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Jonathan Terroir, Nellie Perrin & Pascal Wild. *Comfort of earplugs: results of a field survey based on the COPROD questionnaire*. Pages: 1173-1193.

Many workers are exposed to noise levels that can cause hearing problems. Earplugs remain a common form of protection for workers exposed to hazardous levels. Their comfort directly affects the effective protection by influencing their consistent and correct use. In order to assess comfort, the COPROD questionnaire was previously developed on the basis of four comfort dimensions: acoustic, physical, functional and psychological. During this field survey, nine earplug models were evaluated by 118 participants over a 6-week period. This paper presents analyses of the collected data and compares three families of earplugs: roll-down foam, premolded and custom moulded. Analyses have shown a better rating of custom moulded earplugs in terms of overall comfort and for all dimensions of comfort. Although premolded earplugs are generally preferred to roll-down foam earplugs, from a statistical point of view, the evaluations of these two families are not significantly different for numerous characteristics. **Practitioner Summary:** Earplugs comfort conditions the hearing protection of the users. The COPROD questionnaire was developed to jointly evaluate all dimensions of comfort. Nine earplugs models were evaluated by 118 participants during 6 weeks. This paper presents analyses of the collected data.

- **Keywords:** Ear, plugs, comfort, questionnaires, sound and noise

Manoela Vieira Sousa, Ricardo Sebastião, Pedro Fonseca, Sara Morais, Denise Soares, Inês de Sousa, Leandro Machado, Filipa Sousa, Mário Vaz & João Paulo Vilas-Boas. *Can increased load carriage affect lower limbs kinematics during military gait?* Pages: 1194-1201.

The aim of this study was to investigate if increased load carriage, in male military personnel, can affect the lower limbs kinematics. Twelve male military volunteers from the Portuguese Army were recruited and evaluated in an unloaded and loaded gait condition. Linear kinematics and lower limbs joint angle at heel strike, midstance and toe off were calculated. The stance, swing and double support times were found to be different between load conditions ($p < 0.05$). There was an interaction between load and

limb ($p < 0.05$) for joint angles, during midstance, with limbs performing different movements in the frontal plane during loaded gait. Load increase had a different effect on the right knee, with a reduction in the abduction (valgus). This study may be beneficial in offering suggestion to improve the performance of gait with load and in an attempt to help prevent possible injuries. **Practitioner summary:** Increased load can affect lower limbs of male soldiers at the pelvic, hip and knee angles on the frontal plane, which can alter the joint force distribution. While these alterations may indicate protective mechanics, load management procedures should be implemented along with gait monitoring to avoid negative effects in performance.

- **Keywords:** Gait analysis, biomechanics, load carriage, military personnel

Rina Mariane Alves Dutra, Maria Lúcia Machado Duarte, Gabriel Chaves de Melo & Jorge Alexandre Barbosa Neves. *The effect of whole-body vibration on public transportation passenger performance while typing on smartphones*. Pages: 1202-1214.

This study verified typing performance on smartphones of public transportation passengers using subjective assessments of comfort and difficulty and objective assessments of the number of errors and typing speed. Three frequency values (5, 10, and 15 Hz), two magnitudes (0.6 and 1.2 m/s²) and two types of operating systems (Android and IOS) were adopted. Tests without vibration were applied to analyse the residual effect of vibration. The results showed that vibration significantly influences comfort. The higher the frequency, the less errors and the faster the typing speed. In the magnitude analysis, the increase caused a greater number of errors and greater difficulty. In both assessments, the discomfort was proportional to the increase in frequency or magnitude and the number of errors was inversely proportional to the typing speed. Finally, the IOS operating system showed worse comfort when compared to Android, although no significant differences were observed for the objective assessment. **Practitioner summary:** Public transportation passengers are exposed to WBV while typing on smartphones. The results showed that vibration influences comfort, the number of errors and the typing speed. Therefore, manufacturers should be aware of the level of vibration that vehicles are exposed to in order to provide more performance to the user.

- **Keywords:** Whole-body vibration (WBV), comfort level, smartphone, text message, public transportation

O. Menoni, M. Tasso, R. Manno & N. Battevi. *Application of MAPO (Movement and Assistance of Hospitalized Patients) method in hospitals and nursing homes: frequency of manual patient handling-part 2*. Pages: 1215-1229.

This study examines the evolution of MAPO method for estimating the frequency of overloading tasks in healthcare workers during different shifts. The data presented were collected from 51 in-patient wards (25 hospitals and 26 nursing homes), and 917 workers: the frequency of MPH tasks is a complementary value to the MAPO exposure level, which is useful to implement a prevention plan targeted towards the reduction of overloading tasks. Based on the frequency of manual patient handling, it appears that the afternoon shift is at greatest risk, with tasks liable to cause overloading occurring within a frequency range of 70–85 per worker. The study analyzes different pieces of equipment and their relative percentages of use, concluding that, overall, they are underutilised (especially minor aids and height-adjustable beds). **Practitioner summary:** The organisational data collected in hospitals and nursing homes confirms the availability of patient handling aids and equipment, but also indicates that they are underutilised with respect to the frequency of overloading tasks.

