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Mohd Hafiidz Jaafar, Kadir Arifin, Kadaruddin Aiyub, Muhammad Rizal Razman, Muhammad Izzuddin Syakir Ishak & Mohamad Shaharudin Samsurijan. *Occupational safety and health management in the construction industry: a review*. Pages: 493-506.

The construction industry plays a significant role in contributing to the economy and development globally. During the process of construction, various hazards coupled with the unique nature of the industry contribute to high fatality rates. This review refers to previous published studies and related Malaysian legislation documents. Four main elements consisting of human, worksite, management and external elements which cause occupational accidents and illnesses were identified. External and management elements are the underlying causes contributing to occupational safety and health (OSH), while human and worksite elements are more apparent causes of occupational accidents and illnesses. An effective OSH management approach is required to contain all hazards at construction sites. An approach to OSH management constructed by elements of policy, process, personnel and incentive developed in previous work is explored. Changes to the sub-elements according to previous studies and the related Malaysian legislation are also covered in this review.

- **Keywords:** construction safety, safety management, construction industry, construction fatalities, occupational accidents

Kyeong-Hee Choi, Dae-Min Kim, Sung-Yong Lee, Jun-Hyub Lee & Yong-Ku Kong. *Evaluation of the controlled grip force exertion tasks associated with age, gender, handedness and target force level*. Pages: 507-515.

Introduction. Force control of the hand is an essential factor for operating tools and moving objects. Therefore, a method for quantifying hand functionality more accurately and objectively is very important. *Methods.* The present study included 60 healthy participants (30 elderly and 30 young adults) to evaluate the effects of age, gender and target force levels on tracking performance. Tracking performance was quantified by measuring the difference between target force levels and exerted force. *Results.* Females exerted 59.6% of the maximum grip strength of males and the elderly group exerted 70.5% of maximum grip strength compared with the young group. The elderly group

showed 3.1 times larger tracking error than the young group. There was a significant difference in females between the young and elderly groups, indicating age-related decline in hand function is more pronounced in females. The difference in grip force control ability between the elderly and young groups was significant at the low target force level (5% maximum voluntary contraction). *Conclusions.* The results of this study could be used for hand function evaluation guidelines. In addition, this study could be used as a tool for physiotherapy to improve hand function and prevent its decline in elderly people.

- **Keywords:** grip force exertion, age, gender, tracking task, hand functionality

Sara Bragança, Pedro Arezes, Miguel Carvalho, Susan P. Ashdown & Celina Leão. *Assessment of the intraday variability of anthropometric measurements in the work environment: a pilot study.* Pages: 516-526.

Sitting for long periods of time, both during work and leisure times, is the typical behavior of the modern society. Especially at work, where there is not much flexibility, adopting the sitting posture for the entire day can cause some short-term and long-term effects. As workers' productivity and well-being relies on working conditions, evaluating the effects caused by work postures assumes a very important role. The purpose of this article was to evaluate the variation of some anthropometric measurements during one typical workday to understand whether the known long-term effects can also be seen and quantified in an 8-h period. Twenty participants were measured before and after work, using traditional anthropometry equipment. The data from the two repetitions were compared using statistical tests. The results showed a slight variation in the anthropometric measurements, some with a tendency to increase over time and others with a tendency to decrease.

- **Keywords:** sitting posture, anthropometric variation, work

Tomasz Hermann & Marian Witalis Dobry. *Variability of energy input into selected subsystems of the human-glove-tool system: a theoretical study.* Pages: 527-533.

This article presents an application of the energy method to assess the energy input introduced into two subsystems of the human-glove-tool system. To achieve this aim, a physical model of the system was developed. This consists of dynamic models of the human body and the glove described in Standard No. ISO 10068:2012, and a model of a hand-held power tool. The energy input introduced into the subsystems, i.e., the human body and the glove, was analysed in the domain of energy and involved calculating three component energy inputs of forces. The energy model was solved using numerical simulation implemented in the MATLAB/simulink environment. This procedure demonstrates that the vibration energy was distributed quite differently in the internal structure of the two subsystems. The results suggest that the operating frequency of the tool has a significant impact on the level of energy inputs transmitted into both subsystems.

