



PROTECTION OF HUMAN IN THE WORKING ENVIRONMENT

Yuvin Chinniah & Damien Burlet-Vienney. *Study on Lockout Procedures for the Safety of Workers Intervening on Equipment in the Municipal Sector in Québec. S. 495-511.*

In Québec, workers intervening in hazardous zones of machines, equipment and processes during maintenance, repairs and unjamming activities have to apply lockout procedures. Lockout procedures involve shutting down the equipment, isolating it, applying individual locks, releasing residual energies and verifying the absence of energies. Lockout has mostly been linked to industrial sectors. However, the municipal sector also faces challenges when it comes to controlling hazardous energies. The objectives of this research are to study serious accidents linked to our subject, study the application of lockout in different municipalities in Québec, identify the specificities for the municipal sector and propose some means to support the application of lockout. We will show that lockout procedures are required in different locations in municipalities and that they are currently being implemented in the municipal sector in Québec. Moreover, we propose a model which aims at facilitating the implementation of lockout procedures in the municipal sector.

Majid Motamedzade, Mohammad Amin Faghih, Rostam Golmohammadi, Javad Faradmal & Heidar Mohammadi. *Effects of Physical and Personal Risk Factors on Sick Leave Due to Musculoskeletal Disorders. S. 513-521.*

The purpose of this study was to investigate the effects of physical and personal risk factors on sick leave due to musculoskeletal disorders in an Iranian car company. In this cross-sectional study, 234 workers participated and all of them had sick leave due to musculoskeletal disorders in the past year. A physical risk factor checklist and personal information questionnaire were used as data-gathering tools. There was no significant relationship between physical risk factors and sick leave ($p > .05$). Cigarette smoking ($p = .045$), body mass index >30 ($p = .046$) and age ($p = .044$) showed a significant relationship with sick leave. Workers with lumbar deviation of 20° – 60° (OR 1.10) and $>60^{\circ}$ (OR 1.11) were at greater risk. The ratios for workers with repetitive work (OR 1.30) and workers with force exertion (OR 1.36) were greater than for other workers. Taking preventive actions to improve the ergonomic working conditions of assembly workers and their lifestyle seems crucial.

Mohammad Khandan, Maryam Maghsoudipour, Shahram Vosoughi & Amir Kavousi. *Safety Climate and Prediction of Ergonomic Behavior*. S. 523-530.

One of the most important ways to prevent accidents is to consider safety climate or culture. Moreover, some studies suggest that behavior contributes to 86%–96% of all injuries. This cross-sectional study took place in an Iranian petrochemical company in 2010. Vinodkumar and Bhasi's safety climate questionnaire and an ergonomic behavior sampling checklist were the data collection tools. Cronbach's α for questionnaire reliability was .928. With reference to the results of a pilot study, a sample of 1755 was determined for behavior sampling. We used principal component analysis (PCA) to derive the coefficient of paths in the path model and the Anderson–Rabin method to calculate factor scores. The results showed that safety climate was an effective predictor of ergonomic behavior ($p < .01$). They also showed the importance of decreasing the number of workers with negative safety climate. Moreover, it is necessary to promote workers' ergonomic behaviors in the workplace.

Chorkaew Jaturanonda, Suebsak Nanthavanij & Sanchoy K. Das. *Heuristic Procedure for the Assembly Line Balancing Problem With Postural Load Smoothness*. S. 531-541.

This paper presents a heuristic procedure for assigning assembly tasks to workstations where both productivity and ergonomics issues are considered concurrently. The procedure uses Kilbridge and Wester's algorithm to obtain an initial task–workstation assignment solution which minimizes the balance delay of an assembly line. A task reassignment algorithm was applied to improve the initial solution by exchanging assembly tasks, which smooth postural load among workers, between workstations. A composite index of variation was used to measure the effectiveness of the task–workstation assignment solution. On the basis of clothes assembling, it was found that the task–workstation assignment solution with a minimum composite index of variation can be obtained with relatively equal weights in balance delay and postural load.

Nader Mahmoudi & Majid Bazrafshan. *A Carpet-Weaver's Chair Based on Anthropometric Data*. S. 543-550.

