International Journal of Occupational Safety and Ergonomics – rok 2019, ročník 25

Číslo 4

Pin-Chao Liao, Xinlu Sun, Mei Liu & Yu-Nien Shih. *Influence of visual clutter on the effect of navigated safety inspection: a case study on elevator installation*. Pages: 495-509.

Introduction. Navigated safety inspection based on task-specific checklists can increase the hazard detection rate, theoretically with interference from scene complexity. Visual clutter, a proxy of scene complexity, can theoretically impair visual search performance, but its impact on the effect of safety inspection performance remains to be explored for the optimization of navigated inspection. This research aims to explore whether the relationship between working memory and hazard detection rate is moderated by visual clutter. Methods. Based on a perceptive model of hazard detection, we: (a) developed a mathematical influence model for construction hazard detection; (b) designed an experiment to observe the performance of hazard detection rate with adjusted working memory under different levels of visual clutter, while using an eye-tracking device to observe participants' visual search processes; (c) utilized logistic regression to analyze the developed model under various visual clutter. Conclusion. The effect of a strengthened working memory on the detection rate through increased search efficiency is more apparent in high visual clutter. This study confirms the role of visual clutter in construction-navigated inspections, thus serving as a foundation for the optimization of inspection planning.

- **Keywords:** visual clutter, hazard detection, working memory, inspection, construction safety

Gholamreza Gharedaghi & Manouchehr Omidvari. *A pattern of contractor selection for oil and gas industries in a safety approach using ANP-DEMATEL in a Grey environment*. Pages: 510-523

Contractor selection is one of the major concerns of industry managers such as those in the oil industry. The objective of this study was to determine a contractor selection pattern for oil and gas industries in a safety approach. Assessment of contractors based on specific criteria and ultimately selecting an eligible contractor preserves the organizational resources. Due to the safety risks involved in the oil industry, one of the major criteria of contractor selection considered by managers today is safety. The results indicated that the most important safety criterion of contractor selection was safety records and safety investments. This represented the industry's risks and the impact of safety training and investment on the performance of other sectors and the overall

organization. The output of this model could be useful in the safety risk assessment process in the oil industry and other industries.

- **Keywords:** safety approach, contractor, ANP-DEMATEL, Grey relational analysis, oil and gas industries

Mansour Ziaei, Hamidreza Mokhtarinia, Farhad Tabatabai Ghomshe & Maryam Maghsoudipour. *Coefficient of friction, walking speed and cadence on slippery and dry surfaces: shoes with different groove depths*. Pages: 524-529.

Objective. The present study aimed to determine the coefficient of friction (COF), walking speed (WS) and cadence while walking on slippery and dry surfaces using shoes with different sole groove depths to predict likelihood of fall. Background. Design of shoe sole groove is crucial to prevent slipping during walking. Methods. 22 healthy young men (mean age 24.5, body mass index 22.5) volunteered for this semi-experimental study. Six different conditions of the test (combination of three shoes and two surfaces) were defined and the condition was repeated three times. In total, 396 trials (22 subjects × 3 groove depths × 2 surfaces × 3 times) were obtained for data analysis. COF was recorded by force platform at 1000 Hz and walking parameters recorded using 3D motion analysis with six infrared cameras at 200 Hz. Results. The highest COF was obtained from the deepest groove depth (5.0 mm) on both dry and slippery surfaces. The COF on slippery surfaces was significantly lower in comparison with dry surfaces. WS and cadence were not significantly different on dry and slippery surfaces. Conclusion. The deeper groove is better to prevent slipping because the COF increases by increasing the shoe sole groove depth. WS did not change on dry and slippery surfaces.

- **Keywords:** shoes, coefficient of friction, walking speed, cadence, shoe sole groove depth

Yener Taskin, Yuksel Hacioglu, Faruk Ortes, Derya Karabulut & Yunus Ziya Arslan. *Experimental investigation of biodynamic human body models subjected to whole-body vibration during a vehicle ride*. Pages: 530-544

In this study, responses of biodynamic human body models to whole-body vibration during a vehicle ride were investigated. Accelerations were acquired from three different body parts, such as the head, upper torso and lower torso, of 10 seated passengers during a car ride while two different road conditions were considered. The same multipurpose vehicle was used during all experiments. Additionally, by two widely used biodynamic models in the literature, a set of simulations were run to obtain theoretical accelerations of the models and were compared with those obtained experimentally. To sustain a quantified comparison between experimental and theoretical approaches, the root mean square acceleration and acceleration spectral density were calculated. Time and frequency responses of the models demonstrated that neither of the models showed the best prediction performance of the human body behaviour in all cases, indicating that further models are required for better prediction of the human body responses.