- **Keywords:** hand-arm vibration, biomechanical system, anti-vibration gloves, energy method

Anna Marszałek, Grażyna Bartkowiak & Anna Dąbrowska. *Assessment of the effectiveness of modular clothing protecting against the cold based on physiological tests.* Pages: 534-545.

At many workstations in a cold environment, protective clothing provided for the workers is characterized by inadequate thermal insulation, which results in an adverse impact of

the cold environment on the worker's body. The purpose of this article is to present developed new ergonomic modular cold protective clothing, which allows for easy adaptation of the thermal insulation of clothing to a worker's individual needs. This clothing was compared in a laboratory study with the clothing having so far been used by workers in a cold environment using physiological and physical measurements, subjective ratings of the thermal state as well as a questionnaire for subjective assessment of the used clothing. These measurements and ratings confirmed that the modular cold protective clothing is more effective in the process of ensuring thermal comfort to the wearer during work in a cold environment than the clothing having so far been used.

- **Keywords:** cold environment, protective clothing, modular design

Dorota Molek-Winiarska & Dorota Żołnierczyk-Zreda. *Application of mindfulness-based stress reduction to a stress management intervention in a study of a mining sector company.* Pages: 546-556.

Purpose. The aim of this article was to check whether mindfulness-based stress reduction (MBSR) is an effective intervention in reducing work-related stress in the case of workers in a copper mine. *Methods.* Sixty six employees were randomized to the experimental group (32 participants) or to the control group (34 participants). Work-related stress was measured using the job content questionnaire (JCQ) and mental health was measured using the general health questionnaire (GHQ-28) Experimental manipulation was 40-h MBSR training. *Results.* Multivariate repeated-measures analysis of variance revealed a significant increase of JCQ decision latitude ($F = 17.36, p < 0.001$) and social support (supervisor $F = 9.00, p < 0.004$; coworker $F = 5.61, p < 0.020$), and a significant decrease in GHQ-28 anxiety ($F = 5.28, p < 0.079$) and depression ($F = 3.95, p < 0.048$) due to the intervention. *Conclusions.* The study confirms that MBSR can be effective in reducing stress resulting from the external risk (and/or imagined fear) of losing one's health or life. The use of MBSR could be recommended in health and safety activities in difficult and dangerous work conditions, such as mining, to promote workers' well-being.

- **Keywords:** adaptation, mental health, mindfulness, workplace, work-related stress, psychology

Łukasz Baka. *When do the 'dark personalities' become less counterproductive? The moderating role of job control and social support.* Pages: 557-569.

Introduction. The objective of the study is to examine how job resources modify the relationship between the Dark Triad (DT) and counterproductive work behavior (CWB). Specifically the study examined: (a) the direct link between DT and CWB; (b) the moderation effects of two kinds of job resources (job control and social support); (c) the moderated moderation effect of the job resources (job control \times social support) on the DT-CWB link. Moreover, the effect of social approval on CWB was controlled. *Method.* Data were collected among 659 white-collar and blue-collar workers. The hypotheses were tested by means of the PROCESS method. *Results.* As expected in the hypotheses, a high DT level was found to be directly related to high CWB, and job control moderated (intensified) the link. Social support did not moderate the DT-CWB link. The moderated moderation effect was supported. Social support increases the moderation effect of job control on the DT-CWB link. The lowest level of CWB is observed when job control was low and social support was high.

- **Keywords:** Dark Triad, counterproductive work behavior, job control, social support, moderated moderation effect

Elham Salvarzi, Alireza Choobineh, Mehdi Jahangiri & Sareh Keshavarzi. *Facial anthropometric measurements in Iranian male workers using Digimizer version 4.1.1.0 image analysis software: a pilot study.* Pages: 570-576.

