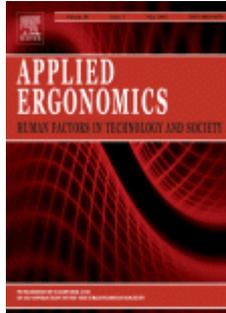


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**Cammie Chaumont Menéndez, Benjamin C. Amick III, Michelle Robertson, Lianna Bazzani, Kelly DeRango, Ted Rooney, Anne Moore. A replicated field intervention study evaluating the impact of a highly adjustable chair and office ergonomics training on visual symptoms. Pages 639-644.**

**Objective**

Examine the effects of two office ergonomics interventions in reducing visual symptoms at a private sector worksite.

**Methods**

A quasi-experimental study design evaluated the effects of a highly adjustable chair with office ergonomics training intervention (CWT group) and the training only (TO group) compared with no intervention (CO group). Data collection occurred 2 and 1 month(s) pre-intervention and 2, 6 and 12 months post-intervention. During each data collection period, a work environment and health questionnaire (covariates) and daily health diary (outcomes) were completed. Multilevel statistical models tested hypotheses.

**Results**

Both the training only intervention ( $p < 0.001$ ) and the chair with training intervention ( $p = 0.01$ ) reduced visual symptoms after 12 months.

**Conclusion**

The office ergonomics training alone and coupled with a highly adjustable chair reduced visual symptoms. In replicating results from a public sector worksite at a private sector worksite the external validity of the interventions is strengthened, thus broadening its generalizability.

**Highlights:** ▶ A replicated study evaluated office ergonomics intervention on visual symptoms. ▶ The highly adjustable chair with office ergonomics training reduced visual symptoms. ▶ The office ergonomics training alone reduced visual symptoms. ▶ Both interventions resulted in reduced visual symptoms at 12 months. ▶ This replicated study strengthened the intervention's external validity.

- **Keywords:** Office ergonomics intervention; Chair; Training; Visual symptoms; Replication; Multi-level modeling

**Tilak Dutta. *Evaluation of the Kinect™ sensor for 3-D kinematic measurement in the workplace.* Pages 645-649.**

Recording posture and movement is important for determining risk of musculoskeletal injury in the workplace, but existing motion capture systems are not suited for field work. Estimates of the 3-D relative positions of four 0.10 m cubes from the Kinect were compared to estimates from a Vicon motion capture system to determine whether the hardware sensing components were sensitive enough to be used as a portable 3-D motion capture system for workplace ergonomic assessments. The root-mean-squared errors (SD) were 0.0065 m (0.0048 m), 0.0109 m (0.0059 m), 0.0057 m (0.0042 m) in the x, y and z directions (with x axis to the right, y axis away from the sensor and z axis upwards). These data were collected over a range of 1.0–3.0 m from the device covering a field of view of 54.0 degrees horizontally and 39.1 degrees vertically. Requirements for software, hardware and subject preparation were also considered to determine the usability of the Kinect in the field.

**Highlights:** ▶ The suitability of the Kinect system to be used for 3D motion capture is examined. ▶ Accuracy of the Kinect is compared to a Vicon system. ▶ Required software, hardware and subject preparation are also considered.

- **Keywords:** Portable motion capture; Kinect; Kinematics

**Michael Clamann, Biwen Zhu, Leah Beaver, Kinley Taylor, David Kaber. *Comparison of infant car seat grip orientations and lift strategies.* Pages 650-657.**

The rear-facing Infant Car Seat (ICS) is designed to meet federal requirements for transporting children less than 1 year old. Typical use includes transfer in and out of a vehicle, which is shown to be a difficult lift. Despite the frequency of this lift, manufacturers provide little guidance for users. Review of relevant literature suggested an ICS featuring an angled handle, promoting a neutral wrist posture, would increase grip stability and decrease lifting effort. Popular press suggested a foot-in-car stance for the ICS lift would do the same. An experiment was conducted in which wrist deviations from neutral posture were recorded along with lifting muscle activation levels (multiple flexor muscles and biceps brachii) and overall perceived exertion for straight versus a new bent handle design and conventional stance versus foot-in-car. Foot position was examined to test the recommendations in the popular press. Surprisingly, wrist deviation was not significantly affected by the new bent handle design (due to compensatory behavior with the straight handle) but was related to foot placement ( $p = 0.04$ ). Results revealed the bent handle to significantly reduce flexor activation compared with the straight handle ( $p = 0.0003$ ); however, the level of biceps activation increased. Biceps activation also significantly increased for foot-in-car stance ( $p = 0.035$ ) but not flexor activation. In general, the bent handle enabled the user to lift the ICS with a steadier grip and less effort.