- **Keywords:** human body modelling, lumped-parameter models, seated human subjects, whole-body vibration

Yasser Labbafinejad, Mohammad Sadegh Ghasemi, Ali Bagherzadeh, Hossein Aazami, Mnsour Eslami-Farsani & Naser Dehghan. *Saddle seat reduces musculoskeletal discomfort in microsurgery surgeons*. Pages: 545-550.

Background. Microsurgery is a surgical procedure requiring a high degree of precision and is commonly facilitated through the use of an intraoperative microscope. When operating the microscope system, the long-term posture leads to musculoskeletal disorders in surgeons, and seats are commonly employed to diminish these problems. The present study was conducted to evaluate musculoskeletal discomfort during work with a saddle seat in comparison with conventional seats for microscopic work. Methods. Two types of seats, a saddle and a conventional one, were evaluated for 73 microsurgical surgeons in terms of musculoskeletal discomfort. Corlett and Bishop's body part discomfort scale was used to assess musculoskeletal discomfort before and after working with the seats. Results. The highest amount of discomfort that microsurgical surgeons acquire in the workplace was focused on their neck, shoulders, arms and back. During work with a saddle seat, a significant reduction was found for discomfort values in the neck, shoulder, arm, back, elbow and forearm, as well as the whole body ($p < 0.05$). Conclusion. This study showed that the use of saddle seats provides a more appropriate physical posture at work, and can decrease musculoskeletal discomfort in different parts of the body of microsurgical surgeons.

- **Keywords:** surgeons, saddle chair, microsurgery, musculoskeletal disorders, body discomfort

Ivan Dolezal, Lubos Hes & Kausik Bal. *A non-destructive single plate method for measurement of thermal resistance of polymer sheets and fabrics*. Pages: 562-567.

Measurement of thermal resistance of polymer sheets and fibrous layers is important in various applications including those within the engineering, ergonomics, clothing design and personal protective equipment fields. Standard methods for measurement of thermal resistance of plain materials are generally time consuming, expensive and often require the sample to be cut. Moreover, the temperature difference between the surfaces of both plates surrounding the sample must be known, as well as the sample thickness. This article describes a new measuring device named the Thermoscope. The Thermoscope is not limited by the aforementioned requirements and is able to evaluate the thermal resistance of polymer sheets and textiles by touching the sample on one surface alone. Simultaneously, the other surface is kept in thermal contact with the supporting base. The accuracy of this device was compared with the Alambeta thermal insulation tester. Effects of various base materials on measurement precision were also studied.

- **Keywords:** thermal resistance, non-destructive testing, single plate, fibrous layer

Dong Hwan Ko & Byung Yong Jeong. *Work-related injuries of educational support staff in schools*. Pages: 568-574.

This study aims to describe the characteristics of occupational injuries to educational support staff (service worker) in schools. In this research, 803 injured workers registered in 2015 were analyzed in terms of their gender, age, work experience, school type, work type, accident type, agency of accident, nature of injury and injured part of the body for each occupation. The workers were classified into after-school instructor, custodian and cooking staff. Accidents occurred mainly due to slips (35.6%) on floor/stair or contact with high temperature (18.1%). Also, the workers mostly fractured (41.2%) or had burns (19.3%) on their leg/foot (37.1%) or arm/hand/finger (29.8%). The results showed the difference in characteristics and injury pattern of injured persons for each occupation type, addressing the need for customized preventative measures for each situation. The results of this study can be a baseline in devising policies and guidelines for preventing accidents of service workers in schools.

- **Keywords:** accident analysis, work-related injury, school safety, educational support staff

Ji Young Song, Min-Gi Kim & Yeon-Soon Ahn. *Injury-related hospital admission of female firefighters in South Korea*. Pages: 575-582.

