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Číslo 1

Kristie Sweeney, Martin Mackey, Jacqueline Spurway, Jillian Clarke & Karen Ginn. *The effectiveness of ergonomics interventions in reducing upper limb work-related musculoskeletal pain and dysfunction in sonographers, surgeons and dentists: a systematic review*. Pages: 1-38

The aim of this systematic review was to summarise the effects of ergonomics interventions on work-related upper limb musculoskeletal pain and dysfunction, and on productivity in sonographers, surgeons and dentists. A total of 31 studies were included. All studies reported effects on upper limb pain. Nine studies reported effects on dysfunction and only two studies reported effects on productivity. Moderately strong evidence in reducing upper limb pain was found for instigation of microbreaks into long duration surgical procedures, and the use of wider, lighter handles in dental instruments. Moderate evidence was also found for use of prismatic glasses and favourable positioning in reducing upper limb pain. Weak, inconsistent or no evidence was found for all other ergonomics interventions in reducing upper limb pain and dysfunction and increasing productivity. The lack of high quality research, particularly in sonographers and in the outcome of productivity, should be addressed. **Practitioner summary:** This systematic review investigates the effectiveness of ergonomics interventions on upper limb pain, dysfunction and productivity in sonographers, dentists and surgeons. Instigation of microbreaks during long duration procedures and the use of wider, lighter instrument handles were most effective in reducing upper limb work-related pain.

- **Keywords:** Ergonomics intervention, health profession, upper limbwork related musculoskeletal disorder

Dania Bani Hani, Rong Huangfu, Richard Sesek, Mark C. Schall Jr., Gerard A. Davis & Sean Gallagher. *Development and validation of a cumulative exposure shoulder risk assessment tool based on fatigue failure theory*. Pages: 39-54.

Objective: To present a new risk assessment tool for shoulder intensive occupational tasks based on fatigue failure theory. **Methods:** The tool estimates cumulative damage (CD) based on shoulder moments and loading cycles using an S–N curve derived from in

vitro tendon fatigue failure tests. If multiple shoulder tasks are performed, the CD for each is summed. In the validation, 293 workers were evaluated for five separate shoulder outcomes. Logistic regression was used to assess the log CD against five shoulder outcomes adjusted for covariates including age, sex, body mass index (BMI), and plant site. **Results:** Both crude and adjusted logistic regression results demonstrated strong dose-response associations between the log CD measure and all five shoulder outcomes (continuous ORs ranged from 2.12 to 5.20). **Conclusions:** The CD measure of The Shoulder Tool demonstrated dose-response relationships with multiple health outcomes. This provides further support that MSDs may be the result of a fatigue failure process. **Practitioner summary:** This study presents a new, easy-to-use risk assessment tool for occupational tasks involving stressful shoulder exertions. The tool is based on fatigue failure theory. The tool was tested against an existing epidemiology study and demonstrated strong relationships to multiple shoulder outcomes.

- **Keywords:** Musculoskeletal disordersfatigue failure theoryrisk assessment and managementconcurrent validationshoulder

Pongsatorn Saiklang, Rungthip Puntumetakul, Manida Swangnetr Neubert & Rose Boucaut. *The immediate effect of the abdominal drawing-in maneuver technique on stature change in seated sedentary workers with chronic low back pai*n. Pages: 55-68.

Many studies have measured stature change arising from loads imposed on the spine during sitting. To improve stature recovery, it is important to stabilise the lumbar spine and compensate forces from the upper body. The abdominal drawing-in maneuver (ADIM) technique has been found to mainly activate deep trunk muscles. The purpose of this study was to determine whether activation of deep trunk muscles by the ADIM technique could immediately improve stature recovery during prolonged sitting. Twenty-four patients with chronic low back pain (CLBP) were randomly allocated into different orders of experimental conditions: control (sitting without ADIM technique) and intervention conditions (sitting with ADIM technique). The latter condition required participants to complete ADIM technique for 1 min and repeat it three times throughout 41 min prolonged sitting time. Stature recovery was improved by 3.292 mm in the intervention condition compared with control condition (p-value = 0.001). Our finding demonstrated that ADIM technique improved stature recovery. **Practitioner Summary:** Prolonged sitting seemingly harms sedentary workers' health, particularly affecting the lower back. Activation of deep trunk muscles using abdominal drawing-in maneuver technique can promote spinal recovery. Clinicians can teach abdominal drawing-in maneuver technique to activate deep trunk muscles in chronic low back pain, thereby promoting self-management of seated stature recovery.