**Highlights:** ▶ We compared two handle designs and strategies for lifting an infant car seat. ▶ A bent handle promoting a neutral wrist posture was compared to a straight handle. ▶ Lift strategies were based on varied foot placement. ▶ We evaluated the differences in terms of lift stability and effort. ▶ The bent handle enabled subjects to lift with a steadier grip and less effort.

- **Keywords:** Handle design; Lifting task; Infant car seat

**Pei-Chun Lin, Jenhung Wang, Shih-Chin Li. *Subjective stress factors in centrifuge training for military aircrews. Pages 658-663.***

This study investigates stress-influence factors perceived by military aircrews undergoing centrifuge training, which lowers the incidence of G-induced loss of consciousness (G-LOC) for the crews of high-performance combat aircrafts. We used questionnaires to assess the subjective stress-influence factors of crews undergoing centrifuge training. Professionals in aviation physiology identified attributes measuring the perceived stress induced by centrifuge training, which were segmented into three constructs by factor analysis, theory lecture, centrifuge equipment, and physical fitness. Considerable interpenetration was discernible between these factors and military rank, age, length of service, flight hours accrued, and type of aircraft piloted. Identifying and quantifying the perceived stressors experienced in human-use centrifuge training enables aviators, astronauts, and air forces of the world to determine which constructs perceptibly increase or alleviate the perceived stress undergone by trainees when partaking in centrifuge training.

**Highlights:** ▶ This study investigates perceived stress when undergoing centrifuge training. ▶ The perceived stress was segmented into: lecture, equipment and physical fitness. ▶ Perceived stress was discernible for military rank, age, and length of service. ▶ Perceived stress was discernible for flight hours and type of aircraft piloted. ▶ Identifying the stressor determines what construct alleviate the perceived stress.

- **Keywords:** Human-use centrifuge; G-induced loss of consciousness; Stress

**Jia-Hua Lin, Raymond W. McGorry, Chien-Chi Chang. *Effects of handle orientation and between-handle distance on bi-manual isometric push strength. Pages 664-670.***

Hand-handle interface is seldom considered in contemporary upper limb biomechanical analyses of pushing and pulling strength. A laboratory study was designed to examine if handle rotation in the frontal plane (0°-horizontal, 45°, and 90°-vertical), anterior tilt (0°-parallel to the frontal plane, and 15°), and distance between two handles (31 and 48.6 cm) affect pushing strength and subjective rating of handle preference. A special testing station was constructed to elicit upper limb push exertions that involved minimal contribution of the torso and legs. Within the station, four load cells were used to measure the horizontal (forward pushing) and vertical components of the pushing forces. Thirty-one participants performed seated bi-manual pushing strength tests. Comparing to the reference handle configuration (horizontal, straight, and a 31-cm between-handle distance), the 45°-rotated and tilted handles with a 31-cm between-handle distance allowed 6.7% more pushing output, while the horizontal and tilted handles with a 31-cm between-handle distance resulted in 2.8% less. Subjective preference was correlated with normalized pushing strength ( $r = 0.89$ ). Tilted handles, at 45°-rotated and vertical positions received highest subjective ratings of preference among all handle configurations. Men exerted greater pushing strength with the 48.6-cm handle distance while women's capacity was greatest with the 31-cm distance. The results demonstrated that handle rotation and tilt angles affected pushing strength and should be taken into consideration when evaluating or designing pushing tasks.

- **Keywords:** Ergonomics design; Anthropometry; Strength testing; Cart; Manual vehicles

**Sue A. Ferguson, William S. Marras, W. Gary Allread, Gregory G. Knapik, Riley E. Splittstoesser. *Musculoskeletal disorder risk during automotive assembly: current vs. seated.* Pages 671-678.**

Musculoskeletal disorder risk was assessed during automotive assembly processes. The risk associated with current assembly processes was compared to using a cantilever chair intervention. Spine loads and normalized shoulder muscle activity were evaluated during assembly in eight regions of the vehicle. Eight interior cabin regions of the vehicle were classified by reach distance, height from vehicle floor and front to back. The cantilever chair intervention tool was most effective in the far reach regions regardless of the height. In the front far reach regions both spine loads and normalized shoulder muscle activity levels were reduced. In the middle and close reach regions spine loads were reduced, however, shoulder muscle activity was not, thus an additional intervention would be necessary to reduce shoulder risk. In the back far reach region, spine loads were not significantly different between the current and cantilever chair conditions. Thus, the effectiveness of the cantilever chair was dependent on the region of the vehicle.

