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Anugrah Shaw, Paul Schiffelbein. *Protective clothing for pesticide operators: part I – selection of a reference test chemical for penetration testing*. Pages 1-6.

A systematic approach was taken to develop a database for protective clothing for pesticide operators; results are reported as a two-part series. Part I describes the research studies that led to identification of a pesticide formulation that could serve as a reference test chemical for further testing. Measurement of pesticide penetration was conducted using different types of pesticide formulations. Six fabrics were tested using 10 formulations at different concentrations. Three formulations were subsequently selected for further testing. Analysis of the data indicated that, when compared with other formulations, mean percent penetration of 5% Prowl 3.3 EC [emulsifiable concentrate diluted to 5% active ingredient (pendimethalin)] is either similar to or higher than most test chemicals. Those results led to choosing 5% Prowl 3.3 EC as a reference test liquid. Part II of the study, published as a separate paper, includes data on a wide range of textile materials.

- **Keywords:** protective clothing, pesticide penetration, performance specifications, Prowl, pipette method, gravimetric method

Anna Donnla O'Hagan, Johann Issartel, Richard Fletcher & Giles Warrington. *Duty hours and incidents in flight among commercial airline pilots*. Pages 165-172.

Introduction. Working long duty hours has often been associated with increased risk of incidents and accidents in transport industries. Despite this, information regarding the intermediate relationship between duty hours and incident risk is limited. This study aimed to test a work hours/incident model to identify the interplay of factors contributing to incidents within the aviation industry. *Methods.* Nine hundred and fifty-four European-registered commercial airline pilots completed a 30-item survey investigating self-report attitudes and experiences of fatigue. Path analysis was used to test the proposed model. *Results.* The fit indices indicated this to be a good fit model ($\chi^2 = 11.066$, $df = 5$, $p = 0.05$; Comparative Fit Index = 0.991; Normed Fit Index = 0.984; Tucker–Lewis Index = 0.962;

Root Mean Square of Approximation = 0.036). Highly significant relationships were identified between duty hours and sleep disturbance ($r = 0.18$, $p < 0.001$), sleep disturbance and fatigue in the cockpit ($r = 0.40$, $p < 0.001$), and fatigue in the cockpit and microsleeps in the cockpit ($r = 0.43$, $p < 0.001$). *Discussion.* A critical pathway from duty hours through to self-reported incidents in flight was identified. Further investigation employing both objective and subjective measures of sleep and fatigue is needed.

- **Keywords:** sleep, fatigue, flight incidents, path analysis

Czesław Cempel, Maciej Tabaszewski & Szymon Ordysiński. *Allometric scaling and accidents at work.* Pages 173-178.

Allometry is the knowledge concerning relations between the features of some beings, like animals, or cities. For example, the daily energy rate is proportional to a mass of mammals rise of 3/4. This way of thinking has spread quickly from biology to many areas of research concerned with sociotechnical systems. It was revealed that the number of innovations, patents or heavy crimes rises as social interaction increases in a bigger city, while other urban indexes such as suicides decrease with social interaction. Enterprise is also a sociotechnical system, where social interaction and accidents at work take place. Therefore, do these interactions increase the number of accidents at work or, on the contrary, are they reduction-driving components? This article tries to catch such links and assess the allometric exponent between the number of accidents at work and the number of employees in an enterprise.

- **Keywords:** accidents at work, allometric scaling, statistical data, size of an enterprise

Tzu-Hsien Lee. *Lifting strength in two-person teamwork.* Pages 179-185.

This study examined the effects of lifting range, hand-to-toe distance, and lifting direction on single-person lifting strengths and two-person teamwork lifting strengths. Six healthy males and seven healthy females participated in this study. Two-person teamwork lifting strengths were examined in both strength-matched and strength-unmatched groups. Our results showed that lifting strength significantly decreased with increasing lifting range or hand-to-toe distance. However, lifting strengths were not affected by lifting direction. Teamwork lifting strength did not conform to the law of additivity for both strength-matched and strength-unmatched groups. In general, teamwork lifting strength was dictated by the weaker of the two members, implying that weaker members might be exposed to a higher potential danger in teamwork exertions. To avoid such overexertion in teamwork, members with significantly different strength ability should not be assigned to the same team.

- **Keywords:** capability, efficiency, teamwork, asymmetric

Marek Dźwiarek & Agata Latała. *Analysis of occupational accidents: prevention through the use of additional technical safety measures for machinery.* Pages 186-192.

