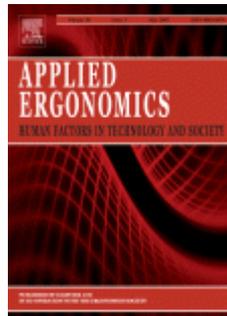


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Maryann H. Long, Venerina Johnston, Fiona Bogossian. *Work-related upper quadrant musculoskeletal disorders in midwives, nurses and physicians: A systematic review of risk factors and functional consequences.* Pages 455-467.

Background: Given a worldwide shortage of primary health care workers predicted to worsen, it is vital to address sources of attrition among these professionals. One such source may be work-related musculoskeletal disorders. We aimed to identify risk factors for and functional consequences of work-related upper quadrant musculoskeletal disorders in midwives, nurses and physicians. **Methods:** Eighteen of 87 studies identified from an electronic database search met the inclusion and quality criteria. **Results:** Job demands, demanding work schedules and physical exposures have the strongest associations with work-related upper quadrant musculoskeletal disorders. Functional consequences included widespread use of prescription and over-the-counter medications and major negative impact on activities of daily living. No studies of midwives were located. **Conclusion:** High-quality studies of midwives as well as better-designed prospective studies of nurses and physicians are needed. Results of such studies could inform preventive strategies and reduce the contribution of work-related musculoskeletal disorders to attrition.

- **Keywords:** Musculoskeletal system/injuries; Health personnel; Risk factors

Sidney Dekker. *Complexity, signal detection, and the application of ergonomics: Reflections on a healthcare case study.* Pages 468-472.

Complexity is a defining characteristic of healthcare, and ergonomic interventions in clinical practice need to take into account aspects vital for the success or failure of new technology. The introduction of new monitoring technology, for example, creates many ripple effects through clinical relationships and agents' cross-adaptations. This paper uses the signal detection paradigm to account for a case in which multiple clinical decision makers, across power hierarchies and gender gaps, manipulate each others' sensitivities to evidence and decision criteria. These are possible to analyze and predict with an applied ergonomics that is sensitive to the social complexities of the workplace, including power, gender, hierarchy and fuzzy system boundaries.

Highlights: ▶ Complexity is a defining characteristic of modern healthcare. ▶ The introduction of new technology often creates reverberations typical of complexity. ▶ Signal detection can be extended to capture the influence that new technology exerts on social and networked complexities. ▶ This includes how multiple interacting and cross-

adapting agents manipulate each others' d' and β . ▶ This raises questions about social order, power, hierarchy, gender and the distribution of resources across a workplace.

- **Keywords:** Musculoskeletal system/injuries; Health personnel; Risk factors

Riley C. Sheehan, Jinger S. Gottschall. *At similar angles, slope walking has a greater fall risk than stair walking.* Pages 473-478.

According to the CDC, falls are the leading cause of injury for all age groups with over half of the falls occurring during slope and stair walking. Consequently, the purpose of this study was to compare and contrast the different factors related to fall risk as they apply to these walking tasks. More specifically, we hypothesized that compared to level walking, slope and stair walking would have greater speed standard deviation, greater ankle dorsiflexion, and earlier peak activity of the tibialis anterior. Twelve healthy, young male participants completed level, slope, and stair trials on a 25-m walkway. Overall, during slope and stair walking, medial-lateral stability was less, anterior-posterior stability was less, and toe clearance was greater in comparison to level walking. In addition, there were fewer differences between level and stair walking than there were between level and slope walking, suggesting that at similar angles, slope walking has a greater fall risk than stair walking.

Highlights: ▶ We investigated the potential fall risk associated with slope and stair walking. ▶ We used variables related to stability and toe clearance to assess fall risk. ▶ Walking on a 33° slope indicated greater fall risk than on 35° stairs.

- **Keywords:** Step length; Step width; Toe clearance; Tibialis anterior

Katrina M. Simpson, Bridget J. Munro, Julie R. Steele. *Does load position affect gait and subjective responses of females during load carriage?* Pages 479-485.