**Highlights:** ▶ The study measured spine loads and shoulder muscle activity in two automobile assembly conditions. ▶ The current automobile assembly condition was compared to using a cantilever chair intervention. ▶ Eight regions of the vehicle were classified based on reach distance, height and front/back. ▶ The cantilever chair condition reduced exposure in far reach regions regardless of height.

- **Keywords:** Musculoskeletal disorder; Intervention; Seated; Automotive assembly

**Yung-Ching Liu, Jing-Wun Jhuang. *Effects of in-vehicle warning information displays with or without spatial compatibility on driving behaviors and response performance.* Pages 679-686.**

A driving simulator study was conducted to evaluate the effects of five in-vehicle warning information displays upon drivers' emergent response and decision performance. These displays include visual display, auditory displays with and without spatial compatibility, hybrid displays in both visual and auditory format with and without spatial compatibility. Thirty volunteer drivers were recruited to perform various tasks that involved driving, stimulus-response, divided attention and stress rating. Results show that for displays of single-modality, drivers benefited more when coping with visual display of warning information than auditory display with or without spatial compatibility. However, auditory display with spatial compatibility significantly improved drivers' performance in reacting to the divided attention task and making accurate S-R task decision. Drivers' best performance results were obtained for hybrid display with spatial compatibility. Hybrid displays enabled drivers to respond the fastest and achieve the best accuracy in both S-R and divided attention tasks.

**Highlights:** ▶ We investigated the effects of five in-vehicle warning information displays. ▶ For single display modality, visual display is better than auditory display. ▶ Auditory display with spatial compatibility improved drivers' performance. ▶ Hybrid display with spatial compatibility caused the best performance results.

- **Keywords:** Display; In-vehicle warning information; Spatial compatibility

**Therese Öhrling, Rupesh Kumar, Lena Abrahamsson. *Assessment of the development and implementation of tools in contract cleaning.* Pages 687-694.**

This paper illustrates and discusses problems with the implementation and use of ergonomic tools and techniques in the process of cleaning. Cleaning is an occupation with a high risk of developing work-related disorders. One high-strain task where recommended tools and techniques are difficult to apply is cleaning staircases. This study evaluated the muscular activity of cleaners while mopping staircases using two different mop handles and found that an easily adjustable mop handle can decrease a cleaner's physical load. The results also show that the implementation and contextualization of the mop are of great importance for how a mop is used. A more holistic approach is needed to improve the benefits of good tools and techniques in cleaning work. More research is needed on how workplace organization can be improved to support the implementation of strategies to increase the health of professional cleaners.

**Highlights:** ▶ More ergonomic cleaning tools can decrease the physical load in cleaning work. ▶ More ergonomic tools and techniques are needed in the cleaning business. ▶ Without good implementation strategies, the benefits of new tools could be lost. ▶ Cleaners' knowledge must be captured in the design of tools and interior design. ▶ A holistic approach must be adopted to improve the working environment for cleaners.

- **Keywords:** Cleaning work; Work organization; Ergonomic equipment

**Sally A. Ferguson, David J. Kennaway, Angela Baker, Nicole Lamond, Drew Dawson. *Sleep and circadian rhythms in mining operators: Limited evidence of adaptation to night shifts.* Pages 695-701.**