This article presents an analysis of results of 1035 serious and 341 minor accidents recorded by Poland's National Labour Inspectorate (PIP) in 2005–2011, in view of their prevention by means of additional safety measures applied by machinery users. Since the analysis aimed at formulating principles for the application of technical safety measures, the analysed accidents should bear additional attributes: the type of machine operation, technical safety measures and the type of events causing injuries. The analysis proved that the executed tasks and injury-causing events were closely connected and there was a relation between casualty events and technical safety measures. In the case of tasks consisting of manual feeding and collecting materials, the

injuries usually occur because of the rotating motion of tools or crushing due to a closing motion. Numerous accidents also happened in the course of supporting actions, like removing pollutants, correcting material position, cleaning, etc.

- **Keywords:** safety of machinery, occupational accident analysis, technical measures of injury prevention

Ahmad Alizadeh, Siavash Etemadinezhad, Jamshid Yazdani Charati & Mahmood Mohamadiyan. *Noise-induced hearing loss in bus and truck drivers in Mazandaran province, 2011. Pages 193-198.*

Background and purpose. Noise-induced hearing loss (NIHL) is among the most prevalent and preventable work-related disorders. This study was conducted to evaluate the prevalence and severity of NIHL in bus and truck drivers of Mazandaran province in north Iran. *Materials and methods.* In a cross-sectional descriptive study, 2283 drivers were examined clinically and para-clinically, including measuring their fasting blood sugar, triglyceride and cholesterol levels. All participants were evaluated for the air and bone thresholds of both ears. Twenty-three individuals were excluded from the study because of conductive hearing loss. Data from 2260 drivers were analyzed using SPSS version 18. *Results.* Of the drivers, 37.5% had hearing loss in the right ear and 41.8% of the drivers had hearing loss in the left ear in one or more frequencies of sound. Hearing loss was significantly more frequent in the left ear and in 6000 Hz followed by 4000 Hz. *Conclusion.* Our study showed that the prevalence and severity of NIHL is high in drivers of Mazandaran province. There was a correlation between hearing loss and age and driving work history. We recommend considering hearing conservation programs more seriously.

- **Keywords:** hearing loss, driver, Iran

Yeon-Ha Kim & Moon-Hee Jung. *Effect of occupational health nursing practice on musculoskeletal pains among hospital nursing staff in South Korea. Pages 199-206.*

Objective. The purpose of this study was to identify whether occupational health nursing variables serve as the contributing factors to musculoskeletal pains (MSP). *Methods.* A self-administered questionnaire composed of demographic characteristics, the practice of occupational health nursing and information regarding MSP was designed based on in-depth interviews with eight nurses. This study included 226 hospital nursing staff who worked at three university hospitals located in Seoul, South Korea. Statistical analysis was performed by using SPSS and AMOS 19.0. *Results.* Shoulder and neck pains occurred when subjects worked more than 46 h/week. Subjects who performed 'work-time adjustment' had lesser chance of having shoulder, leg/foot and wrist/finger pains. Overtime work hours showed an indirect effect on multiple sites of MSP by mediator variable, which was 'work-time adjustment'. Organized night duty days eventually decreased multiple sites of MSP. *Conclusion.* Administration strategies for nurses to adjust work-time within 46 h/week should be considered.

- **Keywords:** occupational health nursing, musculoskeletal pains, hospital nursing staff

Sarolta Tóvölgyi. *User involvement in the ergonomic development of a medical instrument: a longitudinal case study. Pages 207-217.*

In this study the focus is on the continuous ergonomic-focused development of a medical instrument that is capable of performing blood group serological tests. Primarily, a medical device must be clinically effective and safe. At the same time it must also meet

the needs of its users. This calls for consideration of numerous ergonomic aspects. The development process of the product line in question was supported by a longitudinal series of carefully designed focus groups. Altogether, the 23 focus groups conducted included 245 participants from 72 laboratories. The aim of the empirical research was to collect users' experiences, ideas and needs as inputs for the following phase of the product development process. During the mentioned focus group analyses, around 100 development proposals were conceived. Besides presenting more of the mentioned development proposals, the focus group analysis was shown as a proper methodology to involve end-users in the development and implementation of new technology or devices.

- **Keywords:** blood group serology, development of medical instruments, user involvement, focus group analysis

Alireza Tafazzol, Samin Aref, Majid Mardani, Omid Haddad & Mohamad Parnianpour. Epidemiological and biomechanical evaluation of airline baggage handling. Pages 218-227.