Recreational hikers carry heavy loads while often walking long distances over uneven terrain. Previous studies have suggested that not only the load mass but also the position of the load may influence load carriage. The purpose of this study was to determine the effect of vertical load position on gait and subjective responses of female recreational hikers. Fifteen experienced female hikers walked for 2 km over a simulated hiking trail carrying 30% BW in three vertical load positions (high, medium and low). Lower limb and trunk kinematic, electromyography (EMG) and ground reaction force (GRF) data were collected together with heart rate (HR), ratings of perceived exertion (RPE) and discomfort measures. Although HR, RPE and discomfort measures were not able to discern statistical differences between load positions, the high load position was the most preferred by participants. The high load position also resulted in a more upright posture ($p < 0.001$), decreased gastrocnemius integrated EMG compared to the medium ($p = 0.005$) and low load positions ($p = 0.02$) and a higher first peak deceleration vertical GRF compared to the low load position ($p = 0.011$). However, the absolute differences were small and unlikely to be functionally relevant in load carriage studies. Based on the findings of this study, a high, medium or low load position cannot be preferentially recommended for healthy, experienced, female hikers carrying 30% BW.

- **Keywords:** Load carriage; Gait; Walking; Backpack; Biomechanics; Load position

Luca Minin, Simone Benedetto, Marco Pedrotti, Alessandra Re, Francesco Tezauru. *Measuring the effects of visual demand on lateral deviation: A comparison among driver's performance indicators.* Pages 486-492.

In this study we compare the efficacy of three driver's performance indicators based on lateral deviation in detecting significant on-road performance degradations while interacting with a secondary task: the *High Frequency Component of steering wheel* (HFC), and two indicators described in [ISO/DIS 26022 \(2007\)](#): the *Normative* and the *Adapted Lane Change Test (LCT)*. Sixteen participants were asked to perform a simulated lane-change task while interacting, when required, with a visual search task with two levels of difficulty.

According to predictions, results showed that the *Adapted LCT* indicator, taking into consideration individual practices in performing the LCT, succeeded in discriminating between single and dual task conditions. Furthermore, this indicator was also able to detect whether the driver was interacting with an easy or a difficult secondary task. Despite predictions, results did not confirm *Normative LCT* and HFC to be reliable indicators of performance degradation within the simulated LCT.

Highlights: ▶ We compared three indicators in detecting drivers' impairment in single and dual tasks. ▶ Two indicators based on lateral deviation – Adapted and Normative LCT – ISO/DIS26022. ▶ One indicator based on steering wheel variation (HFC). ▶ Adapted LCT discriminated drivers' lateral impairment between single and dual task. ▶ Normative LCT and HFC were not reliable indicators of lateral degradation.

- **Keywords:** Driving performance measures; Lane change test; Visual workload

Aleksandra Browne, Leonard O'Sullivan. A medical hand tool physical interaction evaluation approach for prototype testing using patient care simulators. Pages 493-500.

The purpose of this study was to develop and test a physical ergonomics assessment approach for medical device handles. The method assesses wrist posture and force of exertion simultaneously by task element. Electrogoniometers and EMG sensors were connected through a data acquisition module for synchronization with video recordings of trials. Task analysis of video recordings were performed offline with Observer XT software. Average posture and force data across several repetitions of individual task elements were calculated and presented in a format suitable for informing product designers of specific issues during a test trial. A handle comfort questionnaire is proposed to survey subjective responses. The evaluation approach was applied to an endoscope needle in sampling a biopsy from the stomach wall using a gastrointestinal track simulator with ten physician surrogates. The results showed that for all task elements the wrist was in extension (33°–45°). Peak muscle forces ranged from 28% to 68% MVC across the three muscles studied. Muscle peak forces were above ACGIH HAL maximum threshold limits for four of the seven task elements, and above the action limit for all seven task elements for two muscles. The handle comfort questionnaire data also supported the high muscle force findings, and also on force distribution on the handle due to contact stresses. This combined approach could be used to collect and report detailed early stage ergonomics data from user trials on patient care simulators. The approach is proposed for use by medical device designers at the design stage of new products using prototypes, but it could also be used on existing products with real patients.