Cumulative sleep deprivation is often associated with work patterns involving night shift or early morning shifts. Adaptation of the circadian system to the shift pattern is reported to promote improved duration and quality of sleep and a concurrent improvement in performance. The current study followed twenty-nine operators at a live-in mining operation working to a seven-day, seven-night shift pattern who collected saliva samples for melatonin measurement, recorded sleep using activity monitors and diaries, and underwent performance testing (psychomotor vigilance task) for one complete roster cycle. The time of onset of melatonin secretion changed significantly ( $P = 0.022$ ) across the week of both Day and Night shifts (2104 h  $\pm$  16 min versus 2130 h  $\pm$  16 min, respectively), but the small magnitude of the change indicates a lack of true circadian rhythm adaptation to the lifestyle. Total sleep time was longer following the seventh Day shift (associated with a period of 24 h off prior to the commencement of Night shifts). There were no other changes in total sleep time. Further, there were no improvements in sleep onset latency or sleep efficiency on Day or Night shifts. However, reaction times recorded at the end of the shifts slowed across the seven Day and seven Night shifts indicative of impairments in psychomotor performance ( $F_{6,168} = 6.087$ ,  $P < 0.001$ ). The results suggest that previous reports of adaptation to consecutive night shifts cannot necessarily be applied to onshore or Australian environments. Adaptation is dependent on factors such as light exposure, environmental conditions, shift parameters such as wake-up, work start and work end times and individual characteristics.

**Highlights:** ▶ Circadian adaptation and improvements in sleep and performance are seen shiftworkers. ▶ We looked at melatonin, sleep and reaction time measures in miners in Australia. ▶ There was no evidence for circadian phase shifts or physiological adaptation. ▶ The results are probably due to morning light keeping rhythms entrained.

- **Keywords:** Sleep; Circadian adaptation; Melatonin; Shiftwork

**Enid Montague, Jie Xu. *Understanding active and passive users: The effects of an active user using normal, hard and unreliable technologies on user assessment of trust in technology and co-user. Pages 702-7012.***

The aim of this study was to understand how passive users perceive the trustworthiness of active users and technologies under varying technological conditions. An experimental study was designed to vary the functioning of technologies that active users interacted with, while passive users observed these interactions. Active and passive user ratings of technology and partner were collected. Exploratory data analysis suggests that passive users developed perceptions of technologies based on the functioning of the technology and how the active user interacted with the technology. Findings from this research have implications for the design of technologies in environments where active and passive users interact with technologies in different ways. Future work in this area should explore interventions that lead to enhanced affective engagement and trust calibration.

**Highlights:** ▶ Passive users' role in collaborative systems was examined through experiments. ▶ Active users reported lower trust in technology ratings when a passive user was present. ▶ Passive and active users had shared perceptions of trust in technology. ▶ Trust in technology is calibrated differently for the two types of users.

- **Keywords:** Passive user; Trust in technology; Trust in team

**Raji Tenneti, Daniel Johnson, Liz Goldenberg, Richard A. Parker, Felicia A. Huppert. *Towards a capabilities database to inform inclusive design: Experimental investigation of effective survey-based predictors of human-product interaction. Pages 713-726.***

A key issue in the field of inclusive design is the ability to provide designers with an understanding of people's range of capabilities. Since it is not feasible to assess product interactions with a large sample, this paper assesses a range of proxy measures of design-relevant capabilities. It describes a study that was conducted to identify which measures provide the best prediction of people's abilities to use a range of products. A detailed investigation with 100 respondents aged 50–80 years was undertaken to examine how they manage typical household products. Predictor variables included self-report and performance measures across a variety of capabilities (vision, hearing, dexterity and cognitive function), component activities used in product interactions (e.g. using a remote control, touch screen) and psychological characteristics (e.g. self-efficacy, confidence with using electronic devices). Results showed, as expected, a higher prevalence of visual, hearing, dexterity, cognitive and product interaction difficulties in the 65–80 age group. Regression analyses showed that, in addition to age, performance measures of vision (acuity, contrast sensitivity) and hearing (hearing threshold) and self-report and performance measures of component activities are strong predictors of successful product interactions. These findings will guide the choice of measures to be used in a subsequent national survey of design-relevant capabilities, which will lead to the creation of a capability database. This will be converted into a tool for designers to understand the implications of their design decisions, so that they can design products in a more inclusive way.

**Highlights:** ▶ Identifies the best proxy measures that best predicts product interaction. ▶ Component functions and component activities have greater predictor power. ▶ A database of human capabilities cannot rely on self-report measures alone.

