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Číslo 1



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

Anugrah Shaw, Paul Schiffelbein. *Protective clothing for pesticide operators: part II – data analysis of fabric characteristics.* Pages 7-11.

Development of objective measurements is an important requirement for establishing performance-based standards for protective clothing used while handling pesticide. This study, the second in a two-part series, reports on the work completed to evaluate the performance of approximately 100 fabrics that are either used or have the potential to be used for garments worn by operators while applying pesticides. Part I, published separately, provides an overview of these issues and describes research undertaken to select a test chemical for use in subsequent studies. The goals of this study were first to develop a comprehensive approach to evaluate the performance of garments currently being used by pesticide operators, and second, to use the laboratory and field data in the development of performance specifications.

- **Keywords:** protective clothing, performance specifications, percent penetration

César García-Hernández, Eduardo J. Sánchez-Álvarez, José-Luis Huertas-Talón. *Foot model for tracking temperature of safety boot insoles: application to different insole materials in firefighter boots.* Pages 12-19.

This research is based on the development of a human foot model to study the temperature conditions of a foot bottom surface under extreme external conditions. This foot model is made by combining different manufacturing techniques to enable the simulation of bones and tissues, allowing the placement of sensors on its surface to track the temperature values of different points inside a shoe. These sensors let researchers capture valuable data during a defined period of time, making it possible to compare the features of different safety boots, socks or soles, among others. In this case, it has been applied to compare different plantar insole materials, placed into safety boots on a high-temperature surface.

- **Keywords:** safety boot, extreme temperatures, foot, firefighter

M. Talat Birgonul, Irem Dikmen, Cenk Budayan, Tuncay Demirel. *An expert system for the quantification of fault rates in construction fall accidents.* Pages 20-31.

Introduction. Expert witness reports, prepared with the aim of quantifying fault rates among parties, play an important role in a court's final decision. However, conflicting fault rates assigned by different expert witness boards lead to iterative objections raised by the related parties. This unfavorable situation mainly originates due to the subjectivity of expert judgments and unavailability of objective information about the causes of accidents. As a solution to this shortcoming, an expert system based on a rule-based system was developed for the quantification of fault rates in construction fall accidents. The aim of developing DsSafe is decreasing the subjectivity inherent in expert witness reports. *Methodology.* Eighty-four inspection reports prepared by the official and authorized inspectors were examined and root causes of construction fall accidents in Turkey were identified. Using this information, an evaluation form was designed and submitted to the experts. Experts were asked to evaluate the importance level of the factors that govern fall accidents and determine the fault rates under different scenarios. Based on expert judgments, a rule-based expert system was developed. The accuracy and reliability of DsSafe were tested with real data as obtained from finalized court cases. *Result.* DsSafe gives satisfactory results.

- **Keywords:** construction fall accidents, expert systems, safety

Łukasz Baka, Róża Bazińska. *Polish adaptation of three self-report measures of job stressors: the Interpersonal Conflict at Work Scale, the Quantitative Workload Inventory and the Organizational Constraints Scale.* Pages 32-39.

Aim. The objective of the present study was to test the psychometric properties, reliability and validity of three job stressor measures, namely, the Interpersonal Conflict at Work Scale, the Organizational Constraints Scale and the Quantitative Workload Inventory. *Method.* The study was conducted on two samples ($N = 382$ and 3368) representing a wide range of occupations. The estimation of internal consistency with Cronbach's α and the test-retest method as well as both exploratory and confirmatory factor analyses were the main statistical methods. *Results.* The internal consistency of the scales proved satisfactory, ranging from 0.80 to 0.90 for Cronbach's α test and from 0.72 to 0.86 for the test-retest method. The one-dimensional structure of the three measurements was confirmed. The three scales have acceptable fit to the data. The one-factor structures and other psychometric properties of the Polish version of the scales seem to be similar to those found in the US version of the scales. It was also proved that

the three job stressors are positively related to all the job strain measures. *Conclusions.* The Polish versions of the three analysed scales can be used to measure the job stressors in Polish conditions.

- **Keywords:** interpersonal conflict at work, organizational constraints, workload, Polish adaptation

Nina Ogińska-Bulik, Magdalena Kobylarczyk. *Association between resiliency and posttraumatic growth in firefighters: the role of stress appraisal.* Pages 40-48.

The purpose of this study was to establish the relation between resiliency and the level of positive changes, comprising posttraumatic growth in a group of firefighters experiencing job-related traumatic events and the mediating role of stress appraisal in this relation. The study was performed on a group of 100 firefighters from firefighting and rescue brigades, out of which 75 admitted to experiencing a traumatic event. Firefighters covered by the study were on average 31.51 years old ($SD = 6.34$). A Polish version of Posttraumatic Growth Inventory, the Resiliency Assessment Scale and Stress Appraisal Questionnaire were used in the study. The results have shown that 22.7% of firefighters displayed low, 58.6% average and 18.7% high intensity of positive changes resulting from a traumatic event. Resiliency poorly correlates with posttraumatic growth expressed in changes in self-perception, and strongly correlates with stress appraisal, negatively correlates with threat and harm/loss and positively correlates with challenge. Appraisal of stress as a threat and challenge appeared to be mediators of the relationship between resiliency and posttraumatic growth.