Highlights: ▶ An integrated approach to report muscle activity and wrist postures for steps of a medical procedure. ▶ The ergonomic study of an echoendoscope medical device using a patient simulator. ▶ The trailing of a user feedback handle design questionnaire for a medical device design.

- **Keywords:** Medical device design; Upper limb forces; Posture; Integrated measurement

Annika F.L. Larsson. *Driver usage and understanding of adaptive cruise kontrol.* Pages 501-506.

Automation, in terms of systems such as adaptive/active cruise control (ACC) or collision warning systems, is increasingly becoming a part of everyday driving. These systems are not perfect though, and the driver has to be prepared to reclaim control in situations very similar to those the system easily handles by itself. This paper uses a questionnaire answered by 130 ACC users to discuss future research needs in the area of driver assistance systems. Results show that the longer drivers use their systems, the more aware of its limitations they become. Moreover, the drivers report that ACC forces them to take control intermittently. According to theory, this might actually be better than a more perfect system, as it provides preparation for unexpected situations requiring the driver to reclaim control.

Highlights: ▶ We issued a questionnaire study to 130 drivers to see how they use ACC. ▶ Drivers who had the system over a year are much more aware of limitations. ▶ ACC forces drivers to take control intermittently, which may be beneficial to safety.

- **Keywords:** ACC; ADAS; Drivers; Transfer of control; Learning; Questionnaire

Annie Rydström, Robert Broström, Peter Bengtsson. *A comparison of two contemporary types of in-car multifunctional interfaces.* Pages 507-514.

A driving simulator study was conducted to investigate the effects of carrying out a variety of tasks using two different types of contemporary in-car multifunctional interfaces: a touch screen interface and an interface manoeuvred by a rotary control. Participants drove on a curved rural road while performing tasks such as list scrolling, radio tuning, alphanumeric input and continuous adjustments. The results indicate that, in terms of task completion time and the number of glances made to the display, the optimal interface is dependent on the task being performed. The touch screen interface was better for alphanumeric input tasks and the interface manoeuvred by a rotary control was better for continuous adjustments and list scrolling. Alphanumeric input seems to be more demanding than other tasks, independent of the interface used. It was apparent in this simulator study that both interfaces affected the lateral control performance, but lateral control performance deteriorated to a greater extent when the touch screen interface was used, probably partially as a result of the lower display position.

Highlights: ▶ We compared to types of in-car interfaces – touch screen and rotary control. ▶ Participants carried out tasks with the interfaces while driving a car simulator. ▶ Touch screen is more efficient for alphanumeric input tasks. ▶ Rotary control is more efficient for continuous adjustments and list scrolling. ▶ Touch screen affected lateral control performance to a greater extent.

- **Keywords:** Secondary task; Multifunctional interface; Touch screen; Rotary control

Rita Cordovil, Filomena Vieira, João Barreiros. *Crossing safety barriers: Influence of children's morphological and functional variables.* Pages 515-520.

Thirty-three children between 3 and 6 years of age were asked to climb four different types of safety barriers. Morphological and functional variables of the children, which were expected to influence climbing or passing through skills, were collected. The influence of those variables on children's success rate and time to cross was tested. No barrier offered a total restraining efficacy. The horizontal bars barrier was crossed by 97% of the children. In the group of children that succeeded in crossing the four barriers, mean time to cross the most difficult barrier was 15 s. Age was the best predictor for success in crossing most barriers but morphology and strength were important predictors of time to cross. The influence of anthropometric variables in time to cross was dependent upon the characteristics of the barrier. A good design of safety barriers should consider children's age, morphology and strength.