- **Keywords:** Manual patient handling, frequency of manual patient handling, hoists, sliding sheets, ergocoach training

Alina Tausch, Corinna Peifer, Britta Marleen Kirchhoff & Annette Kluge. *Human-robot interaction: how worker influence in task allocation improves autonomy. Pages: 1230-1244.*

Task allocation research is often efficiency-focussed, but procedural and work-psychological perspectives are required to enable human-centred human-robot interaction (HRI). Hence, the motivational and cognitive outcomes of the degree of worker influence over task allocation are relevant to research objects for allocation process design. In a laboratory experiment, 87 participants manufactured goods in collaboration with a robot under three conditions: (1) a support system decided the allocation, (2) a support-system allocation could be revised, (3) the participant determined the allocation. Conditions affected mental effort, process control and autonomy, resulting in higher values when participants allocated tasks themselves. Satisfaction with the process appears lower with no worker influence. Trust in the support-system moderates the condition effect, with higher satisfaction depending on trust when a system is involved in allocation. An allocation made by the workers and adaptability is preferred. Results show the importance of worker influence over task allocation in HRI. **Practitioner Summary:** Our experiment on allocation processes seeks to satisfy the gap in human-centred psychological research on task allocation in human-robot interaction (HRI). For successful, ergonomic HRI, it is found that workers should be provided with influence over task allocation.

- **Keywords:** Psychological aspects, allocation proces, human-robot interaction (HRI), autonomytrust

Jesse A. Stein, Timothy C. Hepler, Justin A. DeBlauw, Cassandra M. Beattie, Chaddrick D. Beshirs, Kendra M. Holte, Brady K. Kurtz & Katie M. Heinrich. *Lower-body muscular power and exercise tolerance predict susceptibility to enemy fire during a tactical combat movement simulation. Pages: 1245-1255.*

This study examined if field-expedient physical fitness/performance assessments predicted performance during a simulated direct-fire engagement. Healthy subjects ($n = 33$, age = 25.7 ± 7.0 years) completed upper- and lower-body strength and power assessments and a 3-min all-out running test to determine critical velocity. Subjects completed a simulated direct-fire engagement that consisted of marksmanship with cognitive workload assessment and a fire-and-move drill (16×6 -m sprints) while wearing a combat load. Susceptibility to enemy fire was modelled on average sprint duration during the fire-and-move drill. Stepwise linear regression identified predictors for the performance during the simulated direct-fire engagement. Critical velocity ($\beta = -0.30$, $p < 0.01$) and standing broad jump ($\beta = -0.67$, $p < 0.001$) predicted susceptibility to enemy fire ($R^2 = 0.74$, $p < 0.001$). All predictors demonstrated poor relationships with marksmanship accuracy and cognitive performance. These data demonstrate the importance of exercise tolerance and lower-body power during simulated direct-fire engagements and provide potential targets for interventions to monitor and enhance performance and support soldier survivability. **Practitioner Summary:** This study identified field-expedient physical fitness/performance predictors of a simulated direct-fire engagement which evaluated susceptibility to enemy fire, marksmanship, and cognitive performance. Our findings suggest that high-intensity exercise tolerance and lower-body power are key determinants of performance that predicted susceptibility to enemy fire.

- **Keywords:** Marksmanshipcombat survivabilitydirect-fire engagementmilitary performancelethality

Xueke Wang, Steven A. Lavender, Carolyn M. Sommerich & Michael F. Rayo. *Exploring the relationships between computer task characteristics, mental workload, and computer users' biomechanical responses.* Pages: 1256-1265.

Previous biomechanics studies suggest that higher cognitive mental workload when performing office computer tasks may increase the risk of MSDs among office workers. Cognitive workload can be interpreted in terms of task factors (e.g. task complexity and time pressure) and mental workload factors which include mental demand and mental effort. A laboratory study was conducted to further explore how the task and mental workload factors affected computer users' biomechanical responses, specifically the muscle activation levels and sitting postures. Data were collected as 20 participants worked on computer tasks which varied in their levels of task complexity and time pressure. Visual analog scales were used for assessing mental workload factors. Results indicated that the level of mental effort reported, as opposed to the level of task complexity, was associated with changes in participants' biomechanical responses, but primarily occurred when the chair's backrest was not used. **Practitioner summary:** A study was conducted to investigate the association between computer users' cognitive workload and biomechanical responses when performing computer task. While task complexity was not directly associated with the changes in participants' biomechanical responses, higher reported mental effort was associated with increased biomechanical responses, but only when the participants did not use the backrest on the chair.