Purpose. The main objective of this study was to ascertain whether injury-related hospital admission in all South Korea female firefighters is greater than that in the general population. Methods. To perform this comparison, the standardized admission ratios (SARs) and their 95% confidence intervals (CIs) were calculated by person-years and mortality computation software. Results. Compared to the general population, the SARs for overall injury (SAR = 1.57, 95% CI [1.24, 1.96]) and for injury to the lower back (SAR = 2.78, 95% CI [1.81, 4.07]) in the female firefighters were significantly higher. The SARs for injury to the knee (SAR = 2.48, 95% CI [1.18, 4.55]) in emergency medical services (EMS) workers were significantly higher than those in the general population. Conclusions. Our study shows that the SARs of overall injury and injury to the lower back in female firefighters and knee injury in the EMS were significantly higher than those in the general population. Further studies are needed to protect the lower back of firefighters and the knees of EMS.

- **Keywords:** female firefighters, injury, lower back, knee

Concetto Giorgianni, Mariagiuseppina Tanzariello, Domenico De Pasquale, Renato Brecciaroli & Giovanna Spatari. *Equilibrium disorders in workers exposed to mixed solvents*. Pages: 583-586.

Background. Organic solvents cause diseases of the vestibular system. However, little is known regarding the correlation between vestibular damage and exposure to organic solvents below threshold limit values. The best measure by which to evaluate vestibular disorders is static and dynamic posturography. Objective. The aim of this study was to evaluate equilibrium disorders via static and dynamic posturography in workers without clear symptoms and exposed to low doses of mixed solvents. Methods. 200 subjects were selected. Using an Otometrics device (Madsen, Denmark), all subjects endured static and dynamic posturography testing with both eyes-open and eyes-closed conditions. Results were compared with a control group of unexposed individuals. Result. Based on the obtained data, the following results can be drawn: (a) subjects exposed to mixtures of solvents show highly significant differences regarding all static and dynamic posturography parameters in comparison to the control group; (b) posturography testing has proven to be a valid means by which to detect subliminal equilibrium disorders in subjects exposed to solvents. Conclusion. We can confirm that refinery workers exposed to mixtures of solvents can present subliminal equilibrium disorders. Early diagnosis of the latter is made possible by static and dynamic posturography.

- **Keywords:** dynamic posturography, solvents, subliminal equilibrium disorders

Nora E. Munguía Vega, Vania S. Flores Borboa, David S. Zepeda Quintana & Luis E. Velazquez Contreras. *Assessing the effectiveness of integrating ergonomics and sustainability: a case study of a Mexican maquiladora*. Pages: 587-596.

In 2015, the United Nations defined sustainable industrialization as one of 17 sustainable development goals. In this article, an analysis is performed to assess the opportunities for ergonomics to contribute toward sustainability in the manufacturing industry. To that effect, a case study was carried out in a maquiladora of electronic components in the northwestern region of Mexico. The investigation was developed in four stages: (a) diagnosis; (b) planning; (c) implementations; (d) verification of results. Barriers found

during each stage are presented. Finally, a discussion of the obtained results is provided, and areas of opportunity for programs or actions to prevent health risks are identified.

- **Keywords:** ergonomics, sustainability, manufacturing

Katarzyna Naylor, Anna Torres, Robert Gałązkowski & Kamil Torres. *Self-reported occupational blood exposure among paramedics in Poland: a pilot study*. Pages: 597-603.

Introduction. Paramedics are at risk of occupational blood exposure, increased by the immediacy of provided treatment. However, the issue has not been acknowledged to date by any research in Europe. Methods. This research aimed at assessing occupational blood exposure among paramedics in Poland. Respondents represented 21 Polish medical institutions. Their participation was voluntary and anonymous. Paramedics were provided with a self-directed job-specific questionnaire adapted to Polish conditions from an original US version. Results. 118 paramedics participated in the study from institutions constituting the National Emergency Medical System in Poland; including ambulance crews, Helicopter Emergency Medical Services and emergency department employees. Occupational exposure was reported by 18.64% of respondents and the main route of exposure was needlestick events. Conclusions. There is a further need to improve education among paramedics concerning the threat of being infected with blood-borne pathogens through all existing routes. Our findings point to the problem as being hidden and considered a shameful issue.

