomic student desk has completed the manufacturing process its use is expected to lead to a reduction in the incidence of musculoskeletal disorders, neck problems, back pain and pressure on the hips. Ultimately, students having acquired a desk designed to fit their requirements will achieve comfort and satisfaction.

- **Keywords:** ergonomic desk, adjustability mechanism, product development, bill of materials, musculoskeletal disorders, anthropometric measurement

**Özgün Ünal, Mahmut Akbolat, Mustafa Amarat & Süleyman Tilkilioğlu. *The role of the human factor in occupational safety and health performance.* Pages: 179-184.**

*Objectives.* The purpose of this study is to determine the effect of managers' commitment to occupational safety and health (OSH) on employees' safety awareness and competency, employees' involvement, reporting culture and OSH performance; the effect of employees' involvement in OSH on safety awareness and competency, reporting culture and OSH performance; and the mediating role of employees' involvement in the effect of managers' commitment to OSH on OSH performance. *Methods.* The study population consisted of 600 people working in a private company and the sample consisted of 533 employees agreeing to participate in the survey. Data were analyzed using structural equation modeling. *Results.* The analysis results showed that managers' commitment to OSH had no significant effect on OSH performance but a significant positive effect on employees' safety awareness and competency, employees' involvement in OSH and reporting culture. Although managers' commitment to OSH alone had no significant effect on OSH performance, it had a significant effect on OSH performance when employees' involvement was used as a mediating variable. *Conclusion.* OSH should not be considered only as a technical matter. It is recommended that arrangements should be made to improve OSH considering the human factors involved in OSH.

- **Keywords:** occupational health and safety, managers' commitment to OSH, employees' involvement to OSH, OSH performance, reporting culture

**Stanislas Abrard, Mathieu Bertrand, Timothée De Valence & Thierry Schaupp. *Physiological, cognitive and neuromuscular effects of heat exposure on firefighters after a live training scenario*. Pages: 185-193.**

This study investigated physiological, cognitive and neuromuscular performances in firefighters after a structural live-fire scenario. Changes in vital signs, environmental parameters and cognitive and neuromuscular performance were measured before and after a live-fire training session in a closed environment, in conditions similar to those one could encounter in a structural fire. Very high ambient temperature peaks were reached during the 30-min sessions. After the session, the forehead temperature was increased by 0.5 °C, mean water body loss was 639 ml and the mean heart rate increase was 7.5 bpm. Mental calculation speed did not vary significantly, however we observed a reduction in reaction time. These findings demonstrated that after 30 min of exposure, heat stress had little impact on firemen. Stress activation seems beneficial after firefighting operations. Normal vital parameters should allow re-engagement for a second firefighting task. This result must be compared with longer exposures.

- **Keywords:** firefighters, heat stress disorder, temperature regulation, cognitive function, neuromuscular manifestations

**Peter Jackovics. *The role of safety-related criteria in selection of rope-technology equipment for emergency rescue operations*. Pages: 194-200.**

In one of the extreme areas of disaster relief, the volunteer rescue organizations that carry out special rescue operations – most of their civil volunteers having gained their knowledge by practising extreme sports – have an increasingly significant role. Professional-level alpine activity or cave tour guiding has developed from amateur, hobby-like rock climbing or caving; however, there were no professional specifications elaborated for the former activities. Although the activities of a large number of such organizations, in general, are regulated, the safety specifications of the equipment and devices used for rescue, in particular, are not regulated. The methodology and operational procedures of special rescues are not sufficiently elaborated either. The purpose of this study is to provide answers to the issue of safe usability of rope-technology equipment by a related Q-sort on equipment use and to make suggestions of improvements, thus preventing accidents.

- **Keywords:** usability, rope technology, Q-sort, carabiner, descender, ascender, safety

**Chia-Chun Wu & Yi-Nuo Shih. *The effects of background music on the work attention performance between musicians and non-musicians*. Pages: 201-205.**

For occupational safety and ergonomics, the relationship between work attention performance and background music is a trend for the future. Attention performance may be influenced by some personal factors, such as experience of music training. This investigation explores the difference between the attention performance of musicians and that of non-musicians based on a quasi-experimental design to gain a preliminary understanding of the possible effect of background music on the attention performance of both groups. This study found that a musician's attention performance is better than a non-musician's and that background music tends to improve the attention performance of both musicians and non-musicians, but to a greater extent for musicians.