Ergonomic design of chairs has been well studied by ergonomists. Chair design based on anthropometric data analysis is recommended. Weavers in carpet-weaving workshops use chairs with backrests and armrests. An anthropometric survey was carried out among weavers in Tabriz, Iran, to design a flexible chair and to improve its comfort on the basis of design dimensions. This study focused on the design dimensions of a chair for weavers and its recommended dimensions. The developed chair needs to be tested for its effects on weavers' posture and comfort.

Kamalesh J. Dube, Lalit T. Ingale & Sopan T. Ingle. *Respiratory Impairment in Cotton-Ginning Workers Exposed to Cotton Dust*. S. 551-560.

Dust generated during the handling and processing of cotton causes ill health of ginning workers. The purpose of this study was to determine the prevalence of respiratory symptoms among cotton-ginning workers. This study involved 188 workers of 10 cotton-ginning factories. Forced vital capacity (FVC), peak expiratory flow rate (PEFR), and forced expiratory volume in 1 s (FEV_1) declined significantly with increasing duration of exposure ($p < .001$) of the cotton-ginning workers. Results of a standard respirator medical evaluation questionnaire indicated that, depending on duration of exposure, 51%–71% of cotton-ginning workers suffered from chest tightness, 55%–62% experienced chest pain, while 33%–42% of the workers reported

frequent cough. Blood tests of the workers showed higher values of erythrocyte sedimentation rate, eosinophils, and white blood cells when exposure was longer. Byssinosis symptoms were observed among the workers. We recommend regular periodical medical check-ups, compulsory use of personal protective equipment, and proper ventilation at the workplace.

Arpit Gupta, Anil V. Ankola & Mamata Hebbal. *Dental Ergonomics to Combat Musculoskeletal Disorders: A Review.* S. 561-571.

Musculoskeletal disorders (MSDs) are significant workplace problems affecting occupational health, productivity and the careers of dental professionals. The prevalence of MSDs is on the rise for all types of dental workers. In spite of different patterns of work culture, there are parallel levels of symptoms in dentists across nations. Risk factors for MSDs are multifactorial. Symptoms appear very early in careers, with higher prevalence of MSDs even during educational training. Ergonomics improvements, health promotion and organizational interventions are necessary to reduce the risk. An interdisciplinary approach with progressive efforts should be taken to address MSDs in dental professionals.

Pranab K. Nag, Anjali Nag, Heer Vyas & Priyanka Shah. *Disparity of a Seat Cushion and Its Influence on Postural Control.* S 573-581.

Properties of supporting surfaces of a seat have an influence on postural control. Centre of pressure (COP) displacement parameters reflect both the balance controlling process and movements of the centre of a mass of entire body. The subjects of the study were 9 healthy men. A seat cushion was examined with a 2-force platform setup. Force exertion at a seat pan and feet and COP displacement at a seat pan were measured to analyse postural control. Analysis of variance determined the differences in postural control depending on a cushion type among the subjects. Significant differences in COP displacement parameters were in COP trajectory length, medio-lateral COP displacement and COP velocity. The results of the study showed that foam cushion ensures better postural control.

Pranab K. Nag, Heer Vyas, Anjali Nag & Swati Pal. *Postural Stability of Sitting Women.* S. 583-595.

Biomechanical, postural and ergonomic aspects during real patient-assisting tasks performed by nurses using an electric versus a hydraulic hospital bed were observed. While there were no differences in the flexed postures the nurses adopted, longer performance times were recorded when electric beds were used. Subjective effort, force exertion and lumbar shear forces exceeding safety limits proved electric beds were superior. Patients' dependency level seemed to influence the type of nurses' intervention (duration and force actions), irrespective of the bed used. The nurses greatly appreciated the electric bed. Its use seemed to reduce the level of effort perceived during care giving and the postural load during critical subtasks. Ergonomics and organizational problems related to adopting electric beds in hospital wards should be addressed further to make their use more efficient.

PROTECTION OF HUMAN AT THE WORKSTATION

Edda Maria Capodaglio. *Electric Versus Hydraulic Hospital Beds: Differences in Use During Basic Nursing Tasks.* S. 597-606.