Highlights: ▶ The efficacy of safety barriers for children was investigated. ▶ No barriers are childproof and best climbers cross them in a few seconds. ▶ Age is the best predictor for success in crossing most safety barriers. ▶ Morphology and strength are good predictors of time to cross safety barriers. ▶ Design of safety barriers should consider children's age, morphology and strength.

• **Keywords:** Climbing; Safety barriers; Child

Tilak Dutta, Pamela Jean Holliday, Susan Margaret Gorski, Mohammad Sadeqh Baharvandy, Geoff Roy Hernie. *A biomechanical assessment of floor and overhead lifts using one or two caregivers for patient transfers.* Pages 521-531.

This study investigated the differences in peak external hand forces and external moments generated at the L5/S1 joint of the low back due to maneuvering loaded floor-based and overhead-mounted patient lifting devices using one and two caregivers. Hand forces and external moments at the L5/S1 joint were estimated from ground reaction forces and motion capture data. Caregivers gave ratings of perceived exertion as well as their opinions regarding overhead vs. floor lifts. Use of overhead lifts resulted in significantly lower back loads than floor lifts. Two caregivers working together with a floor lift did not reduce loads on the primary caregiver compared to the single-caregiver case. In contrast, two-caregiver operation of an overhead lift did result in reduced loads compared to the single-caregiver case. Therefore, overhead lifts should be used whenever possible to reduce the risk of back injury to caregivers. The use of two caregivers does not compensate for the poorer performance of floor lifts.

• **Keywords:** Patient handling; Patient lifting; Safe patient handling

Jenni Raines, Rodney Snow, Aaron Petersen, Jack Harvey, David Nichols, Brad Aisbett. *Pre-shift fluid intake: Effect on physiology, work and drinking during emergency wildfire fighting.* Pages 532-540.

Wildfire fighters are known to report to work in a hypohydrated state, which may compromise their work performance and health.

Purpose

To evaluate whether ingesting a bolus of fluid before the shift had any effect on firefighters' fluid consumption, core temperature, or the time they spent in high heart rate and work activity zones when fighting emergency wildfires.

Methods

Thirty-two firefighters were divided into non-bolus (AD) and pre-shift drinking bolus (PS, 500 ml water) groups.

Results

Firefighters began work hypohydrated as indicated by urine colour, specific gravity and plasma osmolality (P_{osm}) results. Post-shift, firefighters were classified as euhydrated according to P_{osm} and hypohydrated by urinary markers. No significant differences existed between the drinking groups in pre- or post-shift hydration status, total fluid intake, activity, heart rate or core temperature.

Conclusion

Consuming a bolus of fluid, pre-shift provided no benefit over non-consumption as both groups had consumed equivalent ad libitum volumes of fluid, 2.5 h into the shift. No benefits of bolus consumption were observed in firefighter activity, heart rate response or core temperature response across the shift in the mild weather conditions experienced. Ad libitum drinking was adequate to facilitate rehydration in firefighters upon completion of their emergency firefighting work shift.

- **Keywords:** Hydration; Thermoregulation; Cardiovascular strain

L.B.de M. Guimarães, M.J. Anzanello, J.S. Renner. *A learning curve-based method to implement multifunctional work teams in the Brazilian footwear sector.* Pages 541-547.

This paper presents a method for implementing multifunctional work teams in a footwear company that followed the Taylor/Ford system for decades. The suggested framework first applies a Learning Curve (LC) modeling to assess whether rotation between tasks of different complexities affects workers' learning rate and performance. Next, the Macroergonomic Work Analysis (MA) method (Guimarães, 1999, 2009) introduces multifunctional principles in work teams towards workers' training and resources improvement. When applied to a pilot line consisting of 100 workers, the intervention-reduced work related accidents in 80%, absenteeism in 45.65%, and eliminated work related musculoskeletal disorders (WMSD), medical consultations, and turnover. Further, the output rate of the multifunctional team increased average 3% compared to the production rate of the regular lines following the Taylor/Ford system (with the same shoe model being manufactured), while the rework and spoilage rates were reduced 85% and 69%, respectively.