- **Keywords:** Cognitive workloadcomputer taskmental effortbiomechanical responseoffice ergonomic intervention

Pieter Vansteenkiste, Flore Vermijs, Frederik J. A. Deconinck & Matthieu Lenoir. *Does music affect performance on a hazard perception test for cyclists?* Pages: 1266-1275

Whereas it has been shown that listening to music impairs the detection of auditory and visual signals, it is unclear to what extent music affects a cyclist's ability to detect and interpret hazardous traffic situations. In the current experiment, thirty-seven participants carried out a hazard perception test for cyclists. Participants were divided into three groups: control, passive, or active. The control group did the test without hearing music. The passive and active group did hear music, yet the passive group was asked to ignore the music, while the active group was asked to pay attention to the lyrics. Results showed no differences in reaction rate, reaction time, or gaze behaviour between any of the groups. These findings temper the existing safety concerns about the negative effect of music on traffic safety. Nevertheless, music might still have consequences under certain conditions or in certain risk-groups such as children. **Practitioner summary:** It is unclear how music affects traffic safety. The current experiment tested to what extent hazard perception was affected by listening actively or passively to music. Under the current experimental conditions, listening to music was found to have no effect on hazard perception.

- **Keywords:** Distraction, bicycle safety, traffic safety, attention, reaction time

Albin Stjernbrandt & Erlend Hoftun Farbu. [Occupational cold exposure is associated with neck pain, low back pain, and lumbar radiculopathy.](#) Pages: 1276-1285.

Ambient cold exposure can pose health risks, and this study was aimed at investigating associations with musculoskeletal disorders. A postal survey was performed on 12,627 men and women, ages 18–70 years, living in northern Sweden. Statistical associations were determined using multiple logistic regression. The study sample consisted of 6,886 women (54.5%), and 5,741 men. Reporting high occupational ambient cold exposure was statistically significantly associated with neck pain (OR 1.36; 95% CI 1.16–1.59), low back pain (OR 1.38; 95% CI 1.17–1.63), and lumbar radiculopathy (OR 1.36; 95% CI 1.07–1.73), after adjusting for age, gender, body mass index, physical work load, daily smoking, and stress. We conclude that ambient cold exposure during work was an independent predictor of neck pain, low back pain, and lumbar radiculopathy. In occupational health care settings, cold exposure should be recognised as a possible risk factor for musculoskeletal disorders. **Practitioner summary:** This cross-sectional, survey-based study investigated associations between self-reported occupational ambient cold exposure and musculoskeletal disorders. It showed significant associations between high cold exposure and neck pain, low back pain and lumbar radiculopathy. In occupational health care settings, cold exposure should be recognised as a possible risk factor for musculoskeletal disorders.

- **Keywords:** Occupational exposure, cold climate, ergonomics, neck pain, low back pain, radiculopathy, Sciatca Sweden

Parth Shah, Yan Luximon & Ameersing Luximon. *Measurement of soft tissue deformation at discomfort and pain threshold in different regions of the head.* Pages: 1286-1301.

Understanding of product-soft tissue interface and related discomfort is essential while designing wearable devices. Although pressure thresholds at the perception of discomfort and pain have been measured in the past, associated tissue deformation is yet to be studied. This data can provide a holistic understanding of user discomfort and be a valuable reference for ergonomic product design. Hence, in the current study, tissue deformation at discomfort and pain threshold was measured using an ultrasound indentation device at 18 landmarks for 83 Chinese adults on the head and face. Results show that deformation was higher in the facial region than the scalp and forehead, with maximum deformation in the cheek area and minimum in the forehead region for both thresholds. Also, for most landmarks, the tissue deformation data showed no significant relationship with age and Body Mass Index (BMI). Nearly half of the landmarks exhibited significant gender-based differences. Overall, the measured data showed acceptable within-session and between-session reliability. **Practitioner Summary:** In this study, tissue deformation was measured in different head regions for discomfort and pain thresholds, and corresponding deformation maps were developed. Measured tissue deformation data showed no significant relationship with BMI and age. This data can be a useful reference in the design, testing, and evaluation of headgears.

- **Keywords:** Human headanthropometrysoft tissue deformationdiscomfortpain

Gisele C. Gotardi, Fabio A. Barbieri, Rafael O. Simão, Vinicius A. Pereira, André M. Baptista, Luiz F. Imaizumi, Gabriel Moretto, Martina Navarro, Paula F. Polastri & Sérgio T. Rodrigues. *Parkinson's disease affects gaze behaviour and performance of drivers.* Pages: 1302-1311.

The aim of this study was to investigate the effects of PD and ageing on gaze behaviour and performance of drivers in a simulated task. Ten drivers with PD, ten neurologically healthy older drivers, and ten neurologically healthy younger adult drivers were asked to drive in a car simulator for three minutes, maintaining car speed between 100 and 120 km/h and avoiding collisions. Driver's eye movements were recorded. Drivers with PD had more collisions and spent less time driving within the speed zone than the

younger-drivers. Drivers with PD performed an increased number of fixations towards task-irrelevant areas of the visual scene and higher visual entropy, indicating a more random gaze behaviour. Older drivers restricted their visual search to the lane area in order to detect threat-related stimuli. PD led to drops in performance of drivers in the car simulator. **Practitioner summary:** Parkinson's disease (PD) and ageing process caused a drop in driving performance. Drivers with PD made fewer fixations on task-relevant information and showed higher visual entropy than young adults. Older drivers restricted their visual search to the lane than other areas of interest.

- **Keywords:** Parkinson's disease ageing visual entropy eye movements driving simulator