- **Keywords:** paramedics, occupational exposure, National Emergency Medical System, self-reported, job-specific questionnaire

Syed Harris Laeeque, Atif Bilal, Abdullah Hafeez & Zoia Khan. *Violence breeds violence: burnout as a mediator between patient violence and nurse violence*. Pages: 604-613.

The present study examines whether patient-perpetrated violence triggers anger, hatred and other negative emotions that, under certain circumstances, might motivate nurses to behave violently with patients. In doing so, this study considers burnout as a mediator in the patient violence–nurse violence relationship. To test the causal paths, data were collected from 182 nurses working in two government-sector teaching hospitals of Pakistan's Punjab province. Results confirm that patient violence toward nurses leads to nurse violence toward patients through the mediating effect of burnout. The study advises hospitals to provide wellness and stress management programs to nurses who regularly experience events involving patient violence. Hospitals may consider allowing nurses to take short breaks after an encounter with violently behaving patients. In addition, hospitals should conduct empathy-promoting training, emotional intelligence training and 'lens of the patient' training programs to sensitize their nursing staff.

- **Keywords:** patient violence, nurse violence, burnout, hospitals, Pakistan

Rahul Jain, Makkhan Lal Meena, Manoj Kumar Sain & Govind Sharan Dangayach. *Impact of posture and upper-limb muscle activity on grip strength*. Pages: 614-620.

Purpose. The current research was carried out to determine grip strength (GS) with change in posture and upper-limb muscle activity of manual workers and investigate the impacts of these changes. Methods. For the current research, 120 male and 80 female participants were selected and GS was assessed using a digital hand grip dynamometer in various conditions. Results. The outcomes showed that male participants had higher GS as compared to female participants. Maximum GS was found in a standing posture

with the fixed forward shoulder at 45°, elbow at 90° and a neutral position of the wrist and forearm for all participants. Conclusions. Higher values of GS were attained in standing postures which may result in attainment of higher performance levels by the workers. The outcomes justify the importance of correct postures during manual work in industries employing traditional methods.

- **Keywords:** agriculture, grip strength, manual workers, posture, upper-limb muscle activity

Yun-Ya Fang, Chien-Yuan Huang & Mei-Chi Hsu. *Effectiveness of a physical activity program on weight, physical fitness, occupational stress, job satisfaction and quality of life of overweight employees in high-tech industries: a randomized controlled study*. Pages: 621-629.

Introduction. This study aimed to examine the effectiveness of a physical activity (PA) program on weight control, physical fitness, occupational stress, job satisfaction and quality of life of overweight and sedentary employees in high-tech industries. Methods. Participants in the intervention group (n = 37) were instructed to carry out a PA program at moderate intensity for 60 min/session, 3 sessions/week for 12 weeks. Those in the control group (n = 38) received no PA program and were asked to continue their routine lifestyle. Evaluations were performed at baseline and at the end of the intervention. Results of structured questionnaires and blood biochemistry tests and evaluations of physical fitness were analyzed. Results. The PA program effectively reduced the number of risk factors for metabolic syndrome and body fat percentage, and improved physical fitness such as flexibility, muscular strength and endurance and cardiorespiratory endurance. The intervention also significantly decreased levels of serum triglyceride, total cholesterol and low-density lipoprotein cholesterol. Significant positive effects on work control, interpersonal relationships at work, global job satisfaction and quality of life were also demonstrated. Conclusion. This study showed that a PA program can be helpful in improving physical, physiological and psychological outcomes for overweight and sedentary employees in high-tech industries.

- **Keywords:** physical activity, overweight, occupational stress, job satisfaction, quality of life, nursing practice

Maja Račić, Aleksandra Virijević, Nedeljka Ivković, Bojan N. Joksimović, Vedrana R. Joksimović & Biljana Mijovic. *Compassion fatigue and compassion satisfaction among family physicians in the Republic of Srpska, Bosnia and Herzegovina*. Pages: 630-637.