Highlights: ▶ We model workers' learning process to implement a multifunctional work system. ▶ The method reduced work related accidents, absenteeism and musculoskeletal disorders. ▶ The output rate of multifunctional teams increased compared to traditional teams.

- **Keywords:** Learning curve; Multifunctional system; Teamwork; Shoe manufacturing

D.J. Xiao, Jack J. Jakimowicz, A. Albayrak, R.H.M. Goossens. *Ergonomic factors on task performance in laparoscopic surgery training.* Pages 548-553.

This paper evaluates the effect of ergonomic factors on task performance and trainee posture during laparoscopic surgery training. Twenty subjects without laparoscopic experience were allotted into 2 groups. Group 1 was trained under the optimal ergonomic

simulation setting according to current ergonomic guidelines (Condition A). Group 2 was trained under non-optimal ergonomic simulation setting that can often be observed during training in a skills lab (Condition B). Posture analysis showed that the subjects held a much more neutral posture under Condition A than under Condition B ($p < 0.001$). The subjects had less joint excursion and experienced less discomfort in their neck, shoulders, and arms under Condition A. Significant difference in task performance between Conditions A and B ($p < 0.05$) was found. This study shows that the optimal ergonomic simulation setting leads to better task performance. In addition, no significant differences of task performance, for Groups 1 and 2 using the same test setting were found. However, better performance was observed for Group 1. It can be concluded that the optimal and non-optimal training setting have different learning effects on trainees' skill learning.

Highlights: ▶ We evaluate the effect of ergonomic factors on task performance and trainee posture. ▶ The subjects hold more neutral posture under optimal ergonomic setting. ▶ The optimal ergonomic setting leads to better task performance. ▶ The optimal and non-optimal settings have different effects on trainees' learning.

• **Keywords:** Ergonomics; Laparoscopy; Simulator; Task performance

Erin M. Eatough, Jason D. Way, Chu-Hsiang Chány. *Understanding the link between psychosocial work stressors and work-related musculoskeletal complaints. Pages 554-563.*

It is well established that psychosocial work stressors relate to employees' work-related musculoskeletal disorder (WRMSD) symptoms. Using a model investigating psychological strain as a mediator between work stressors and WRMSD complaints, this study demonstrated that high levels role conflict, low job control, and low safety-specific leadership are associated with increased employee strain. Strain, in turn, was related to higher levels of WRMSD symptoms of the wrist/hand, shoulders, and lower back. Partial mediation of some relationships was also found, suggesting that additional mediational mechanisms for the relationships between stressors and musculoskeletal symptoms are plausible. This work supports the notion that psychosocial stressors in the work environment have important links to employee health, especially WRMSDs.

Highlights: ▶ We test a model investigating psychological strain as a mediator between work stressors and WRMSDs. ▶ Role conflict, low job control, and low safety-specific leadership are related to employee strain. ▶ Strain is related to higher levels of WRMSD symptoms of the wrist/hand, shoulders, and lower back. ▶ Psychosocial stressors in the workplace have important links to WRMSDs.

• **Keywords:** Work-related musculoskeletal disorders; Occupational stress; Strain

Kristie L. Young, Christina M. Rudin-Brown, Michael G. Lenné, Amy R. Williamson. *The implications of cross-regional differences for the design of In-vehicle Information Systems: A comparison of Australian and Chinese drivers. Pages 564-573.*

The increasing global distribution of automobiles necessitates that the design of In-vehicle Information Systems (IVIS) is appropriate for the regions to which they are being exported. Differences between regions such as culture, environment and traffic context can influence the needs, usability and acceptance of IVIS. This paper describes two studies aimed at identifying regional differences in IVIS design needs and preferences

across drivers from Australia and China to determine the impact of any differences on IVIS design. Using a questionnaire and interaction clinics, the influence of cultural values and driving patterns on drivers' preferences for, and comprehension of, surface- and interaction-level aspects of IVIS interfaces was explored. Similarities and differences were found between the two regional groups in terms of preferences for IVIS input control types and labels and in the comprehension of IVIS functions. Specifically, Chinese drivers preferred symbols and Chinese characters over English words and were less successful (compared to Australians) at comprehending English abbreviations, particularly for complex IVIS functions. Implications in terms of the current trend to introduce Western-styled interfaces into other regions with little or no adaptation are discussed.

