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PROTECTION OF HUMAN IN THE WORKING ENVIRONMENT

Tzu-Hsien Lee, Chia-Yun Tseng. *Grip Force and Heart Rate Responses to Manual Carrying Tasks : Effects of Material, Weight, and Base Area of the Container?* S. 377-383.

This study recruited 16 industrial workers to examine the effects of material, weight, and base area of container on reduction of grip force (Δ GF) and heart rate for a 100-m manual carrying task. This study examined 2 carrying materials (iron and water), 4 carrying weights (4.4, 8.9, 13.3, 17.8 kg), and 2 base areas of container (24 ´ 24 cm, 35 ´ 24 cm). This study showed that carrying water significantly increased Δ GF and heart rate as compared with carrying iron. Also, Δ GF and heart rate significantly increased with carrying weight and base area of container. The effects of base area of container on Δ GF and heart rate were greater in carrying water condition than in carrying iron condition. The maximum dynamic effect of water on Δ GF and heart rate occurred when water occupied ~60%–80% of full volume of the container.

Donato Masi, Enrico Cagno, Guido J.L. Micheli. *Developing, Implementing and Evaluating OSH Interventions in SMEs : a Pilot, Exploratory Study.* S. 385-405.

The literature on occupational safety and health (OSH) interventions contains many debates on how interventions should work, but far less attention has been paid to how they actually do work, and to the contextual factors that influence their implementation, development and effect. The need of improving the understanding of the OSH interventions issue is particularly relevant for small and medium-sized enterprises (SMEs), since they experience worse OSH conditions, and have fewer physical, economic and organizational resources if compared to larger enterprises; thus, SMEs strongly need to focus their few resources in the decision-making process so as to select and put in place only the most proper interventions. This exploratory study is based on interviews with safety officers of 5 SMEs, and it gives an overview of the key features of the actual intervention process in SMEs and of the contextual factors making this actual intervention process similar or dissimilar to the ideal case. The results show how much qualitative and experience driven the actual intervention process is; they should be used to direct the future research towards an increasingly applicable one, to enable

practitioners from SMEs to develop, implement and evaluate their OSH interventions in an "ideal" way.

Pietro Nataletti, Andrea Bogi, Massimo Borra, Domenico Gioia, Rosaria Falsaperla, Enrico Marchetti, Andrea Militello. *Occupational Exposure to Physical Agents : the New Italian Database for Risk Assessment and Control*. S. 407-420.

This article presents the new Italian database of physical agents, which is available at <http://www.portaleagentifisici.it>. It supports in risk assessment employers who have to comply with Italy's Legislative Decree 81/2008 (transposing into law European Union Directives 2003/10/EC, 2002/44/EC, 2004/40/EC and 2006/25/EC). The database currently contains measurements and declared European Community (EC) values from over 2540 machines; in particular, the database hosts data on mechanical vibration from over 1430 hand-held power tools (e.g., pneumatic and electric hammers, chainsaws, grinders, drills, sanders and saws) and from over 1020 whole-body machines (e.g., buses, fork lifts and wheel tractors). The database is continuously updated as soon as new experimental and declared data are acquired.

Tzu-Hsien Lee. *Subjective Perception of Load Heaviness*. S. 421-427.

This study examined human subjective perception of load heaviness. Forty-two (3 boxes × 14 weights) and 27(3 boxes × 9 weights) experimental conditions were randomly presented to male and female participants, respectively. The results showed that the participants were not able to discriminate the effect of the box on perceived weight. The participants underestimated the weight for low weights and overestimated it for high weights. The females perceived a greater increase in weight than the males for the same increase in weight. The participants' linguistic term for perceived weight was positively correlated to the magnitude of weight. Approximately 50% of the males perceived a weight of 20 kg or over as risky, while ~60% of the females perceived a weight of 14 kg or over as risky. This study supposes that the gender difference in muscular capability is responsible for the effect of gender on the risk perception of weight.

Jian Liu, Thurmon Lockhart, Sukwon Kim. *Reaction Moment at the L5/S1 Joint During a Simulated Forward Slipping With a Handheld Load*. S. 429-436.