- **Keywords:** positive changes, trauma, posttraumatic growth, resiliency, firefighters

Anamai Thetkathuek, Parvena Meepradit, Wanlop Jaidee. *Factors affecting the musculoskeletal disorders of workers in the frozen food manufacturing factories in Thailand.* Pages 49-56.

The purpose of this research was to study factors affecting musculoskeletal disorders. The sample population of the study was 528 factory workers from the frozen food industry, as well as a controlled group of 255 office workers. The samples were collected during interviews using the Nordic questionnaire to assess musculoskeletal disorders, and to assess the risk by the rapid upper limb assessment and rapid entire body assessment techniques. The findings of the study were that most symptoms were found in the dissecting department, higher than in the controlled group. The details of the symptoms were, accordingly: elbow pain (adjusted odds ratio, 35.1; 95% CI [17.4, 70.9]). Regarding the risk of alcohol drinking, workers were exposed to more risks when alcohol was consumed. It is suggested that workers' health should be monitored regularly. People who work in a cold environment should be encouraged to wear body protection and to avoid drinking.

- **Keywords:** frozen food manufacturing, musculoskeletal disorder, workers, Thailand

Sidney Dekker, Corrie Pitzer. Examining the asymptote in safety progress: a literature review. Pages 57-65.

Many industries are confronted by plateauing safety performance as measured by the absence of negative events – particularly lower-consequence incidents or injuries. At the same time, these industries are sometimes surprised by large fatal accidents that seem

to have no connection with their understanding of the risks they faced; or with how they were measuring safety. This article reviews the safety literature to examine how both these surprises and the asymptote are linked to the very structures and practices organizations have in place to manage safety. The article finds that safety practices associated with compliance, control and quantification could be partly responsible. These can create a sense of invulnerability through safety performance close to zero; organizational resources can get deflected into unproductive or counterproductive initiatives; obsolete practices for keeping human performance within a pre-specified bandwidth are sustained; and accountability relationships can encourage suppression of the 'bad news' necessary to learn and improve.

- **Keywords:** asymptote, safety bureaucracy, vision zero, behavioral safety, resilience, accidents

Grzegorz Owczarek, Grzegorz Gralewicz, Natalia Skuza, Piotr Jurowski. *Light transmission through intraocular lenses with or without yellow chromophore (blue light filter) and its potential influence on functional vision in everyday environmental conditions. Pages 66-70.*

In this research the factors used to evaluate the light transmission through two types of acrylic hydrophobic intraocular lenses, one that contained yellow chromophore that blocks blue light transmission and the other which did not contain that filter, were defined according to various light condition, e.g., daylight and at night. The potential influence of light transmission through intraocular lenses with or without yellow chromophore on functional vision in everyday environmental conditions was analysed.

- **Keywords:** light transmission, intraocular lenses, recognition of light sources

Tzu-Hsien Lee. *Endurance time, muscular activity and the hand/arm tremor for different exertion forces of holding. Pages 71-76.*

This study aimed to examine the effects of exertion force on endurance time, muscular activity and hand/arm tremor during holding. Fifteen healthy young males were recruited as participants. The independent variable was exertion force (20%, 40%, 60% and 80% maximum holding capacity). The dependent variables were endurance time, muscular activity and hand/arm tremor. The results showed that endurance time decreased with exertion force while muscular activity and hand/arm tremor increased with exertion force. Hand/arm tremor increased with holding time. Endurance time of 40%, 60% and 80% maximum holding capacity was approximately 22.7%, 12.0% and 5.6% of that of 20% maximum holding capacity, respectively. The rms (root mean square) acceleration of hand/arm tremor of the final phase of holding was 2.27-, 1.33-, 1.20- and 1.73-fold of that of the initial phase of holding for 20%, 40%, 60% and 80% maximum holding capacity, respectively.

- **Keywords:** vibration, steadiness, capability, musculoskeletal injury

Danuta Roman-Liu. *The influence of confounding factors on the relationship between muscle contraction level and MF and MPF values of EMG signal: a review. Pages 77-91.*

The purpose of this article is to gather results of studies on the relationship between median frequency (MF) and mean power frequency (MPF) and the level of muscle contraction, and to use those results to discuss the differences in the trends according to factors related to measurement technique and subject. Twenty-one studies with 63 cases for upper limb muscles and nine studies with 31 cases for lower limb muscles were analysed. Most results showed an increase in parameters with an increased level of

muscle contraction, only some studies showed a decrease. The influence on parameters of the level of muscle contraction and factors such as subjects, type of contraction, muscle length and electrodes was analysed for each muscle. It was concluded that when analysing the influence of different factors on MF and MPF, because those factors interact they should be considered together, not separately.