- **Keywords:** Stature recovery, stature loss, spinal load, deep trunk muscles

Daniel A. del Cid, Daniel Larranaga, Matthew Leitao, Robert L. Mosher, Sara R. Berzenski, Vipal Gandhi & Stefanie A. Drew. *Exploratory factor analysis and validity of the virtual reality symptom questionnaire and computer use survey*. Pages: 69-77.

The widespread use of virtual reality head-mounted-displays (HMDs) calls for a re-examination of the impact of prolonged exposure to fixed visual displays at close ocular proximity. The purpose of this study is to validate the Virtual Reality Symptoms Questionnaire (VRSQ), created to understand symptoms of prolonged HMDs use, and Computer Use Survey (CUS), created to assess general physical and visual discomfort symptoms. Participants ($N = 100$) recorded their general discomfort symptoms using the CUS, performed an interactive task using a HMD for thirty minutes, and then answered the CUS again along with the VRSQ. VRSQ, analysed using an exploratory factor analysis,

indicated a clear two-factor solution, and demonstrated very good internal consistency ($a = 0.873$). The CUS, also analysed using an exploratory factor analysis, indicated a four-factor solution, and demonstrated good internal consistency ($a = 0.838$). **Practitioner Summary:** A quantitative-experimental study was conducted to explore the factor structure and validate both the Virtual Reality Symptoms Questionnaire (VRSQ), and the Computer Use Survey (CUS). Findings indicate the VRSQ and CUS are precise and accurate survey instruments for evaluating discomfort after VR-HMD use and the latter for computer use.

- **Keywords:** Virtual reality, head-mounted-displays, visual discomfort, motion sickness, exploratory factory analysis

Bram B. Van Acker, Davy D. Parmentier, Peter D. Conradie, Stephanie Van Hove, Alessandro Biondi, Klaas Bombeke, Peter Vlerick & Jelle Saldien. *Development and validation of a behavioural video coding scheme for detecting mental workload in manual assembly*. Pages: 78-102

Manual assembly in the future *Industry 4.0* workplace will put high demands on operators' cognitive processing. The development of mental workload (MWL) measures therefore looms large. Physiological gauges such as electroencephalography (EEG) show promising possibilities, but still lack sufficient reliability when applied in the field. This study presents an alternative measure with a substantial ecological validity. First, we developed a behavioural video coding scheme identifying 11 assembly behaviours potentially revealing MWL being too high. Subsequently, we explored its validity by analysing videos of 24 participants performing a high and a low complexity assembly. Results showed that five of the behaviours identified, such as freezing and the amount of part rotations, significantly differed in occurrence and/or duration between the two conditions. The study hereby proposes a novel and naturalistic method that could help practitioners to map and redesign critical assembly phases, and researchers to enrich validation of MWL-measures through measurement triangulation. **Practitioner summary:** Current physiological mental workload (MWL) measures still lack sufficient reliability when applied in the field. Therefore, we identified several observable assembly behaviours that could reveal MWL being too high. The results propose a method to map MWL by observing specific assembly behaviours such as freezing and rotating parts.

- **Keywords:** Mental workload, measurement, behavioural video coding, validation, assembly

Megan L. Bartlett & Jason S. McCarley. *Ironic efficiency in automation-aided signal detection*. Pages: 103-112.

Decision makers often make poor use of the information provided by an automated signal detection aid; recent studies have found that participants assisted by an automated aid fell well short of best-possible sensitivity levels. The present study tested the generalisability of this finding over varying levels of aid reliability. Participants performed a binary signal detection task either unaided or with assistance from a decision aid that was 60%, 85%, or 96%-reliable. Assistance from a highly reliable aid (85% or 96%) improved discrimination performance, while assistance from a low-reliability aid (60%) did not. Because their ideal strategy is to place less weight on less reliable cues, however, the decision makers' tendency to disuse the aid became more appropriate as the aid's reliability declined. Automation-aided efficiency was thus near to optimal when the aid was close to chance but became highly inefficient, ironically, as the aid's reliability increased. **Practitioner Summary:** Investigating operators' automation-aided information integration strategies allows human factors practitioners to predict the level of performance the operator will attain. Ironically, in an aided signal detection task,

performance when assisted by a highly reliable aid is far less efficient than that obtained when assisted by a far less reliable aid.