Highlights: ▶ Differences existed across the two regions in IVIS preferences and comprehension. ▶ Chinese drivers preferred symbols and Chinese characters over English words. ▶ Chinese drivers were less successful at comprehending complex English abbreviations. ▶ Introducing Western IVIS into China with limited adaptation is problematic.

- **Keywords:** Cross-cultural design; In-vehicle Information Systems; Human machine interface

Seung-Nam Min, Jung-Yong Kim, Mohamad Parnianpour. *The effects of safety handrails and the heights of scaffolds on the subjective and objective evaluation of postural stability and cardiovascular stress in novice and expert construction workers.* Pages 574-581.

Work performed on scaffolds carries the risk of falling that disproportionately threatens the safety and health of novice construction workers. Hence, objective measures of the postural stability, cardiovascular stress, and subjective difficulty in maintaining postural balance were evaluated for four expert and four novice construction workers performing a manual task in a standing posture on a scaffold with and without safety handrails at two different elevation heights. Based on a multivariate analysis of variance, the experience, scaffold height, and presence of a handrail were found to significantly affect measures of the postural stability and cardiovascular stress. At a lower level of worker experience, a higher scaffold height, and in the absence of a handrail (which may correspond to higher risk of a fall), postural stability was significantly reduced, while cardiovascular stress and subjective difficulties in maintaining postural balance increased. We emphasize the importance of training and handrails for fall prevention at construction sites.

Highlights: ▶ We studied postural stability and cardiovascular stress in construction worker. ▶ In the higher scaffold height, stability was reduced. ▶ In the absence of a handrail, postural stability was reduced. ▶ We emphasize the importance of training and handrails for fall prevention.

- **Keywords:** Postural stability; Cardiovascular stress; Construction scaffold

Hilko Ehmen, Marten Haesner, Ines Steinke, Mario Dorn, Mehmet Gövercin, Elisabeth Steinhagen-Thiessen. *Comparison of four different mobile devices for measuring heart rate and ECG with respect to aspects of usability and acceptance by older people.* Pages 582-587.

In the area of product design and usability, most products are developed for the mass-market by technically oriented designers and developers for use by persons who themselves are also technically adept by today's standards. The demands of older people are commonly not given sufficient consideration within the early developmental process.

In the present study, the usability and acceptability of four different devices meant to be worn for the measurement of heart rate or ECG were analyzed on the basis of qualitative subjective user ratings and structured interviews of twelve older participants. The data suggest that there was a relatively high acceptance concerning these belts by older adults but none of the four harnesses was completely usable. Especially problematic to the point of limiting satisfaction among older subjects were problems encountered while adjusting the length of the belt and/or closing the locking mechanism. The two devices intended for dedicated heart rate recording yielded the highest user ratings for design, and were clearly preferred for extended wearing time. Yet for all the devices participants identified several important deficiencies in their design, as well as suggestions for improvement. We conclude that the creation of an acceptable monitoring device for older persons requires designers and developers to consider the special demands and abilities of the target group.

Highlights: ▶ In this study we measured the usability of four devices meant to be worn for the measurement of heart rate or ECG. ▶ Results based upon qualitative subjective user ratings and structured interviews. ▶ The participant had to decide which system he is willing to wear for three hours. ▶ Majority of problems were observed by closing the locking mechanism. ▶ The subjective ratings show a clear demand by older persons for an inconspicuous belt.

• **Keywords:** Usability test; Consumer satisfaction; Physiologic monitoring

Frédéric Dehais, Mickaël Cause, François Vachon, Sébastien Tremblay. *Cognitive conflict in human-automation interactions: A psychophysiological study.* Pages 588-595.

