

# **Ergonomics in Hygiene Products The Influence of Pad Design on Caregiver Back Load and Perception of Physical Exertion**

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## **Abstract**

*Modern pad designs are complex constructions that can both absorb and contain large quantities of fluid together with improved odour control while at the same time giving improved user (patient) comfort and dignity. The results from this study shows, however, that pad design also is an important issue for the caregiver by making pad change easier, less time consuming and with improved work postures for the lower back.*

## **Keywords**

Hygiene products, Pad design, Nursing personnel, Lower back load

## **1 INTRODUCTION**

About 20% of the employed women in Sweden work as registered nurses, assistant nurses, attendants in psychiatric care, home care workers or as assistants for mentally retarded. The prevalence of low back symptoms during the 12 previous months among nursing personnel varies between 37 to 70% (Josephson, 1998). Work posture, incorrect lifting of objects or persons, and similar physical strains, are some of the factors associated with back injuries and disorders. One of the most stressful patient handling tasks for nurses have been found to be transfer between bed and wheelchair, and toilet and wheelchair. Also the pulling and turning of patients in bed, and the resulting load on the torso has been explained as a possible cause for a high incidence of low back pain. Risks in the environment such as lack of space, lack of transfer devices, lack of information and training of transfer techniques are contributing factors sometimes leading the personnel to perform their task in a risky way (Engkvist, 1997; 1999).

### **1.1 Hygiene products**

During the last two decades a lot of attention has been paid to ergonomics in nursing personnel every day work. Considerably less focus has been on the ergonomics of many of the products used by nursing personnel in care-giving situations. An example of common products are hygiene products, such as pads. Design related features of the pad, such as overall shape and form, type and form of the adhesive tapes used, may

alone or together complicate work for the care-giver. Depending on the situation, the position, disability and the motoric skills of the patient, changing pads often require that the caregiver must adapt the body posture and the physical strength exerted to the situation at hand. To reduce the physical load and/or to make the work less time consuming for a single caregiver, two care-givers can together perform the work.

Modern pad designs are complex constructions. This has resulted in a product that can both absorb and contain large quantities of fluid with improved odour control while at the same time giving improved user (patient) comfort and dignity. It would be no overstatement to say that the design process hitherto has primarily been focused on the technical qualities of the pad together with the patient comfort in mind. However, in this study, three pads from a Swedish company will be evaluated from a user/caregiver point of view.

## 1.2 Aim

The aim of the present study has been to evaluate the influence of pad design on caregiver lower back load and subjective responses of physical exertion during pad change with three pad designs on a patient in typical work situations.

## 2 MATERIAL AND METHODS

Ten healthy females, employed by a Swedish company doing surveys for the Swedish Drug Industry, participated as subjects in the study. All had previous experience of work with patients as nursing personnel in hospitals.

### 2.1 Experimental design

The study was performed in a laboratory setting using a standard hospital bed with adjustable bed height. The subjects were assigned to change pads on a patient that was in a lying and/or standing position. The work was performed without and with assistance, respectively. Three pads in the TENA-line from SCA Hygiene Products within the Swedish SCA Group, were used. The pads used were TENA flex, comfort and slip, see Figure 1. TENA flex is the latest pad in the TENA-line and was introduced during the summer of 2002. Of the features incorporated in this design, that stand out from previous designs, is an integrated waist belt, which is claimed to offer easier fixation/handling routines. TENA comfort is by comparison the oldest design of the three examined pads. It is a disposable body shaped pad and is used together with a separate fixating pant. TENA slip is an all-in-one-protection pad specifically designed for demanding patients lying down. The most outstanding feature of this design is four adhesive tape slips which are used to secure the positioning of this pad.



Figure 1. Pad designs used in the study.

The following measurements were recorded during and/or after the completion of each of the different work cycles: 1. work cycle time, 2. lower back posture and 3. ratings of perceived physical exertion.

The time for the subjects to complete each of the work cycles was measured with a stop watch and the time in seconds was registered. For recording of lower back posture during performance of the work cycles a video system containing four video cameras was used. The pictures were stored on video tape for subsequent analysis. Lower back forward flexion was calculated by measurement of time duration in three forward flexion angle sectors, 0 - 30°, 30 - 60° and 60 - 90°. Also, the cumulative time duration for occurrence of simultaneous lower back forward flexion/rotation was measured. For each working position, the subjects were asked to rank each of the three used pads in which order, between one to three, they perceived most favourable from a physical work load point of view.

## 2.2 Statistical evaluation

The results for the parametric variables were tested statistically by means of ANOVA (Repeated Measures Design) and the nonparametric variables by using the Kruskal-Wallis test. Differences between results were considered significant if  $p \leq 0.05$ .

## 3 RESULTS

Mean work cycle time differed significantly between the three pad designs, between work without and with assistance and between work with patient in lying and standing positions, see Figure 2 and Table 1. Comfort had the fastest work cycle time while slip had the longest. Slip was the pad design that gained the most by changing from work without assistance to work with assistance.