Aims. The aim of this study was to examine self-perceived compassion fatigue and compassion satisfaction among family physicians in Bosnia and Herzegovina and describe potential contributing factors. Methods. The cross-sectional study enrolled 120 family physicians. Professional quality of life compassion satisfaction and fatigue version 5 (ProQOL5) was used to assess compassion satisfaction and two components of compassion fatigue, secondary traumatic stress and burnout. The symptoms of chronic fatigue were evaluated using the Chalder fatigue scale. Results. The majority of family physicians had moderate levels of compassion satisfaction (70%), burnout (75%) and secondary traumatic stress (55.8%). Family physicians with higher levels of secondary traumatic stress reported chronic fatigue ($p = 0.001$), longer length of service ($p = 0.024$) and residency training ($p = 0.041$). Chronic fatigue ($p = 0.001$), living in a rural environment ($p = 0.033$), larger size of practice ($p = 0.006$) and high number of patients with chronic disease ($p = 0.001$) were associated with a higher risk of burnout. Conclusion. Family physicians with large practices, long years of experience, a high number of chronically ill patients and experiencing chronic fatigue are at risk of developing compassion fatigue. A systematic exploration of compassion fatigue in

relation to working conditions might provide an appropriate starting point for the development of preventive interventions.

- **Keywords:** family medicine, compassion fatigue, empathy, personal satisfaction, burnout

Vladimir Berezutsky. *Possibilities of kinesio taping to prevent injuries of professional dancers*. Pages: 638-645.

A literature review of the application of kinesio taping in the prevention of professional dancers' injuries indicated frequent dance-related and overuse injuries and a lack of organized information about this issue. This study aimed to assess the impact of kinesio taping on the musculoskeletal system of dancers, based on scientific research data from 2015–2017. The analysis revealed that kinesio taping can effectively reduce muscle spasms, rebuild muscle strength of the injured extremity, improve static and dynamic balance and ease pain, due to its ability to improve proprioception of joints and regulate muscle tone. These effects reduce muscle imbalance and joint instability, thus increasing treatment efficacy and shortening the physical load limitation. Kinesio taping significantly reduces the risk of overuse syndromes and dance-related injuries during dance training and strenuous exercises of people with chronic musculoskeletal diseases. Therefore, kinesio taping has broad utility in primary and secondary prevention of dance-related injuries.

- **Keywords:** kinesio taping, dance-related injury, overuse injuries

Danuta Kunecka & Łukasz Skowron. *The model of professional satisfaction of nursing staff in Poland – brief communication*. Pages: 646-649.

The aim of this study was to create an empirical model that would help understand how to obtain the optimal level of professional satisfaction among Polish nurses. The study was performed using a standardized questionnaire among 1066 nurses. Descriptive and explanatory methods have been used in the statistical analysis of path-analytic approaches. The simulations showed that the model that achieved the highest measure of fit was a simple one which included 15 thematic areas, determining the varying degrees of job satisfaction of Polish nurses. The modeling approach to the process of understanding the professional satisfaction of Polish nurses allows for it to be used in the process of motivating and building organizational commitment of nurses, which creates new opportunities for effective management. This is especially important in an era of growing social needs in the care services sector, not only in Poland but throughout the world.

- **Keywords:** nurse's work, determinants of job satisfaction, professional image

Anna Abelsson & Lars Lundberg. *Simulation as a means to develop firefighters as emergency care professionals*. Pages: 650-657.

Objective. The aim of this study was to evaluate the simulated emergency care performed by firefighters and their perception of simulation as an educational method. Methods. This study had a mixed method with both a quantitative and a qualitative approach. Data were collected by simulation assessment, a questionnaire and written comments. Descriptive analysis was conducted on the quantitative data whereas a qualitative content analysis was conducted on the qualitative data. Finally, a contingent analysis was used where a synthesis configured both the quantitative and the qualitative results into a narrative result. Results. The cognitive workload that firefighters face during simulated emergency care is crucial for learning. In this study, the severity and complexity of the scenarios provided were higher than expected by the firefighters.

Clearly stated conditions for the simulation and constructive feedback were considered positive for learning. Patient actors induced realism in the scenario, increasing the experience of stress, in comparison to a manikin. Conclusion. Simulation in a realistic on-scene environment increases firefighters' cognitive ability to critically analyze problems and manage emergency care. Simulation of emergency care developed the firefighters as professionals.

- **Keywords:** cognitive load, contingent analysis synthesis, emergency care, firefighter, simulation