Objectives. Musculoskeletal disorders (MSDs) are prevalent among airline baggage handlers due to manual materials handling. In this study, the Nordic musculoskeletal questionnaire (NMQ), the revised National Institute for Occupational Safety and Health (NIOSH) lifting equation, and the University of Michigan 3D Static Strength Prediction Program™ (3DSSPP) were used to analyze MSDs among baggage handlers. *Methods.* The NMQ was filled out by 209 baggage handlers and 46 arbitrarily selected baggage handlers were evaluated using the NIOSH method and 3DSSPP. *Results.* The obtained results showed that the most common MSDs occurred in the lower back region. The next risky regions included knees, neck, and upper back, respectively. The NIOSH results confirmed that the subjects lifted loads heavier than the permitted limit and their lifting postures were inappropriate. The results of the 3DSSPP also indicated that compression forces exceeded the NIOSH limit in these awkward postures. *Conclusions.* Relying on this study, holding compulsory ergonomic lifting training courses could be proposed for workers and regulations adjusting an upper limit for maximum baggage weight must be also enacted in order to improve occupational health and prevent the prevalence of increasing MSDs.

- **Keywords:** airline baggage handling, ergonomic risk factors, musculoskeletal disorders, Nordic musculoskeletal questionnaire, revised NIOSH lifting equation, spinal load

Vesna K. Spasojević Brkić, Zorica A. Veljković, Tamara Golubović, Aleksandar Dj. Brkić & Ivana Kosić Šotić. *Workspace design for crane cabins applying a combined traditional approach and the Taguchi method for design of experiments.* Pages 228-240.

Procedures in the development process of crane cabins are arbitrary and subjective. Since approximately 42% of incidents in the construction industry are linked to them, there is a need to collect fresh anthropometric data and provide additional recommendations for design. In this paper, dimensioning of the crane cabin interior space was carried out using a sample of 64 crane operators' anthropometric measurements, in the Republic of Serbia, by measuring workspace with 10 parameters using nine measured anthropometric data from each crane operator. This paper applies experiments run via full factorial designs using a combined traditional and Taguchi approach. The experiments indicated which design parameters are influenced by which anthropometric measurements and to what degree. The results are expected to be of use

for crane cabin designers and should assist them to design a cabin that may lead to less strenuous sitting postures and fatigue for operators, thus improving safety and accident prevention.

- **Keywords:** crane cabin workspace, anthropometric measurements, design of experiments, contribution ratio, contribution ratio index

Edibe Pirincci & Bengu Altun. *An analysis of hospital cleaning staff's attitudes and conduct regarding hand hygiene and cleaning.* Pages 241-245.

Objective. The aim of this study was to analyze the attitudes and conduct of hospital cleaning staff regarding cleaning and hand hygiene. *Methods.* In May and June 2014, the cleaning staff of Elazig Training and Research Hospital participated in this descriptive research. Data was collected by a survey prepared by the researchers. The SPSS program was used to analyze the data. *Results.* Of the participants, 70.3% of them were male and their mean age was 38.69 ± 6.61 . The percentage of those hand washing before starting work was 29.8% for primary school graduates or those with lower education. For those with higher levels of education, the percentage was 68.2% ($p < 0.001$). The percentage of participants who wash their hands after work was 54.3% for primary school graduates and those with lower levels of education. For those with a higher level of education, the percentage was 84.1% ($p < 0.001$). The participants' use of personal protective equipment during work was that 97.8% of them used gloves, 39.9% bonnets and 56.5% medical masks. *Conclusions.* The attitudes and conduct of the cleaning staff are not sufficiently hygienic. These employees need training before and throughout their employment.

- **Keywords:** cleaning staff, hand hygiene, cleaning, hospital

Mehmet Burak Şenol. *Anthropometric evaluation of cockpit designs.* Pages 246-256.

The objective of this research is to evaluate all the critical reaches in a cockpit and determine the visual sufficiency of a cockpit to accommodate 90% of potential pilots. While mismatches of measurements with cockpit dimensions are revealed, proposals are made to improve cockpit ergonomics. Regression models were generated to predict and assure adequate exterior vision. Mean, lower and upper control limits of all measurements were found acceptable except eye level. There are very strong positive relationships between stature and eye level ($R^2 = 0.972$, $p < 0.01$), and eye level and visual angle ($R^2 = 0.994$, $p < 0.01$). Display panel height should be at least $1.645 \times SD$ smaller than the eye level mean or seating adjustment limits in height may be changed. In general, cockpit design is acceptable in terms of fit/reach accommodation for pilots, except eye level and visual variables that could be solved by better seat adjustments.

- **Keywords:** anthropometric evaluation, cockpit design, aviator reach compatibility, aviation ergonomics

Payel Maity, Sujaya De, Amitava Pal & Prakash C. Dhara. *An experimental study to evaluate musculoskeletal disorders and postural stress of female craftworkers adopting different sitting postures.* Pages 257-266.

This study aimed to evaluate musculoskeletal disorders (MSDs) and postural stress among female craftworkers. The study was carried out on 75 adult female craftworkers in different districts of West Bengal. The prevalence of MSDs, body part discomfort (BPD) rating and body joint angles of the workers were evaluated with standard methods.