- **Keywords:** Inclusive design; Design practice; Design tools; User-centred design; Human factors

**Baiduri Widanarko, Stephen Legg, Mark Stevenson, Jason Devereux, Amanda Eng, Andrea 't Mannetje, Soo Cheng, Neil Pearce. *Prevalence and work-related risk factors for reduced activities and absenteeism due to low back symptoms. Pages 727-737.***

Although quite a lot is known about the risk factors for low back symptoms (LBS), less is known about the risk factors for the consequences of LBS. A sample of 3003 men and women randomly selected from the New Zealand Electoral Roll, were interviewed by telephone about self reported physical, psychosocial, organizational, environmental factors and the consequences of LBS (i.e. self-reported reduced activities and absenteeism). The 12-month period prevalence of reduced activities and absenteeism were 18% and 9%, respectively. Lifting (OR 1.79 95% CI 1.16–2.77) increased the risk of reduced activities. Working in awkward/tiring positions (OR 2.11 95% CI 1.20–3.70) and in a cold/damp environment (OR 2.18 95% CI 1.11–4.28) increased the risk of absenteeism. Among those with LBS, reduced activities increased with working in a hot/warm environment (OR 2.14 95% CI 1.22–3.76) and absenteeism was increased with work in awkward/tiring positions (OR 2.06 95% CI 1.13–3.77), tight deadlines (OR 1.89 95% CI 1.02–3.50), and a hot/warm environment (OR 3.35 95% CI 1.68–6.68). Interventions to reduce the consequences of LBS should aim to reduce awkward/tiring positions, lifting and work in a cold/damp environment. For individuals with LBS, additional focus should be to reduce tight deadlines, and work in hot/warm environments.

**Highlights:** ▶ The prevalence of reduced activities and absenteeism due to LBS were 18% and 9%. ▶ Lifting increased the risk of reduced activities. ▶ Awkward/tiring positions and a cold/damp environment increased the risk of absenteeism. ▶ Interventions: reduce awkward/tiring positions, lifting, work in a cold/damp environment.

- **Keywords:** Back pain; Disability; Consequences; Nordic musculoskeletal questionnaire; Environment

**Kristie L. Young, Eve Mitsopoulos-Rubens, Christina M. Rudin-Brown, Michael G. Lenné. *The effects of using a portable music player on simulated driving performance and task-sharing strategies. Pages 728-746.***

This study examined the effects of performing scrollable music selection tasks using a portable music player (iPod Touch™) on simulated driving performance and task-sharing strategies, as evidenced through eye glance behaviour and secondary task performance. A total of 37 drivers (18–48 yrs) completed the PC-based MUARC Driver Distraction Test (DDT) while performing music selection tasks on an iPod Touch. Drivers' eye glance behaviour was examined using faceLAB eye tracking equipment. Results revealed that performing music search tasks while driving increased the amount of time that drivers spent with their eyes off the roadway and decreased their ability to maintain a constant lane position and time headway from a lead vehicle. There was also evidence, however, that drivers attempted to regulate their behaviour when distracted by decreasing their speed and taking a large number of short glances towards the device. Overall, results suggest that performing music search tasks while driving is problematic and steps to prohibit this activity should be taken.

**Highlights:** ▶ Portable music players with touch screen interfaces are increasingly popular with drivers. ▶ We examined the effects of scrollable music search tasks on driving performance. ▶ The music tasks increased the amount of time drivers spent with their eyes off the road. ▶ The tasks also lead to degraded lateral and longitudinal control. ▶ However, drivers regulated their interaction by taking a large number of short glances to the device.

- **Keywords:** Driver distraction; Portable music players; Driving simulator; Eye movements; Task-sharing

**Devin Lucas, Jennifer Lincoln, Philip Somervell, Theodore Teske. *Worker satisfaction with personal flotation devices (PFDs) in the fishing industry: Evaluations in actual use. Pages 747-752.***

The purpose of this study was to determine which type of commercially available PFD resulted in the highest satisfaction among workers in the fishing industry. Fishing industry workers on four types of vessels wore and evaluated six different PFDs during their fishing seasons. Linear regression was used to test the differences in mean satisfaction scores, adjusting for clustered observations on vessels. The data were stratified by vessel type to determine the differences in PFD satisfaction within each vessel type. PFD D had the highest mean satisfaction score, but satisfaction with particular PFDs varied depending on the vessel type. Although the common objections by workers to wearing PFDs are that they are bulky and uncomfortable, some of the PFDs that were evaluated in this study received high scores for comfort and satisfaction. Given the availability of PFDs that are comfortable to wear while working, fishing vessel owners and operators should consider implementing policies mandating the use of PFDs on deck.