- **Keywords:** Human-automation interaction, signal detection theory, decision making-strategies, reliabilityefficiency

Sylvie Leclercq, Gaël Morel, Christine Chauvin & Laurent Claudon. *Analysis method for revealing human and organisational factors of occupational accidents with movement disturbance (OAMDs)*. Pages: 113-128.

Slips, trips and other movement disturbances account for 20 to 30% of recorded occupational accidents (OAs). The causal representations of these accidents hamper their prevention. An analysis method dedicated to occupational accidents with movement disturbance (OAMDs) has been developed to change these representations. In France, the causal tree method (CTM) is very commonly used for analysing OAs. An initial version of an OAMD analysis method, which overcomes the problems encountered when analysing these accidents using the CTM, has been developed. This OAMD analysis method was reviewed by six targeted prevention officers and as a result some proposals have been discarded and this initial version has been transformed into three additional CTM modules. The purpose of these modules is to identify human and organisational factors and provide a formal representation of damage caused, beyond bodily injuries. **Practitioner summary:** A method for analysing occupational accidents triggered by a slip, a trip or any other movement disturbance has been developed in consideration of the practices and constraints in companies. In particular, this method allows us to highlight the human and organisational factors involved in the accident situation.

- **Keywords:** 'Slips, trip sand falls', accident with movement disturbance, safety at work, analysis method, anthropocentric approach

Sebastian Keller, Simon Kohne, Wilhelm Bloch & Moritz Schumann. *Comparison of two different cooling systems in alleviating thermal and physiological strain during prolonged exercise in the heat*. Pages: 129-138.

This study compared the efficacy of an ice vest comprising of water (WATER) or a water-carbon (CARBON) emulsion on thermophysiological responses to strenuous exercise in the heat. Twelve male cyclists completed three 50-minute constant workload trials (55% of peak power output, ambient temperature 30.4 ± 0.6°C) with WATER, CARBON, and without ice vest (CONTROL), respectively. The increase in core body temperature (Tcore) was lower in WATER at 40 (−0.49 ± 0.34 °C) and 50 minutes (−0.48 ± 0.48 °C) and in CARBON at 30 (−0.41 ± 0.48 °C), 40 (−0.54 ± 0.51 °C), and 50 minutes (−0.67 ± 0.62 °C) as compared to CONTROL ($p < 0.05$, ES > 0.8). While heart rate and blood lactate kinetics did not differ between the conditions, statistical main effects in favour of both WATER and CARBON were found for thermal sensation (condition $p < 0.001$ and interaction $p < 0.01$) and rating of perceived exertion (condition $p < 0.05$). Per-cooling with CARBON and WATER similarly reduced Tcore but not physiological strain during prolonged exercise in the heat. **Practitioner Summary:** Exercise in the heat is characterised by increases in thermophysiological strain. Both per-cooling with a novel carbon-based and a conventional water-based ice vest were shown to reduce core temperature significantly. However, due to its lower mass, the carbon-based system may be recommended especially for weight-bearing sports.

- **Keywords:** Ice vestper-cooling, cycling, phase change material (PCM), body core temperature (Tcore)

Mark Batey, David J. Hughes, Lana Crick & Andra Toader. *Designing creative spaces: an experimental examination of the effect of a nature poster on divergent thinking*. Pages: 139-146.

This paper reports the results of an independent samples experiment designed to examine the effects of the presence of a large poster depicting a natural woodland scene on individual performance on two Divergent Thinking tasks. In comparison to the no-poster control condition, the presentation of a large poster depicting a nature scene was found to lead to greater levels of creativity as rated by judges who were blind to the experimental design. The effects of the large poster on Divergent Thinking were found to hold when controlling for Openness-to-Experience and Mood. Exploratory analyses of participant ratings of room characteristics indicated that the mechanism underlying the posters' effect related to elevated stimulation. **Practitioner summary:** This study compared the effects of presenting a large poster depicting a natural woodland scene (experimental condition) versus no poster (control condition) on individual creative thinking. Three judges, who were unaware of the design of the study, did not know the participant responses were from two different conditions and who did not facilitate the experiment rated the responses of the participants who were exposed to the large poster as significantly more creative.

- Keywords: Creativity, divergent thinking, creative space, office design, enrichment