The purpose of the study was to investigate the effects of load on the net moment response at the L5/S1 joint during simulated slip events. Six young individuals were instructed to take one step with a handheld load. Sudden floor movement was randomly introduced to simulate unexpected slips. Different loads conditions (0%, 10%, 20%, 30% of body weight) were introduced at random. Three-dimensional net moments at the L5/S1 joint were computed via downward inverse dynamic model. Peak joint moment generated at 30% load level was found to be significantly higher compared to no-load condition. No peak moment differences were found among no-load, 10% or 20% load levels. Additionally, the findings from this study indicated a flexion-dominant net L5/S1 joint moment pattern during motion phase associated with slip-induced falls.

Ruifeng Yu. *Effect of Background Music on Maximum Acceptable Weight of Manual Lifting Tasks*. S. 437-445.

This study used the psychophysical approach to investigate the impact of tempo and volume of background music on the maximum acceptable weight of lift (MAWL), heart rate (HR) and rating of perceived exertion (RPE) of participants engaged in lifting. Ten male college students participated in this study. They lifted a box from the floor, walked 1-2 steps as required, placed the box on a table and walked back twice per minute. The

results showed that the tempo of music had a significant effect on both MAWL and HR. Fast tempo background music resulted in higher MAWL and HR values than those resulting from slow tempo music. The effects of both the tempo and volume on the RPE were insignificant. The results of this study suggest fast tempo background music may be used in manual materials handling tasks to increase performance without increasing perceived exertion because of its ergogenic effect on human psychology and physiology.

PROTECTION OF HUMAN AT THE WORKSTATION

Christopher Edet Ekpenyong, Udoinyang Clement Inyang. *Associations Between Worker Characteristics, Workplace Factors, and Work-Related Musculoskeletal Disorders : a Cross-Sectional Study of Male Construction Workers in Nigeria.* S. 447-462.

Objective. This study assessed the association between worker characteristics, workplace factors, and workrelated musculoskeletal disorders (WMSDs) in Nigeria's construction industry. **Methods.** A cross-sectional site-by-site survey was conducted in 5 existing construction companies in Uyo, Nigeria. The subjects (n = 1200 males), aged 18–55 years, filled in the semistructured Nordic musculoskeletal questionnaire and the job content questionnaire on demographics, work and lifestyle characteristics, and workplace risk factors for WMSDs. **Results.** The overall prevalence of WMSDs was 39.25%. Differences in age, race, weight, body mass index (BMI), education status, and employment status were significantly associated with the prevalence of WMSDs. Prevalence according to trade was as follows: ironworkers highest at 49% and administrative staff lowest at 31%. Ironworkers (55.7%), administrative staff (53.3%), and security staff (38.7%) scored higher on physical, psychosocial, and individual risk factors, respectively. Workplace factors with increased odds for WMSDs were psychological demands and mental workload, age, BMI, low work experience, low education status, awkward movement of head and arms, working against force or vibration, fast work pace, and race. **Conclusion.** The recorded high prevalence was multifactorial in etiology; hence, multi-intervention strategies are required.

Bhornsawan Thanathornwong, Siriwan Suebnukarn, Kan Ouivirach. *A System for Predicting Musculoskeletal Disorders Among Dental Students.* S. 463-475.

Objective. This study aimed to develop a system for predicting work-related musculoskeletal disorders (WMSD) among dental students. **Materials and methods.** The system comprised 2 accelerometer sensors to register neck and upper back postures and movements, and software developed to collect and process the data. Hidden Markov models (HMMs) were used to predict the likelihood of WMSD in dental students by comparing their neck and upper back movement patterns with WMSD and non-WMSD HMMs learned from previous data. To evaluate the performance of the system, 16 participants were randomly assigned into a 2 × 2 crossover trial scheduled for each sequence of working: receiving feedback or no-feedback from the system. The primary outcome measure was the extension of the neck and upper back, before (pre-test) and after (posttest) receiving feedback or no-feedback from the system. The secondary outcome measure was the log likelihood of classifying the movements as WMSD. **Results and discussion.** The results showed that in the group that received feedback, the extension of the neck in the y axis and of the upper back in the y axis decreased significantly (t test, p < .05) on the post-test. **Conclusion.** The system for predicting and preventing WMSD aids the correction of the extension of the neck and upper back in the y axis.