**Highlights:** ▶ Certain PFDs that were evaluated by workers received high scores for satisfaction. ▶ Satisfaction with particular PFDs varied depending on the type of fishing vessel. ▶ PFD satisfaction did not change significantly with use over time during the study. ▶ Fishing vessel owners should consider policies mandating the use of PFDs on deck. ▶ The unique conditions on each vessel type must be considered when selecting a PFD.

- **Keywords:** Commercial fishing; Personal flotation device; Satisfaction

**Martina Jakob, Falk Liebers, Sylvia Behrendt. *The effects of working height and manipulated weights on subjective strain, body posture and muscular activity of milking parlor operatives – Laboratory study. Pages 753-761.***

The incidence of work-related musculoskeletal disorders among milking parlor operatives has increased while milking parlors were getting bigger. At the same time parlor design was improved regarding the physical load as well as body postures.

In contrast to former studies on workload in parlor milking this project was designed and performed as an experimental study in a laboratory setting including 6 female subjects. Motion analysis and psycho-physiological analysis (EMG, heart rate, subjective perceived strain index) were carried out. Intra-individual comparisons were made for the different settings using general linear models for repeated measurements. The effects of working height and weight of milking unit during parlor milking were investigated regarding the impact on muscular load and body posture. The results showed that the optimal working

height for attaching the cluster is having the teats at shoulder level of the parlor operative. Another important workload reduction was achieved by reducing the weight of the milking cluster.

The named discomfort, localized fatigue and the body posture analysis provide evidence that the changes in modern milking parlors due to mechanization still bear the risk of overburden for the worker.

**Highlights:** ▶ We measure effects of changes in working height and cluster weight in milking parlors. ▶ Helps understanding the impact of parlor design, anthropometrics and bovimetrics. ▶ Advice to improve workplace dimensions and implementation can be drawn from results.

- **Keywords:** Workload assessment; Dairy farming; MSD

**Meghan L. Rogers, Will B. Heath, Chad C. Uy, Sameerajan Suresh, David B. Kaber. *Effect of visual displays and locations on laparoscopic surgical training task. Pages 762-767.***

The number of minimally invasive surgical (MIS) procedures has substantially increased since its introduction due to health and recovery benefits for patients. However, there are potential performance issues in MIS for surgeons due to perceptual processing demands associated with supporting technologies. Monitor location has been identified as a major factor influencing performance in these types of procedures. This study examined the effect of multiple monitors on performance during a laparoscopic surgical training task (peg transfer among instruments). Twenty-four novice subjects were exposed to different monitor conditions including a default position, a biomechanically compatible position, and a position collocated with the operating surface as well as the combination of the latter two. Subjective rankings and cognitive workload were also assessed. Results revealed a significant effect of monitor position on task time when compared to subjects' baseline training task time using the default monitor setup. Collocating the monitor with the operating surface was shown to be superior in terms of task time. There were no significant differences among monitor positions in terms of perceived workload. The results of this study provide an applicable guide for the design of MIS setups in the operating room to promote surgeon performance.

**Highlights:** ▶ Optimal visual display location and setup still undefined in terms of performance for MIS. ▶ We examine the effect of visual display location on simulated laparoscopic surgery. ▶ Monitors collocated with the operating surface produced the most improvement when compared to the traditional MIS setup. ▶ Multiple stacked monitors did not result in performance improvements compared to the constituent monitors.

- **Keywords:** Minimally invasive surgery; Monitor position

**Monica N. Lees, Joshua Cosman, John D. Lee, Shaun P. Vecera, Jeffrey D. Dawson, Matthew Rizzo. *Cross-modal warnings for orienting attention in older drivers with and without attention impairments. Pages 768-776.***

Older adults are overrepresented in fatal crashes on a per-mile basis. Those with useful field of view (UFOV) reductions show a particularly elevated crash risk that might be mitigated with vehicle-based warnings. To evaluate cross-modal cues that could be used in these warnings, we applied a variation of Posner's orienting of attention paradigm. Twenty-nine older drivers with UFOV impairments and 32 older drivers without impairments participated. Cues were presented in either a single modality or a