Objective. Craniometry is a subset of anthropometry, which measures the anatomical sizes of the head and face (craniofacial indicators). These dimensions are used in designing devices applied in the facial area, including respirators. This study was conducted to measure craniofacial dimensions of Iranian male workers required for face protective equipment design. *Methods.* In this study, facial anthropometric dimensions of 50 randomly selected Iranian male workers were measured by photographic method and Digimizer version 4.1.1.0. Ten facial dimensions were extracted from photographs and measured by Digimizer version 4.1.1.0. Mean, standard deviation and 5th, 50th and 95th percentiles for each dimension were determined and the relevant data bank was established. *Results.* The anthropometric data bank for the 10 dimensions required for respirator design was provided for the target group with photo-anthropometric methods. The results showed that Iranian face dimensions were different from those of other nations and ethnicities. *Conclusions.* In this pilot study, anthropometric dimensions required for half-mask respirator design for Iranian male workers were measured by Digimizer version 4.1.1.0. The obtained anthropometric tables could be useful for the design of personal face protective equipment.

- **Keywords:** craniometry, design, facial anthropometry, half-face mask

Raquel Fornaziero Gomes, Alessandra Giannella Samelli & Sylvio R. Bistafa. *Earmuff efficacy in the workplace using F-MIRE – a case report.* Pages: 577-581.

Purpose. To determine the field efficacy of an earmuff used by the employees of a private company. *Methods.* Measurements were performed using a double-channel noise dosimeter. Noise levels collected in one-third-octave bands were corrected with the frequency response for diffuse sound field and attenuation was compared with values provided by the manufacturer of the hearing protection device (HPD). *Results.* Comparisons between the corrected noise reduction and the attenuation provided by the manufacturer of the HPD show no statistically significant differences in attenuation for most frequency bands, with higher mean values for the observed corrected noise reduction. However, despite the fact that the field attenuation values are above those obtained in the laboratory, when individual attenuation values were compared with expected attenuation values it was found that the employees have below-expected noise attenuation in all frequency bands. *Conclusions.* The fact that over 60% of the employees had frequency band attenuations below that expected for most frequency bands underscores the need for individual assessment of attenuation provided by the HPD in the workplace, to assess whether the HPD is functional and what provisions should be implemented in a specific workplace.

- **Keywords:** hearing loss, noise, hearing protection devices, prevention

Miao Tian, Huiju Park, Jun Li, Heekwang Koo & Qinwen Xu. *Effects of load carriage and work boots on lower limb kinematics of industrial workers.* Pages: 582-591.

Load and footwear condition are two crucial elements varying the kinematic responses during walking, which probably lead to chronic injury. Fifteen healthy male individuals with no obvious gait abnormalities participated in this study. Apart from a no-load condition, four external load conditions with two load levels were investigated. Work boots were compared with running shoes to determine footwear effects. Significant

impacts were found for lower limb range of motion at certain joints when carrying loads. A greater hip and ankle flexion–extension while wearing the work boots indicated that participants needed to lift the leg higher to complete toe clearance off the walking surface. Work boots also increased the vertical excursion of the center of body mass, which may impact body balance and induce falling. No significant influencing pattern of carrying modes was found, which was probably due to the light load and relatively stable mode of shoulder carrying.

- **Keywords:** load carriage, center of mass, kinematics, industrial workers, work boots

Siddharth Bhardwaj & Abid Ali Khan. *Ergonomics investigation for orientation of the handles of wood routers.* Pages: 592-604.