The review of literature in sociology and distributed artificial intelligence reveals that the occurrence of conflict is a remarkable precursor to the disruption of multi-agent systems. The study of this concept could be applied to human factors concerns, as man-system conflict appears to provoke perseveration behavior and to degrade attentional abilities with a trend to excessive focus. Once entangled in such conflicts, the human operator will do anything to succeed in his current goal even if it jeopardizes the mission. In order to confirm these findings, an experimental setup, composed of a real unmanned ground vehicle, a ground station is developed. A scenario involving an authority conflict between the participants and the robot is proposed. Analysis of the effects of the conflict on the participants' cognition and arousal is assessed through heart-rate measurement (reflecting stress level) and eye-tracking techniques (index of attentional focus). Our results clearly show that the occurrence of the conflict leads to perseveration behavior and can induce higher heart rate as well as excessive attentional focus. These results are discussed in terms of task commitment issues and increased arousal. Moreover, our results suggest that individual differences may predict susceptibility to perseveration behavior.

Highlights: ▶ Conflict is a precursor of the degradation of human-system interactions. ▶ A conflict is induced between an unmanned ground vehicle and volunteers. ▶ Conflict provokes perseveration behavior, attentional shrinking and physiological stress. ▶ Individual differences may predict susceptibility to perseveration behavior.

- **Keywords:** Human-automation conflicts; Robotic; Perseveration behavior; Attentional shrinking; Eye tracking; Physiological measurement

Reuven Sussman, Robert Gifford. *Please turn off the lights: The effectiveness of visual prompts.* Pages 596-603.

Two early studies showed that visual prompts can be effectively used to encourage people to turn off the lights in unoccupied classrooms, but they were methodologically limited. The current study used an ABAB-B design with an 11-week follow-up to investigate whether two different visual prompts (large and small signs) could be employed to increase "lights off" behaviour in 17 unoccupied washrooms. The odds were eight times higher that lights would be turned off in washrooms with signs than washrooms without, and large signs trended toward being more effective than small signs. Signs in washrooms with windows appeared to be the most effective, but this finding merits further research. Behaviour change persisted throughout the follow-up period, but reactance by a single washroom user resulted in some signs being removed. Compared to previous research, the current study used an improved methodology with a larger number of study sites. This study demonstrated that a simple, well-designed sign can effectively encourage energy conservation.

Highlights: ▶ We changed our data analysis approach and significantly revised our results section. ▶ We added a section to the discussion addressing electricity and cost savings. ▶ We revised our discussion of limitations to include the reviewer's comments. ▶ We included a brief description of preliminary sign designs.

- **Keywords:** Visual prompts; Lights; Energy conservation; Environmental psychology; Signs

David I. Douphrate, Nathan B. Fethke, Matthew W. Nonnenmann, John C. Rosecrance, Stephen J. Reynolds. *Full shift arm inclinometry among dairy parlor workers: A feasibility study in a challenging work environment.* Pages 604-613.

Over the last 20 years, the US dairy industry has experienced a significant transformation from small farm operations to an industrialization of the milking process. This transformation has resulted in improvements in process efficiency and product quality. Milking tasks in large-herd parlors are highly-repetitive involving awkward postures and high muscle loads of the upper extremity. Field-based direct measures of physical exposures have been limited in challenging work settings such as dairies. This study evaluated full-shift exposures of posture and motion of the upper extremity among large-herd parlor milkers using wireless inclinometry. Results suggest large-herd parlor workers may be exposed to high exposure levels (posture, movement velocity, repetition, and inadequate rest) associated with the development of shoulder pathology. Compared to other high-risk occupations involving shoulder-intensive work, parlor workers may have higher exposure levels. These findings warrant the need for continued field-based research with larger sample sizes to facilitate the development of cost-effective intervention strategies.

- **Keywords:** Work-related musculoskeletal disorders; Exposure assessment; Agriculture

J.A. Rose, C. Barman. *Making effective use of task analysis to identify human factors issues in new rail technology.* Pages 614-624.