combination of modalities (visual, auditory, haptic). Drivers experienced three cue types (valid spatial information, invalid spatial information, neutral) and an uncued baseline. Following each cue, drivers discriminated the direction of a target (a Landolt square with a gap facing up or down) in the visual panorama. Drivers with and without UFOV impairments showed comparable response times (RTs) across the different cue modalities and cue types. Both groups benefited most from auditory and auditory/haptic cues. Redundant visual cues, when paired with auditory cues, undermined performance rather than enhanced it. Overall, drivers responded faster to targets with valid spatial information followed by neutral, invalid, and uncued targets. Cues provide the greatest benefit in alerting rather than orienting the driver. The cue expected to be most effective at orienting attention – the extra-vehicular cue – performs most poorly when the spatial information is either invalid or neutral. Even when the spatial information is valid the extra-vehicular cue underperforms the auditory cues. The results suggest that temporal information dominates spatial information in the ability of cues to speed responses to targets. This study represents a first step in assessing whether combining a cognitive science paradigm and a driving simulator environment can quickly assess how different warning signals alert and orient drivers.

**Highlights:** ▶ We applied a variation of the Posner paradigm to evaluate collision warnings for older drivers. ▶ Drivers with and without UFOV impairments showed similar response times for cue modalities. ▶ Drivers with and without UFOV benefited most from auditory and auditory/haptic cues. ▶ Cues provide the greatest benefit in alerting rather than orienting the driver. ▶ The study shows a cognitive science paradigm can assess how warnings might alert and orient drivers.

- **Keywords:** Spatial attention; Older drivers; Useful field of view; Driving; Warning signal; Interface design

**Adelaide Nascimento, Pierre Falzon. *Producing effective treatment, enhancing safety: Medical physicists' strategies to ensure quality in radiotherapy.* Pages 777-784.**

The purpose of this article is to understand the way in which medical physicists take into account treatment effectiveness and safety when selecting a treatment plan, with respect to the medical prescription and the technical, human and organizational resources available. Data-gathering was based on the allo-confrontation method: 14 medical physicists from five different treatment centers commented on real treatment plans that had been drawn up by their colleagues. Results show that medical physicists have two means at their disposal to control treatment effectiveness and safety: risk avoidance and risk reduction. Risk avoidance is achieved when conceiving the treatment solution. Risk reduction occurs after the design of the plan and consists in accompanying and assisting the radiographers at the workstation where the treatment is carried out.

- **Keywords:** HumanSafety; Effectiveness; Quality; Radiotherapy

**Jeng-Feng Yang, Chiung-Yu Cho. *Comparison of posture and muscle control pattern between male and female computer users with musculoskeletal symptoms.* Pages 785-791.**

The primary purpose of this study was to compare the posture and muscle control patterns between male and female computer users with musculoskeletal symptoms. Forty computer users were recruited. Each subject performed a preferred speed typing, a fast speed typing, and a repetitive mouse task. The independent variables were gender, typing speed, and time. There were significant differences between genders for head and

neck flexion angles when they were performing the preferred speed typing task. Significant differences between genders were also found for upper extremity angles when they were performing the repetitive mouse task. Male computer users had a smaller root mean square of the right extensor digitorum than females. In general, postural differences were significant between genders, even when the subjects' table and chair were adjusted to meet their anthropometry. Our results suggest that modifications of the computer working environment may be different between genders.

**Highlights:** ▶ We compare postures and EMGs between men and women while they were performing different computer tasks. ▶ We examine changes in different typing speed, and across time. ▶ Postural differences were significant between genders. ▶ Male computer users had a smaller root mean square of the right extensor digitorum than females. ▶ Modifications of the computer working environment may be different between genders.

- **Keywords:** Cumulative trauma disorder; Computer users; Musculoskeletal symptoms; Gender

**S.P. Singh, Surendra Singh, Pratap Singh. *Ergonomics in developing hand operated maize Dehusker–Sheller for farm women. Pages 792-798.***

A hand operated maize dehusker–sheller to be operated by farm women was designed and developed to dehusk and shell the maize cobs using ergonomics (anthropometric, strength and physiological workload). Axial-flow maize dehusker–sheller with 540 mm cylinder length and 380 mm diameter required 3.03 N-m torque on cylinder shaft while operating at 5.6 m s<sup>-1</sup> peripheral speed and 100 kg h<sup>-1</sup> feed rate by feeding cob one by one. This torque was 30% of isometric torque obtained at front position of handle (greatest distance) with lowest crank length. The heart rate of subject while operating the maize dehusker–sheller at 54 rpm (5.6 m s<sup>-1</sup>) was 142 beats min<sup>-1</sup>. The output of 60 kg h<sup>-1</sup> was obtained at the feed rate of 80 kg h<sup>-1</sup>. Two subjects can operate the machine for an hour with a rest pause of 15 min by swapping the operation.