Biomechanical, postural and ergonomic aspects during real patient-assisting tasks performed by nurses using an electric versus a hydraulic hospital bed were observed. While there were no differences in the flexed postures the nurses adopted, longer

performance times were recorded when electric beds were used. Subjective effort, force exertion and lumbar shear forces exceeding safety limits proved electric beds were superior. Patients' dependency level seemed to influence the type of nurses' intervention (duration and force actions), irrespective of the bed used. The nurses greatly appreciated the electric bed. Its use seemed to reduce the level of effort perceived during care giving and the postural load during critical subtasks. Ergonomics and organizational problems related to adopting electric beds in hospital wards should be addressed further to make their use more efficient.

Salami Olasunkanmi Ismaila, Kolawole Taofik Oriolowo & Olusegun Gabriel Akanbi. *Cardiovascular Strain of Sawmill Workers in South-Western Nigeria*. S. 607-611.

This study aimed to assess cardiovascular strain during sawmilling operations in terms of physical workload, based on heart rate changes. We measured resting and working heart rates and calculated cardiovascular load (%CVL), cardiovascular strain (%CVS) and relative heart rate (%RHR) in 35 sawmill workers. Based on heart rate only, the work in sawmills was classified as very heavy and extremely heavy. Similarly, a high-level category was recorded for %CVL and a very high range for %CVS. Thus, the workload in sawmill operations is usually very high and can lead to physiological strain of the workers. There is a need to redesign the work content of this occupation to prevent excessive strain in the workers, as this will increase their productivity and reduce their health risk.

Rajat Gupta & Sanjoy Kumar Dey. *Assessment of Safety and Health in the Tea Industry of Barak Valley, Assam: A Fuzzy Logic Approach*. S. 613-621.

Traditional safety and health system measurement procedures, practiced in various industries produce qualitative results with a degree of uncertainty. This paper presents a fuzzy-logic-based approach to developing a fuzzy model for assessing the safety and health status in the tea industry. For this, the overall safety and health status at a tea estate has been considered as a function of 4 inputs: occupational safety, occupational health, behavioral safety and competency. A set of fuzzy rules based on expert human judgment has been used to correlate different fuzzy inputs and output. Fuzzy set operations are used to calculate the safety and health status of the tea industry. Application of the developed model at a tea estate showed that the safety and health status belongs to the fuzzy class of good with a crisp value of 7.2.

Luiza Tayar Facchin, Elucir Gir, Antonio Pazin-Filho, Miyeko Hayashida & Silvia Rita Marin da Silva Canini. *Under-Reporting of Accidents Involving Biological Material by Nursing Professionals at a Brazilian Emergency Hospital*. S. 623-629.

Background. Pathogens can be transmitted to health professionals after contact with biological material. The exact number of infections deriving from these events is still unknown, due to the lack of systematic surveillance data and under-reporting. **Methods.** A cross-sectional study was carried out, involving 451 nursing professionals from a Brazilian tertiary emergency hospital between April and July 2009. Through an active search, cases of under-reporting of occupational accidents with biological material by the nursing team were identified by means of individual interviews. The Institutional Review Board approved the research project. **Results.** Over half of the professionals (237) had been victims of one or more accidents (425 in total) involving biological material, and 23.76% of the accidents had not been officially reported using an occupational accident report. Among the underreported accidents, 53.47% were percutaneous and 67.33% were bloodborne.

The main reason for nonreporting was that the accident had been considered low risk. **Conclusions.** The under-reporting rate (23.76%) was low in comparison with other studies, but most cases of exposure were high risk.

Nenad Milijic, Ivan Mihajlovic, Nada Strbac & Zivan Zivkovic. *Developing a Questionnaire for Measuring Safety Climate in the Workplace in Serbia. S. 631-645.*

This study was conducted because a real method for measuring safety climate had never been developed and assessed in Serbian industry. The aim of this paper was to start the process of developing a safety climate questionnaire that could be used in Serbia. As a starting point a 21-item questionnaire was adopted after an extensive literature review. The questionnaire was distributed at several Serbian factories; 1098 workers responded. After a statistical analysis of the data obtained with the questionnaire and a critical comparison with the available reference results, a final questionnaire with 21 questions, divided into 7 groups, was developed. The 7 groups of questions (factors) were safety awareness and competence, safety communication, organizational environment, management support, risk judgment and management reaction, safety precautions and accident prevention, and safety training.

