

Focus on IFA's work

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Musculoskeletal workloads during pulling and pushing hospital beds and wheelchairs

Problem

Nursing professions need to be organized to make them more attractive, not least in view of the ageing of society and the fear of a shortage of nursing personnel. This includes analysis of impairing physical stress that may arise, and proposals for how it can be avoided if at all possible or reduced. Nursing staff in hospitals and in the community are exposed to a wide range of physical stresses. Persons requiring nursing care must for example be turned, raised and supported. Equipment to reduce the strain upon the spine during these tasks (such as sliding mats and lifting and transfer aids) is being developed, information is being produced on procedures that reduce the stress upon the back (DGUV Information 207-008, Nienhaus, 2014), and courses are available in special work techniques for avoiding back stress. The extent to which the body is subjected to stress specifically during pulling and pushing of hospital beds and wheelchairs has not been extensively studied before now. A pilot study was therefore conducted in order to determine the hand forces arising during these tasks, in order to permit estimation of the forces acting upon the spine based on the results.

Activities

In order for the scale of musculoskeletal workloads associated with the pulling and pushing of hospital beds and wheelchairs to be estimated, a number of pushing and pulling tasks were simulated in a laboratory study. For the purpose of testing, ten



Body posture measurement system and dummy in a wheelchair during travel over a ramp (top). Force measurement handles on the bed and wheelchair (bottom)

subjects moved a standard hospital bed and a wheelchair over a number of routes. These included pushing and pulling in a straight line, manoeuvring in a room, and negotiating a step and a ramp with the wheelchair.

Dummies of different weights were used to simulate a range of patient weights during the tests. The required parameters by means of which stress in the lumbar spine region (L5/S1) can

be estimated were recorded by means of force measurement handles and the CUELA body posture measurement system developed at the IFA (Ellegast et al., 2010).

Results and application

During the initial pulling phase, the torques and compression forces attained considerably higher values than during the remainder of the movement. This can plausibly be explained by unfavourable body postures. The "Dortmunder" guideline values (Jäger et al., 2001) were however attained or exceeded only at single maximum values during pulling of the bed (with dummy weights of 80 kg and 100 kg) in the initial phase and during overcoming of a rising step with the wheelchair. The results of this study show that high stresses in the lumbar spine region are not necessarily apparent from the body posture alone. High diagonal forces and torques can in some cases be quantified only by means of resource-intensive measurement methods such as the use of force measurement handles; for detailed calculation of the torques and compression forces on L5/S1, a complex muscle model with an elaborate biomechanical model calculation is also required. The values determined in the study can serve as input values for such biomechanical models.

The high stress values arising in some cases during the start phases and during negotiation of the ramp and step demonstrate the need for teamwork and for training of employees in handling and the procedure to be followed during pulling and pushing of heavy loads. They also underline the need for building design measures for the reduction of physical stresses upon nursing personnel and for the assurance of accessibility.

Area of Application

German Social Accident Insurance Institution for the health and welfare services; nursing institutions

Additional information

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Expert assistance

IFA, Division 4: Ergonomics – Physical Environmental Factors

Literature requests

IFA, Central Division