- **Keywords:** median frequency, mean power frequency, power spectrum, muscle contraction, muscle length, electrodes, age and gender groups

Krzysztof Kosała, Bartłomiej Stępień. *Analysis of noise pollution in an andesite quarry with the use of simulation studies and evaluation indices.* Pages 92-101.

This paper presents the verification of two partial indices proposed for the evaluation of continuous and impulse noise pollution in quarries. These indices, together with the sound power of machines index and the noise hazard index at the workstation, are components of the global index of assessment of noise hazard in the working environment of a quarry. This paper shows the results of acoustic tests carried out in an andesite quarry. Noise generated by machines and from performed blasting works was investigated. On the basis of acoustic measurements carried out in real conditions, the sound power levels of machines and the phenomenon of explosion were determined and, based on the results, three-dimensional models of acoustic noise propagation in the quarry were developed. To assess the degree of noise pollution in the area of the quarry, the continuous and impulse noise indices were used.

- **Keywords:** noise, machines, quarries, acoustic model, noise evaluation indices

Enrico Cagno, Donato Masi, Celina Pinto Leão. *Drivers for OSH interventions in small and medium-sized enterprises.* Pages 102-115.

The debate concerning occupational safety and health (OSH) interventions has recently focused on the need of improving the evaluation of interventions, and in particular on the need for providing information about why the intervention worked or not, under what circumstances and in which context. Key concepts in the analysis of the context are the drivers, i.e., those factors enabling, fostering or facilitating OSH interventions. However, the concept of driver for an OSH intervention is both confused and contested. Although the term is widely used, there is little consensus on how drivers should be understood, how important they are in different contexts and how they can facilitate interventions. This exploratory study based on interviews with the owner-managers and the safety officers of small and medium-sized enterprises (SMEs) gives an overview of the most characteristic drivers for OSH interventions. The results will be used to make an initial evaluation of SMEs' needs, and will help orient interventions and future research.

- **Keywords:** occupational safety and health interventions, drivers, small and medium-sized enterprise, empirical investigation

César García-Hernández, José-Luis Huertas-Talón, Eduardo J. Sánchez-Álvarez, Javier Marín-Zurdo. Effects of customized foot orthoses on manufacturing workers in the metal industry. Pages 116-124.

This 8-week study evaluates the effects of customized foot orthoses on work-related musculoskeletal disorders (WMSDs) of metal industry workers. These WMSDs were evaluated applying the Nordic musculoskeletal questionnaire (NMQ) at three different times (start, 4th week and 8th week) and additional questions were also formulated to obtain information about adaptation, fatigue, comfort and possible improvements.

According to the NMQ results, statistical significance was found in the improvements after 4 weeks ($p < 0.05$ in two areas, $p < 0.01$ in three areas, $p < 0.001$ in two areas and no significance in the other two) and after 8 weeks ($p < 0.01$ in three areas, $p < 0.001$ in four areas and no significance in the other two). The additional questions indicated fatigue reduction (both in general and in lower extremity), comfort level increase (after the adaptation period) and good acceptance, according to workers' answers, suggesting customized orthoses can be effective in reducing and preventing WMSDs in several body regions.

- **Keywords:** occupational health, metal industry, Nordic musculoskeletal questionnaire, foot orthoses, musculoskeletal disorders

Seyyed Jalil Mirmohammadi, Amir Houshang Mehrparvar, Mehrdad Mostaghaci, Mohammad Hossein Davari, Maryam Bahaloo, Samaneh Mashtizadeh. *Anthropometric hand dimensions in a population of Iranian male workers in 2012. Pages 125-130.*

Background. The mismatch between the hand size of workers and the size of industrial instruments is a growing concern; it can lead to various musculoskeletal complications. Currently, there are few reliable studies available to address this concern in Iran. This study was conducted to measure 30 upper-extremity parameters in a group of Iranian industrial workers. *Methods.* This study is a cross-sectional study on 529 workers. The study population was randomly selected from male Iranian industrial workers who were referred to the Yazd hospital occupational medicine clinic for surveillance evaluations. *Results.* The M (SD) age of the participants was 30.13 (8.29) years. Statistical analysis was performed using the mean, standard deviation and 5th, 50th and 90th percentiles for each measured hand dimension. A considerable number of dimensions were significantly different between the measurements of right and left hands in each examinee. The results showed significant differences between Iranian hand size and that of other populations. *Conclusion.* This study provided a valuable databank of hand dimensions in a population of Iranian male workers. These data can be used by manufacturers in designing high-quality hand-tools and industrial gloves, taking into consideration Iranian worker characteristics.