**Highlights:** ▶ Ergonomics is essential for developing gender friendly equipment. ▶ 30% of lowest isometric torque enables the farm women for its smooth handling. ▶ Hand cranking speed of 50–55 rpm may be taken for design of equipment. ▶ Development and testing simultaneously are good practice. ▶ Ergonomic designed equipment reduced physiological and economic costs over others.

- **Keywords:** Maize dehusker–sheller; Shelling; Hand cranking

**Cato A. Bjørkli, Kjell I. Øvergård, Conrad Arnfinn Bjørshol, Helge Myklebust, Thomas Hoff. *Effects of socio-emotional stressors on ventilation rate and subjective workload during simulated CPR by lay rescuers. Pages 799-802.***

Several studies have documented the occurrence of high ventilation rates during cardiopulmonary resuscitation, but to date, there have been no scientific investigation of the *causes* of hyperventilation.

The objective of the current study was to test the effects of socio-emotional stressors on lay rescuers' ventilation rate in a simulated resuscitation setting using a manikin model. A within-subjects experiment with randomized order of conditions tested lay rescuers' ventilation rate on an intubated manikin during exposure to socio-emotional stressors

and during a control condition where no external stressors were present. Ventilation rates and subjective workload were significantly higher during exposure to socio-emotional stressors than during the control condition. All but one of the nine participants ventilated at a higher ventilation rate in the experimental condition. All nine participants rated the subjective workload to be higher during exposure to socio-emotional stressors. Hence, exposure to socio-emotional stressors is associated with increased ventilation rates performed by lay rescuers during simulated cardiac arrest using a manikin model. These findings might have implications for the understanding of the type of situations which hyperventilation may occur. Awareness of these situations may have implications for training of lay rescues.

**Highlights:** ▶ Previous studies have found that rescuers deviate from medical guidelines in a resuscitation situation. ▶ This study investigated how socio emotional stress affect performance on a ventilation task in a resuscitation situation. ▶ The study shows that socio emotional stress is associated with high rates of ventilation that exceeds medical guidelines. ▶ Possible implications for training are discussed.

- **Keywords:** Hyperventilation; Simulated CPR; Subjective workload; Socio-emotional stressors

**I. Åkesson, I. Balogh, G.-Å. Hansson. *Physical workload in neck, shoulders and wrists/hands in dental hygienists during a work-day.* Pages 803-811.**

Physical workload was recorded by electromyography, inclinometry and goniometry for twelve female dental hygienists during authentic work. Their work was, in relation to other types of work, characterised by pronounced head flexion (90th percentile 46°), high loads on the forearm extensor muscles (90th percentile 23% and 18% of maximal EMG (MVE), for the right and left sides, respectively), average loads on trapezius muscles (90th percentile 15% and 14% MVE), average arm elevation (99th percentile 83° and 72°) and average wrist flexion and velocities (50th percentiles 17° of extension and 7.3°/s, for the right side). Manual scaling and machinery (use of ultrasonic scaling and hand-pieces) showed higher loads on the trapezius muscles, regarding muscular rest, as well as the 10th and 50th percentiles, than the other tasks, and for the forearm extensor muscles, an almost complete lack of muscular rest (0.1% time), and much higher loads regarding the 10th and 50th percentiles. Further, more pronounced head flexion and lower head and upper arm velocities were found, indicating more constrained postures for the neck and shoulders for the manual scaling and machinery. Use of ultrasonic scaler reduced the 50th percentile loads on the right forearm extensor muscles, but had no effect on the fraction of muscular rest and on the 10th percentile load. These findings are consistent with the high prevalences of musculoskeletal disorders among dental hygienists.

**Highlights:** ▶ Physical workload was recorded for dental hygienists during authentic work. ▶ The head flexion was pronounced (90th percentile 46°). ▶ The load on the forearm extensor muscles was high (90th percentile 23% of maximal EMG). ▶ Manual scaling resulted in lack of rest for the forearm extensor muscles. ▶ The exposure is consistent with the high prevalence of musculoskeletal disorders.

- **Keywords:** Electromyography; Inclinometry; Goniometry