Objectives. Improperly designed hand tools not only expose workers to potential health risks but also hamper their productivity. This study tries to improve the ergonomics of wood routing tasks, suggesting better handle orientations for hand-held wood routers. *Methods.* Seven different handle combinations were tested over two routing tasks (beading and dado) with regard to perceived discomfort, electromyography (EMG) of biceps brachii and extensor carpi radialis brevis and hand–arm vibrations (HAV). *Results.* Handles with 30° and 60° inclinations were found more comfortable than previous 90° handle inclinations for routing tasks. Perceived discomfort in the dado task was found to be significantly higher than in the beading task ($p < 0.001$); EMG activity also supported this observation. However, EMG data showed no significant difference for the different handles used in the study. No worthwhile reduction was obtained in HAV levels for the modified wooden handles compared to initial plastic handles. *Relevance to industry.* The ergonomic intervention in wood routers described in this article will contribute to the existing knowledge of ergonomics of handle design and will aid the designers/engineers to design such tool handles that may reduce the risk of work-related musculoskeletal disorders/hand–arm vibration syndrome in workers using wood routers.

- **Keywords:** Hand–arm vibration, electromyography, discomfort score, ergonomic design, handle orientation, wrist deviation, work-related musculoskeletal disorders

Lessby Gómez, Carlos A. Díaz, Gustavo A. Orozco & José J. García. *Dynamic analysis of forces in the lumbar spine during bag carrying.* Pages: 605-613.

Objective. The intervertebral disc supports axial and shear forces generated during tasks such as lifting and carrying weights. The objective of this study was to determine the forces in the lumbar spine of workers carrying a bag on the head, on the shoulder and on the anterior part of the trunk. *Methods.* Kinematic measurements were recorded for 10 subjects carrying bags of 10, 20 and 25 kg on each of the three aforementioned positions. A simple dynamic model implemented in a custom program was then developed to determine the lumbar forces using the accelerations and positions obtained from the kinematic analysis. *Results.* The analyses yielded a maximum compressive force of 2338.4 ± 422 N when a 25-kg bag was carried on the anterior part of the trunk. *Conclusion.* Carrying bags on the anterior part of the trunk generated higher lumbar forces compared to those developed by carrying the bag on the head or on the shoulder. Force levels suggest that this activity represents a moderate risk for the subjects. However, future biomechanical models should be developed to analyze the cumulative effect in the discs when longer periods of time are spent in this activity.

- **Keywords:** bag carriage, intervertebral disc, lumbar forces, lumbar spine

Ayako Toyoshima, Michiko Moriyama, Kenichiro Asano, Keiko Mitsuhashi & Md Moshir Rahman. *Workers' sleep condition and related disorders in*

Japan: an analysis based on health insurance claim data and questionnaire. Pages: 614-623.

The purpose of this study was to clarify the sleep disorders and sleep conditions among workers in a company through descriptive statistics. We analyzed the data of individuals with suspected sleep disorders based on the 1-year outpatient health insurance claim data of 2803 employees in a company in Japan. We conducted a questionnaire survey to determine the sleep condition and drug usage of the same participants. Claim data of 339 employees (12.1%) were selected for analysis, and the breakdown of diseases comprised 153 (5.5%) with sleep disorders, 149 (5.3%) with headache, 119 (4.2%) with depression and 17 (0.6%) with autonomic imbalance. We recovered 2608 questionnaire responses (93.0%) and found that 1852 subjects (71.0%) were aware of insomnia symptoms within 1 year. Our findings highlight the prevalence of sleep disorders and drug usage among workers in a company, and the conditions of these disorders, including awareness of insomnia.

- **Keywords:** sleep disorders, descriptive statistics, psychotropic drugs, health insurance claim data, autonomic imbalance

Toivo Niskanen. Implementation of a novel taxonomy based on cognitive work analysis in the assessment of safety performance. Pages: 624-637.