Electromyography (EMG) of the shoulder and back muscles was recorded with the BIOPAC system. The prevalence of MSDs, BPD rating and deviation of joint angle were comparatively lower in the case of sitting on the floor with folded legs than squatting and sitting on the floor with stretched legs postures. The EMG and rms values of the shoulder and back muscles were comparatively lower in this posture. Therefore, it was concluded that sitting on the floor with folded legs was less hazardous and it imposed less postural stress in comparison to other sitting postures.

- **Keywords:** posture, MSD, BPD, EMG, craftworker

Peyman Piranveyseh, Majid Motamedzade, Katerine Osatuke, Iraj Mohammadfam, Abbas Moghimbeigi, Ahmad Soltanzadeh & Heidar Mohammadi. *Association between psychosocial, organizational and personal factors and prevalence of musculoskeletal disorders in office workers. Pages 267-273.*

The purpose of this study was to investigate the relationship between organizational and personal (individual) factors with the prevalence of musculoskeletal disorders (MSDs) in office workers of the Iranian Gas Transmission Company. The participants rated two questionnaires – the standardized Nordic Musculoskeletal Questionnaire to measure the prevalence of MSDs, and the Veterans Healthcare Administration All Employee Survey questionnaire (2004 version) – to measure psychosocial, organizational and individual aspects of job satisfaction and workplace climate. The highest prevalence of MSDs was found in the lower back (49.7%) and neck (49.0%) regions. Results of the logistic regression models showed that some psychosocial and organizational factors and also some individual factors were associated with prevalence of MSDs ($p < 0.05$). These findings illustrate the need to consider all elements of the work system as a whole in future studies and in organizational planning.

- **Keywords:** musculoskeletal disorders, psychosocial factors, organizational factors, office workers

Edgar Tristán Hernández, Ignacio Pavón García, Juan Manuel López Navarro & Eleazar Samuel Kolosovas-Machuca. *Evaluation of noise environments during daily activities of university students. Pages 274-278.*

Noise conditions specifically in areas inside university facilities and its impact on the quality of life of university students are topics that have received little attention. This paper presents a study of the noise conditions in which university students of various institutions in Madrid, Spain, carry out their daily studies. A representative number of measurements was carried out using noise dosimeters and dataloggers in order to evaluate the levels of noise, noise dose and exposure to noise during school periods and extracurricular activities. The results were compared with the recommendations given by current environmental noise regulations. This paper was complemented with a survey to get to know how students perceive the exposure to noise in university environments.

- **Keywords:** university environments, noise at universities, noise dose

Tadeusz Juliszewski, Filip Kadłuczka & Paweł Kielbasa. *Determining eyeball surface area directly exposed to the effects of external factors. Pages 279-282.*

This article discusses determining the surface area of eyeballs of men and women exposed to the direct effects of external factors in the working environment. For one eye,

the mean surface is 172–182 mm². The determined surface area can be used in formulas for calculating the exposure of eyeballs to harmful chemical substances in workplace air.

- **Keywords:** surface area of the eyeball, exposure

Tahereh Gholami, Ahmad Heidari Pahlavian, Mahdi Akbarzadeh, Majid Motamedzade & Rashid Heidari Moghaddam. *The role of burnout syndrome as a mediator for the effect of psychosocial risk factors on the intensity of musculoskeletal disorders: a structural equation modeling approach.* Pages 283-290.

This study examined the hypothesis that burnout syndrome mediates effects of psychosocial risk factors and intensity of musculoskeletal disorders (MSDs) among hospital nurses. The sample was composed of 415 nurses from various wards across five hospitals of Iran's Hamedan University of Medical Sciences. Data were collected through three questionnaires: job content questionnaire, Maslach burnout inventory and visual analogue scale. Results of structural equation modeling with a mediating effect showed that psychosocial risk factors were significantly related to changes in burnout, which in turn affects intensity of MSDs.

- **Keywords:** burnout syndrome, musculoskeletal disorders, structural equation modeling, psychosocial risk factors, Iran

Małgorzata Peçiłło. *The concept of resilience in OSH management: a review of approaches.* Pages 291-300.

The concept of resilience has become very popular, especially in the 21st century. This concept is applicable to many fields, from mechanics to a broad range of social sciences. Resilience has even become part of the national and global policies of the USA, the United Nations and the European Commission. The concept of resilience has also been implemented in the area of safety and health based on the criticism of the traditional approach to occupational safety and health, which does not result in a satisfactory level of occupational safety. The concept of resilience was adopted to research occupational safety and health in different fields and thus with different approaches, such as via socio-technical studies, the psychological and behavioral aspects of organizational resilience and the link with research on individual or family resilience and its influence on work.

- **Keywords:** resilience, occupational safety and health