- **Keywords:** music training, attention, background music

**Haji Omid Kalteh, Seyyed Bagher Mortazavi, Eesa Mohammadi & Mahmood Salesi. *The relationship between safety culture and safety climate and safety performance: a systematic review*. Pages: 206-216.**

Introduction. There is a close relationship between safety culture and safety climate and safety performance. However, the details of this relationship are somewhat unclear, due to different attitudes toward safety culture and safety climate, and the use of various tools for their evaluation, and various measures of safety performance. Methods. In this study, articles published in English from 2005 to 2017 were selected from various databases. Then, certain journals in the field of safety were specifically searched using the keywords 'safety and safety performance', 'safety climate and safety performance', 'safety culture and safety performance', 'safety climate and safety outcome', 'safety culture and safety outcome', 'safety culture and injury and fatalities' and 'safety climate and injuries and fatalities'. Results. In the current article, the role of safety culture and safety climate in improving safety performance was evaluated in 31 selected studies. It seems that reactive criteria and safety compliance is more consistent with safety climate and safety culture. Conclusions. The findings emphasized that increasing the level of safety climate and safety culture could be effective in reducing incidents and improving safety performance indicators.

- **Keywords:** safety culture, safety climate, safety performance, accident rate, safety compliance, safety participation

**Ana Colim, Pedro Arezes, Paulo Flores, Pedro Ribeiro Rocha Monteiro, Inês Mesquita & Ana Cristina Braga. *Obesity effects on muscular activity during lifting and lowering tasks*. Pages: 217-225.**

Obesity is an emerging health problem and its incidence has been increasing throughout the workforce. In industrial workstations, vertical handling tasks (VHT), including lifting and lowering, are very common and can cause a significant muscular overload for the involved workers. During these tasks, muscular activity may be considerably affected by workers' body conditions. This study aims to analyze and compare the muscular activity in subjects with different obesity levels, using surface electromyography (EMG), during predefined VHT. Six different VHT (combining 5, 10 and 15-kg loads with two task styles) were performed. EMG data normalization was based on the percentage of maximum contraction during each task (MCT%). The results show that obesity influences the MCT%, which in turn increases the muscular effort during VHT. The current investigation demonstrates that obesity is a relevant musculoskeletal risk factor regarding VHT. The engineering analysis and design implications of this work can thus be perceived.

- **Keywords:** obesity, vertical handling tasks, muscular activity, electromyography, percentage of maximum contraction during each task

**Andrzej Sobolewski, Magdalena Młynarczyk, Maria Konarska & Joanna Bugajska. *The influence of air humidity on human heat stress in a hot environment*. Pages: 226-236.**

This article aims to present the physical adaptation capabilities of a human, seen as a response to extreme hot and dry or hot and humid conditions. Adaptation capabilities are expressed as safe exposure time in two variants: at rest and during physical activity. The study shows the results of calculations of the variability over time of the core temperature and skin temperature as well as heat balance. Calculations were made according to Standard No. EN ISO 7933:2005 on the basis of assumed and actual meteorological data. The results of the calculations show that in these conditions a hot

but dry environment enables a human (although to a limited extent) to stay and perform low physical activity, provided access to drinking water is ensured. In contrast, a hot but humid environment causes more serious problems, due to the inability to reduce skin temperature by evaporation of sweat from the skin surface.

- **Keywords:** heat stress, heat balance, hot environment, air humidity, partial pressure of water vapor, predicted heat strain

**Andrzej Sobolewski, Magdalena Młynarczyk, Maria Konarska & Joanna Bugajska. *Effect of previous lowering of skin temperature on the time of safe exposure to a hot environment: a case study.* Pages: 237-246.**

*Objective.* The purpose of the study was to determine the influence of initial conditions of a microclimate on volunteers' permissible exposure limits to a hot and humid environment. *Materials and methods.* Eighteen experimental studies with the participation of three volunteers were performed under controlled microclimate conditions (two climate chambers). The skin temperature and body core temperature were measured after they had stabilized in the following microclimate conditions: temperature of 17, 21 and 23 °C, relative humidity of 50% and hot microclimate conditions, i.e., temperature of 35 and 42 °C, humidity of 80% and physical work load at 30 W. The time needed to reach a body core temperature of 38 °C was determined under hot conditions. Heat accumulation was calculated. *Results.* Lowering volunteers' skin temperature under conditions of stabilized physiological parameters prolongs the time necessary for the body core temperature to reach 38 °C during physical work in a hot and humid environment. *Conclusions.* Appropriate acclimatization before exposure may prolong the time of safe work in a hot environment, e.g., during activities of rescue services.