Task analysis is an important tool that enables designers to consider the human factors implications of a new technology. This paper details a task analysis for the task of driving long-haul freight trains in Australia and describes how this task analysis was used to evaluate a new in-cab information support technology. This paper then explores similarities and differences between this task analysis and one proposed by [Roth and Multer \(2009\)](#). It is argued that these two task analyses can form the basis for many future task analyses so that we can avoid 'reinventing the wheel,' allowing us to focus more on potential interesting differences between operations and geographical locations.

Highlights: ▶ We provide a detailed task analysis of long-haul train driving. ▶ We use task analysis to evaluate a new in-cab information support technology. ▶ We compare the Australian freight train driving task with US passenger train driving.

• **Keywords:** Task analysis; Train driving; Technology

Benjamin C. Amick III, Cammie Chaumont Menéndez, Lianna Bazzani, Michelle Robertson, Kelly DeRango, Ted Rooney, Anne Moore. *A field intervention examining the impact of an office ergonomics training and a highly adjustable chair on visual symptoms in a public sector organization.* Pages 625-631.

Objective

Examine the effect of a multi-component office ergonomics intervention on visual symptom reductions.

Methods

Office workers were assigned to either a group receiving a highly adjustable chair with office ergonomics training (CWT), a training-only group (TO) or a control group (C). A work environment and health questionnaire was administered 2 and 1 month(s) pre-intervention and 3, 6, and 12 months post-intervention. Multi-level statistical models tested hypotheses.

Results

The CWT intervention lowered daily visual symptoms ($p < 0.01$) post-intervention. The TO group did not significantly differ from the control group. The CWT group differed significantly from the TO group ($p = 0.01$) post-intervention.

Conclusion

Workers who received a highly adjustable chair and office ergonomics training had reduced visual symptoms and the effect was maintained through twelve months post-intervention. The lack of a training-only group effect supports implementing training in conjunction with the highly adjustable chair to reduce visual symptoms.

Highlights: ▶ There remains little intervention research on how to improve visual health. ▶ A highly adjustable chair with an office ergonomics training reduced visual symptoms. ▶ Symptom reduction was maintained through 12 months of follow-up. ▶ Office ergonomics training alone did not reduce visual symptoms. ▶ There is a need for replication studies.

• **Keywords:** Office ergonomics intervention; Visual symptoms; Multi-level modeling

Sara Dockrell, Eleanor O'Grady, Kathleen Bennett, Clare Mullarkey, Rachel Mc Connell, Rachel Ruddy, Seamus Twomey, Colleen Flandery. *An investigation of the reliability of Rapid Upper Limb Assessment (RULA) as a method of assessment of children's computing posture. Pages 632-636.*

Rapid Upper Limb Assessment (RULA) is a quick observation method of posture analysis. RULA has been used to assess children's computer-related posture, but the reliability of RULA on a paediatric population has not been established. The purpose of this study was to investigate the inter-rater and intra-rater reliability of the use of RULA with children. Video recordings of 24 school children were independently viewed by six trained raters who assessed their postures using RULA, on two separate occasions. RULA demonstrated higher intra-rater reliability than inter-rater reliability although both were moderate to good. RULA was more reliable when used for assessing the older children (8–12 years) than with the younger children (4–7 years). RULA may prove useful as part of an ergonomic assessment, but its level of reliability warrants caution for its sole use when assessing children, and in particular, younger children.

Highlights: ▶ Rapid Upper Limb Assessment (RULA) is a moderately reliable tool for use in the assessment of children's computing posture. ▶ RULA demonstrated higher intra-rater reliability than inter-rater reliability. ▶ RULA was more reliable for assessment of older children than younger children.

• **Keywords:** Reliability; RULA; Posture; Children

W. Vaughn McCall, Niki Boggs, Alan Letton. *Erratum to "Changes in sleep and wake in response to different sleeping surfaces: A pilot study" [Appl. Ergon. (43/2) 386–391]. Pages 637.*