Farideh Golbabaei, Monireh Khadem, Asghar Ghahri, Mohammad Babai, Mostafa Hosseini, Mirghani SeyedSomea & Behnam Dinari. *Pulmonary Functions of Welders in Gas Transmission Pipelines in Iran. S. 647-655.*

This study evaluated the influence of welding on pulmonary functions in welders. Spirometry tests were performed before and after work shift in 91 welders and 25 clerks (control group). We examined forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), FEV1/FVC ratio and forced expiratory flow 25%–75% (FEF 25–75). Significant differences were found for FVC and FEV1/FVC between welders and the control group in pre- and post-shift measurements ($p < .001$). In welders, smoking and nonsmoking habit had no significant effects on any pulmonary indices before or after shift. Work experience and fume concentrations also had no significant effects on the majority of spirometric indices ($p > .05$). Most welders had at least 1 of the respiratory symptoms. Significant differences were found between pre- and post-shift indices (as percentage of predicted values calculated with spirometer) and between the welders engaged in some welding tasks and the control group before work shift. This study documented work-related changes in pulmonary functions in the welders and marked drops in these functions without symptoms in some welders.

Subhashis Sahu, Santi Gopal Maity, Subhabrata Moitra, Moumita Sett & Prasun Halder. *Cardiovascular Load During Summer Work of Two Age Groups of Van-Rickshaw Pullers in West Bengal, India. S. 657-665.*

Van-rickshaw is a popular mode of transport of people and merchandise in developing countries. The purpose of this study was to assess the effect of age on cardiovascular load of van-rickshaw pullers in the summer season (March–June) in real situations. In 142 participants, divided into 2 age groups (25–40 and 41–55 years), cardiovascular load was assessed on the basis of working and partial recovery heart rate (HR), predicted maximal HR, working maximal HR, average working HR, percentage of reserved HR, sum of recovery heart beats, percentage of recovery, relative and net cardiac cost, etc. Except for percentage of recovery, all parameters differed significantly between the groups and were significantly correlated with age. As this activity is very stressful, it places a heavy demand on the cardiovascular system. Therefore, age is an important factor for sustainability of the work, especially in a hot environment. Some ergonomic interventions are necessary to reduce cardiovascular load.

Hadi Daneshmandi, Abdolreza Rajae Fard & Alireza Choobineh. *Estimation of Aerobic Capacity and Determination of Its Associated Factors Among Male Workers of Industrial Sector of Iran.* S. 667-673.

Introduction. The aim of this study was to estimate maximal aerobic capacity (VO₂ max), to determine its associated factors among workers of industrial sector of Iran and to develop a regression equation for subjects' VO₂ max. **Methods.** In this study, 500 healthy male workers employed in Shiraz industries participated voluntarily. The subjects' VO₂ max was assessed with the ergocycle test according to the Åstrand protocol. Required data was collected with a questionnaire covering demographic details (i.e., age, job tenure, marital status, education, nature of work, shift work, smoking and weekly exercises). **Results.** The subject's mean VO₂ max was 2.69 ± 0.263 l/min. The results showed that there was an association between VO₂ max and age, BMI, hours of exercise and smoking, but there was no association between VO₂ max and height, weight, nature of work and working schedule. On the basis of the results, regression equations were developed to estimate VO₂ max. **Conclusion.** Final regression equation developed in this study may be used to estimate VO₂ max reliably without the need to use other laboratory instruments for aerobic measurement.

Heidar Mohammadi, Majid Motamedzade, Mohammad Amin Faghih, Hadi Bayat, Majid Habibi Mohraz & Saeed Musavi. *Manual Material Handling Assessment Among Workers of Iranian Casting Workshops.* S. 675-681.

Manual material handling (MMH) tasks can be found in most workplaces and they may constitute a risk factor for work-related musculoskeletal disorders (WMSDs). This study was conducted to determine the prevalence of WMSDs and to compare MMH loads with the acceptable weight and force limits among Iranian casting workers. Data were collected from 50 workers of casting workshops who performed MMH tasks. The Nordic musculoskeletal disorders questionnaire and the Snook tables were used as tools for data collection. Hand/wrist symptoms were the most prevalent problems among the workers (84%). The results of the Snook tables showed that the loads in lifting (84%), lowering (86%), carrying (66%), pushing with initial (43%) and sustained force (59%), and pulling tasks with initial (48%) and sustained force (93%) exceeded recommended limits. WMSDs occurred in high rates among the workers and, thus, ergonomics interventions should focus on decreasing WMSDs and redesigning MMH tasks.