- **Keywords:** heat load, skin and body temperature, heat accumulation, time of safe exposure to heat, pre-cooling

**Denise Harari & Raquel Aparecida Casarotto. *Effectiveness of a multifaceted intervention to manage musculoskeletal disorders in workers of a medium-sized company.* Pages: 247-257.**

*Purpose.* This study investigated the effectiveness of a workplace-based multifaceted intervention to manage musculoskeletal disorders (MSDs) and their consequences in the workers of a medium-sized company. *Materials and methods.* A program consisting of participatory ergonomics (PE), workplace exercises (WE) and acupuncture as the main resources of physical therapy (PT) performed at the workstations was conducted for 22 months with 126 workers. The outcomes were complaints of MSDs and absenteeism measured by the Nordic musculoskeletal questionnaire. We also measured workers' perceptions about the intervention using a Likert-based questionnaire. *Results.* The rate of MSDs was significantly reduced in at least one body region ( $p = 0.001$ ). Absenteeism was also significantly reduced ( $p = 0.020$ ). For workers with pain at baseline, at least 40% improved totally, while for others the duration, frequency and intensity of pain was reduced for all body regions, except for the lower back and fingers. For workers without pain at baseline, a 70% target for prevention of MSDs was achieved. Most workers (56–99%) agreed that the intervention improved the consequences of MSDs. *Conclusions.* A multifaceted intervention consisting of PE, WE and acupuncture as the main resources of PT performed at the workstations may be relevant to managing MSDs in working populations.

- **Keywords:** ergonomics, musculoskeletal diseases, occupational health, acupuncture, physical exercises

**Kok Suen Cheng, Jun Xiang Lee & Poh Foong Lee. *Designing a neurofeedback device to quantify attention levels using coffee as a reward system.* Pages: 258-266.**

*Purpose.* Work performance is closely related to one's attention level. In this study, a brain-computer interface (BCI) device suitable for office usage was chosen to quantify the individual's attention levels. *Methods.* A BCI system was adopted to interface brainwave signals to a coffee maker via three ascending levels of laser detectors. The preliminary test with this prototype was to characterize the attention level through the collected coffee amount. Here, the preliminary testing was comparing the correlation between the attention level and the participants' cumulative grade point average (CGPA) and scores from the 21-item depression, anxiety, and stress scale (DASS-21) and the attentional control scale (ACS) using ordinal regression. It was assumed that a greater CGPA would generate a greater attention level. *Result.* The generated coffee amount from the BCI system had a significant positive correlation with the CGPA ( $p = 0.004$ ), mild depression ( $p = 0.019$ ) and mild and extremely severe anxiety ( $p = 0.044$  and  $p = 0.019$ , respectively) and a negative correlation with the ACS score ( $p = 0.042$ ). *Conclusion.* This simple and cost-effective prototype has the potential to enable everyone to know their immediate attention level and predict the possible correlation to their mental state.

- **Keywords:** coffee maker, brain-computer interface, attention level, electroencephalogram, neurofeedback

**Chidiebele Petronilla Ojukwu, Godson Emeka Anyanwu, Benjamin Eze, Sylvester Caesar Chukwu, Chioma Linda Onuchukwu & Emelie Morris Anekwu. *Prevalence, pattern and correlates of work-related musculoskeletal disorders among school teachers in Enugu, Nigeria.* Pages: 267-277.**

*Introduction.* There is insufficient literature on the prevalence of and risk factors for work-related musculoskeletal disorders (MSDs) among teachers in Nigeria. This study aimed to investigate the prevalence of work-related MSDs and their associations with occupational and socio-demographic factors of Nigerian-based school teachers. *Materials and methods.* Socio-demographic and occupational characteristics, prevalence and pattern of work-related MSDs of 352 school teachers (age 24–60 years) were investigated using a standard Nordic questionnaire. Data were summarized with descriptive statistics. Univariate and multivariate analyses were used to assess predictors of work-related MSDs. *Results.* The results showed that 70.2% of the teachers had work-related MSDs predominantly in the shoulder (62.3%) and neck (57.9%) regions. Most of the studied socio-demographic features and anthropometric and occupational characteristics were significantly associated ( $p < 0.05$ ) with MSDs in at least one body region. *Conclusions.* There was a prevalence of work-related MSDs among the teachers. Advanced educational qualification, elevated teaching boards, teaching experience over 10 years and age range of 35–50 years were the major predictors of MSDs.