Arto Reiman, Janne Pekkala, Seppo Väyrynen, Ari Putkonen, Mikael Forsman. *Participatory Video-Assisted Evaluation of Truck Drivers' Work Outside Cab : Deliveries in Two Types of Transport. S. 477-489.*

The aim of this study was to identify risks and ergonomics discomfort during work of local and short haul delivery truck drivers outside a cab. The study used a video- and computer-based method (VIDAR). VIDAR is a participatory method identifying demanding work situations and their potential risks. The drivers' work was videoed and analysed by subjects and ergonomists. Delivery truck drivers should not be perceived as one group with equal risks because there were significant differences between the 2 types of transportation and specific types of risks. VIDAR produces visual material for risk management processes. VIDAR as a participatory approach stimulates active discussion about work-related risks and discomfort, and about possibilities for improvement. VIDAR may be also applied to work which comprises different working environments.

Seung-Nam Min, Jung-Yong Kim, Mohamad Parnianpour. *The Effects of Experience and the Presence of a Scaffold Handrail on Postural and Spinal Stability in Construction Workers. S. 491-502.*

The goal of this study was to quantify the effect of experience and handrail presence on trunk muscle activities, rotational spinal stiffness and postural stability of construction workers. We evaluated spinal stability, and objective and subjective postural stability in 4 expert and 4 novice construction workers who were performing a manual task in a standing position on a scaffold, with and without a safety handrail. Center of pressure was computed using measurements taken with insole pressure transducers. Muscle activity was monitored using surface electrodes placed on 8 trunk muscles that predicted active trunk rotational stiffness. Standard deviations of the center of pressure, back muscle activity and spinal stiffness were greater in novices and in the absence of a handrail. We infer that the risk of a fall due to postural and spinal instability may be greater with a lower level of experience and in the absence of a safety handrail.

Heap Yih Chong, Thuan Siang Low. *Accidents in Malaysian Construction Industry : Statistical Data and Court Cases. S. 503-513.*

Safety and health issues remain critical to the construction industry due to its working environment and the complexity of working practises. This research attempts to adopt 2 research approaches using statistical data and court cases to address and identify the causes and behavior underlying construction safety and health issues in Malaysia. Factual data on the period of 2000–2009 were retrieved to identify the causes and agents that contributed to health issues. Moreover, court cases were tabulated and analyzed to identify legal patterns of parties involved in construction site accidents. Approaches of this research produced consistent results and highlighted a significant reduction in the rate of accidents per construction project in Malaysia.

Paweł Górski. *Occupational Exposure to Noise From Authorized Emergency Vehicle Sirens. S. 515-523.*

Warning signals generated by sirens of authorized emergency vehicles should be audible and recognizable to all road users. Currently, there is no legislation in Poland defining sound pressure levels (SPLs) of audible warning signals generated by sirens of authorized emergency vehicles. Measured A-weighted SPLs of those signals range between 104 and 108 dB. While for road users, an audible warning signal is a source of important information and its A-weighted SPL is acceptable, it may be a source of annoying noise to an emergency vehicle crew. That is why, it is necessary to find a method of improving the acoustic comfort of the crew and, at the same time, maintaining the informational function of audible warning signals.

NOTES

Zhan Jiaxing, Mohammad Fard, Reza Jazar. *A Model to Assess the Comfort of Automotive Seat Cushions*. S. 525-533.

A large number of independent and interacting factors affect seating comfort such as seat shape, stability, lumbar support and seat height. Although many subjective comfort studies have been conducted, few of them considered seating comfort from its subassembly level. This paper analyzed the automotive seat cushion designed with geared four-bar linkage for the seat height adjustment. The operation torque and lift distance of this mechanism was investigated as 2 major comfort factors. Ten cushions with this kind of design in the market were compared and assessed.