Purpose. The aim of this study was to examine how the developed taxonomy of cognitive work analysis (CWA) can be applied in combination with statistical analysis regarding different sociotechnical categories. *Materials and methods.* This study applied a combination of quantitative and qualitative methodologies. Workers ($n = 120$) and managers ($n = 85$) in the chemical industry were asked in a questionnaire how different occupational safety and health (OSH) measures were being implemented. The exploration of the qualitative CWA taxonomy consisted of an analysis of the following topics: (a) work domain; (b) control task; (c) strategies; (d) social organization and cooperation; (e) worker competencies. *Results and conclusions.* The following hypotheses were supported – activities of the management had positive impacts on the aggregated variables: near-accident investigation and instructions (H_1); OSH training (H_2); operations, technical processes and safe use of chemicals (H_3); use of personal protective equipment (H_4); measuring, follow-up and prevention of major accidents (H_5). The CWA taxonomy was applied in mixed methods when testing H_1 – H_5 . A special approach is to analyze the work demands of complex sociotechnical systems with the taxonomy of CWA. In problem-solving, the CWA taxonomy should seek to capitalize on the strengths and minimize the limitations of safety performance.

- **Keywords:** cognitive work analysis, taxonomy, safety, health, qualitative method, quantitative method, workers, managers

Fong-Gong Wu & Wen-Zhou Shi. The input efficiency of chord keyboards. Pages: 638-645.

This study focused on an innovative mobile input device model that integrated ergonomic design principles to create a chord keyboard for use in concert with pointing devices. We conducted usability tests to demonstrate the operating performances of such keyboards using keys with four characters per key. Twelve right-handed subjects between the ages of 20 and 30 years and with no wrist disability participated in the usability tests. We analyzed the resulting data to compare the differences among the means. The results indicated that keyboards with multiple characters per key created some confusion among users but that keys with multiple characters per key nonetheless resulted in better input performance.

- **Keywords:** chorded keyboard, pointing device, input efficiency

Azian Hariri, Noraishah Mohamad Noor, Nour Azreen Paiman, Ahmad Mujahid Ahmad Zaidi & Siti Farhana Zainal Bakri. *Heavy metals found in the breathing zone, toenails and lung function of welders working in an air-conditioned welding workplace.* Pages: 646-651.

Welding operations are rarely conducted in an air-conditioned room. However, a company would set its welding operations in an air-conditioned room to maintain the humidity level needed to reduce hydrogen cracks in the specimen being welded. This study intended to assess the exposure to metal elements in the welders' breathing zone and toenail samples. Heavy metal concentration was analysed using inductively coupled plasma mass spectrometry. The lung function test was also conducted and analysed using statistical approaches. Chromium and manganese concentrations in the breathing zone exceeded the permissible exposure limit stipulated by Malaysian regulations. A similar trend was obtained in the concentration of heavy metals in the breathing zone air sampling and in the welders' toenails. Although there was no statistically significant decrease in the lung function of welders, it is suggested that exposure control through engineering and administrative approaches should be considered for workplace safety and health improvement.

- **Keywords:** welding fumes, toenail biomarker, Malaysia, pulmonary function

Anna Abellsson & Lars Lundberg. *Cardiopulmonary resuscitation quality during CPR practice versus during a simulated life-saving event.* Pages: 652-655.

Introduction. As a part of the emergency medical services, the Swedish fire brigade can increase the survival rate in out-of-hospital cardiac arrests. *Aim.* To compare the quality of cardiopulmonary resuscitation (CPR) performed by firefighters at a routine CPR practice versus when involved in a simulated life-saving event. *Methods.* In this study, 80 firefighters divided into two groups performed CPR according to guidelines: one group indoors during a routine training session; the other group outdoors during a smoke diving exercise wearing personal protective clothing and self-contained breathing apparatus. Descriptive and inferential statistics were used to analyze the data. *Results.* The results showed a tendency for the outdoor group to perform CPR with better ventilation and compression quality, as compared to the indoor group. The ventilation of the manikin was not hampered by the firefighters wearing personal protective clothes and self-contained breathing apparatus, as the Swedish firefighters remove their facial mask and ventilate the patient with their mouth using a pocket mask. *Conclusions.* Overall, the results in both groups showed a high quality of CPR which can be related to the fire brigade training and education traditions. CPR training is regularly performed, which in turn helps to maintain CPR skills.

- **Keywords:** cardiopulmonary resuscitation, firefighter, practice, simulation, smoke diving