- **Keywords:** school teacherswork-related musculoskeletal disorderssocio-demographic factorsoccupational factorsNigeria

**Ralf Caers, Key Lales Akgul, Stijn Baert, Tim De Feyter & Marijke De Couck. *Too sick or not too sick? The importance of stress and satisfaction with supervisor support on the prevalence of sickness presenteeism.* Pages: 278-289.**

In a sample of 3274 full-time Belgian workers, this article found that 62% of workers went to work while being sick (sickness presenteeism) at least once over the past 12

months. Of all workers who did not show sickness presenteeism themselves, another 6 out of 10 saw or heard about sickness presenteeism in their own organization. Women were more likely to report sickness presenteeism than men and junior workers were more prone to sickness presenteeism than senior workers. Education did not explain the choice for sickness presenteeism. Satisfaction with the supervisor had a direct negative effect on sickness presenteeism. Finally, indirect effects were found between satisfaction with the supervisor and sickness presenteeism via the prevalence of stress. While previous studies showed that good supervisor support can make sick workers more productive when they show up at work, this study shows that good supervisor support makes sick workers stay at home.

**Seth Oppong. *Development and testing of culturally adapted road hazard communication designs.* Pages: 290-301.**

This study was conducted to assess comprehension of existing road hazard communication designs (RHCDs) in relation to culturally adapted designs among commercial vehicle drivers using a two-part study. In study 1, nine participants were recruited and their comprehension of 20 existing RHCDs was tested. Results of the analysis revealed that only 50% of the designs met the acceptance criterion of 67% set by the International Organization for Standardization (ISO). Culturally adapted symbols were then developed for the 10 symbols which failed to meet the ISO acceptance criterion through a longitudinal focus group discussion involving the nine participants. In study 2, 226 commercial vehicle drivers were drawn from four bus terminals. Results of a paired-samples t test showed that comprehension of the culturally adapted designs was significantly better than comprehension of their equivalent existing designs. The findings are discussed in the context of extant literature and practice.

- **Keywords:** ergonomics, human factors, culturally adapted symbols, road safety, traffic psychology

**Tzu-Hsien Lee & Jing-Kai Lin. *Effects of hand placement, handles and support on manual holding tasks.* Pages: 302-307.**

This study recruited 16 participants to examine the effects of hand placement, handles and support on the muscular activities of the musculus biceps brachii and erector spinae, box tilt angle and total center of pressure (CoP) length beneath the feet in manual holding tasks. Each participant was asked to hold a box in two hand placement conditions (symmetrical hand placement and asymmetrical hand placement) × two handle conditions (handles and no handles) × two support conditions (hands-and-body and hands). The results showed that symmetrical hand placement reduced the overall muscular activities of the musculus biceps brachii and erector spinae, box tilt angle and CoP length. The same results were also found in the handles condition and in the hands-and-body support condition. This study recommends that box designers should provide symmetrical handles, and people should keep the box against their front body while holding.

**Keywords:** holding strategy, electromyography, stability

**Csaba Czabán, Péter Jackovics & György Kis. *Application of the safety through organizational learning methodology for the post analysis of an adverse event during a search and rescue operation.* Pages: 308-315.**

Experiences show that during the investigation of accidents, focusing on the direct causes of the event and thus ignoring other facts that also contributed to the event from the background is a recurring problem. In this article we set out to present the lessons learnt from applying a novel approach using the safety through organizational learning (event analysis) methodology for the analysis of an occupational accident. We used this method to analyse a fatal accident during a search and rescue operation, where the victim was

one of the members of the search and rescue team. Our analysis also reviewed some contributing factors, which had not been identified by the previously conducted official investigation. As part of our method, we reflected on these factors by specifying concrete management measures, thus laying the foundations of organizational learning.

- **Keywords:** accident, search and rescue, safety through organizational learning, event analysis, safety, organizational learning, root cause analysis