- **Keywords:** anthropometry, hand dimensions, industrial workers, hand-instrument size mismatch

Dominic Bourassa, François Gauthier, Georges Abdul-Nour. *Equipment failures and their contribution to industrial incidents and accidents in the manufacturing industry. Pages 131-141.*

Accidental events in manufacturing industries can be caused by many factors, including work methods, lack of training, equipment design, maintenance and reliability. This study is aimed at determining the contribution of failures of commonly used industrial equipment, such as machines, tools and material handling equipment, to the chain of causality of industrial accidents and incidents. Based on a case study which aimed at the analysis of an existing pulp and paper company's accident database, this paper examines the number, type and gravity of the failures involved in these events and their causes. Results from this study show that equipment failures had a major effect on the number and severity of accidents accounted for in the database: 272 out of 773 accidental events were related to equipment failure, where 13 of them had direct human consequences. Failures that contributed directly or indirectly to these events are analyzed.

- **Keywords:** accidents, safety, reliability, maintenance policy, availability, pulp and paper company, safety and failure database, manufacturing

Bibhuti B. Mandal, Neil J. Mansfield. Contribution of individual components of a job cycle on overall severity of whole-body vibration exposure: a study in Indian mines. Pages 142-151.

Drivers of earth-moving machines are exposed to whole-body vibration (WBV). In mining operations there can be a combination of relatively high magnitudes of vibration and long exposure times. Effective risk mitigation requires understanding of the main aspects of a task that pose a hazard to health. There are very few published studies of WBV exposure from India. This paper reports on a study that considered the contribution of the component phases of dumper operations, on the overall vibration exposure of the drivers. It shows that vibration magnitudes are relatively high, and that haulage tasks are the main contributor to the exposure. It is recommended that driver speed, haul road surfaces and vehicle maintenance/selection are optimized to ensure minimization of vibration. If this is not sufficient, operation times might need to be reduced in order to ensure that the health guidance caution zone from Standard No. ISO 2631-1:1997 is not exceeded.

- **Keywords:** whole-body vibration, job safety analysis, physical hazards in mining

Reynaldo Mauricio Rodríguez Amaya, Sandra Milena Becerra Pinto. Knowledge, attitudes and practices of occupational risks in Colombian taxi drivers. Pages 152-158.

Objective. The objective of this study was to learn about the health and safety strategies in a sample of taxi drivers in Bucaramanga, Colombia. *Methods.* A cross-sectional study was conducted among 138 taxi drivers. A survey was used to identify the socio-demographic and working characteristics, knowledge, attitudes and practices according to their occupational risk. *Results.* Eighty-five percent of the workers labored 9–15 h/day. Of those who suffered accidents, 27% were not affiliated to an occupational risk administrator ($p = 0.028$). Of the workers who had a work-related accident, 58% considered that the use of a cell phone while driving would not always reduce their attention, 50% always used their seat belt and 7% took active breaks and wore their seat belt ($p = 0.01$). *Conclusions.* Within this group of taxi drivers, having or believing to possess knowledge regarding an occupational risk did not ensure that they had a safe attitude or safe working practices.

- **Keywords:** occupational health, safety, accident prevention

Jose A. Prieto, Paloma Nistal, David Méndez, Cristian Abelairas-Gomez, Roberto Barcala-Furelos. Impact of error self-perception of aerobic capacity in the safety and efficacy of the lifeguards. Pages 159-163.

Introduction. The strong physical demands that are required of lifeguards during rescues also require an accurate self-perception of one's fitness level to be able to regulate the intensity of effort. *Objectives.* The aim of this study was to determine the real aerobic capacity (RAC) and to compare it with two self-reported measurements: subjective appraisal of aerobic capacity (SAAC) and appraisal of physical exercise (APE). *Methods.* Fifty-two professional lifeguards were included in the study. For an objective assessment of RAC, the lifeguards' maximum oxygen uptake ($V_{O_{2max}}$) values were measured during treadmill stress tests. A fitness assessment questionnaire was used to obtain the SAAC and APE values. *Results.* We found a statistically significant association between the APE and RAC variables in the contingency analysis ($p < 0.001$). In total, 93.7% of the lifeguards who obtained a $V_{O_{2max}}$ value below $43 \text{ ml kg}^{-1} \text{ min}^{-1}$ considered their aerobic capacity to be *high* or *very high*. *Conclusion.* This self-perception error of true aerobic capacity could lead to premature fatigue during a rescue, endangering both the lifeguard's life and the life of the victim. These data may help lifeguards and beach

managers to become aware of the need to know lifeguards' true physical conditions through testing and structured training programs.

- **Keywords:** self-perception of physical fitness, aerobic capacity, lifeguards, safety of beaches