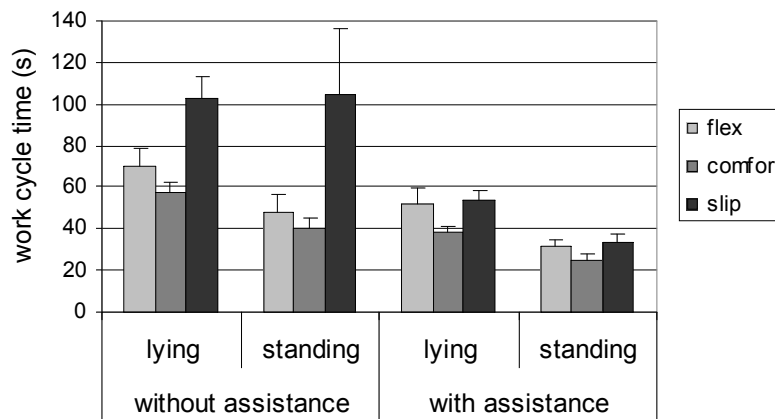


Figure 2. Mean work cycle time  $\pm$  one standard deviation in seconds (s).

The results for lower back mean forward flexion can be viewed in Figure 3 and Table 1. Using flex required significantly less lower back mean forward flexion compared to the other two pad designs. Compared to flex, using comfort and slip, increased mean forward flexion between 12 to 44% and 12 to 27%, respectively.

The results for the mean time duration of lower back combined forward flexion/rotation is presented in Figure 4 and Table 1. Flex showed significantly shorter time duration in flexion/rotation compared to the other two pad designs. Using comfort, the time duration (s) was increased by 3 to 88 % compared to flex. Using slip, the time

duration increased by 51 to 387 % compared to flex. For slip, pad change without assistance and with the patient in a standing position required combined flexion/rotation during more than 50 % of the work cycle time.

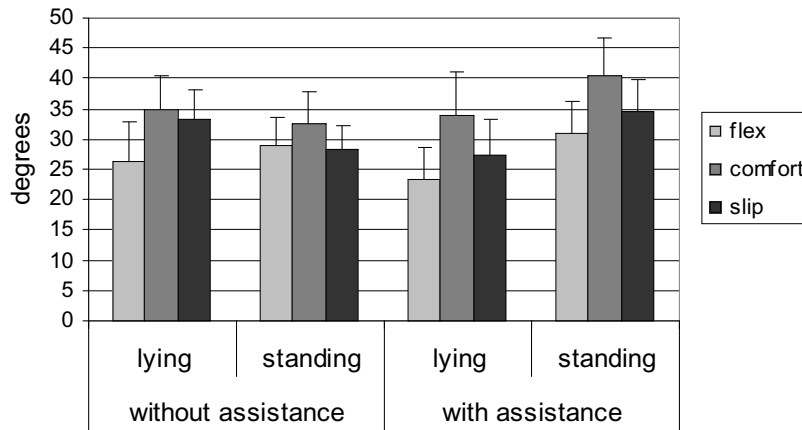


Figure 3. Lower back mean forward flexion  $\pm$  one standard deviation in degrees.

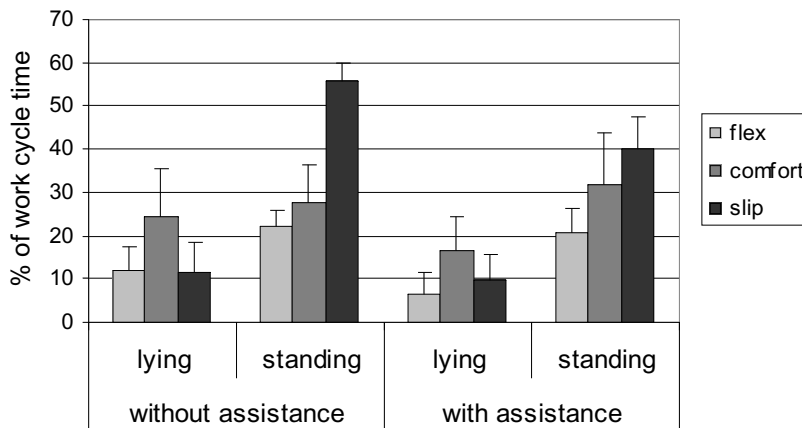


Figure 4. Mean time duration  $\pm$  one standard deviation in % of the work cycle time for lower back combined flexion/rotation.

The results of the ranking of pad design by way of rating of physical exertion can be viewed in Figure 5. Using flex and comfort, 80% of the subjects experienced some level of discomfort from the lower back while using slip, all of the subjects experienced discomfort in the lower back. Using slip, between 10 to 40 % of the subjects also experienced perceived discomfort in the shoulders, knees and wrists. The differences in ranking, using the Kruskal-Wallis test for analysis of variance of nonparametric variables showed a significant difference ( $p < 0.001$ ) between the three pad designs

Table 1.

Summary of ANOVA for the parametric variables

Independent variables	Dependent variables			
	work cycle time	forward flexion	flexion/rotation	significances
Main effects				
assistance	<0.001*	0.336	<0.001*	2
pad design	<0.001*	<0.001*	<0.001*	3
position	<0.001*	0.007*	<0.001*	3
Interactions				
pad x ass	<0.001*	0.243	<0.001*	2
pad x pos	0.045*	0.258	<0.001*	2
pos x ass	0.199	<0.001*	<0.001*	2
pad x ass x pos	0.016*	0.311	<0.001*	2
R Squared	0.851	0.412	0.898	
significances	6	3	7	16

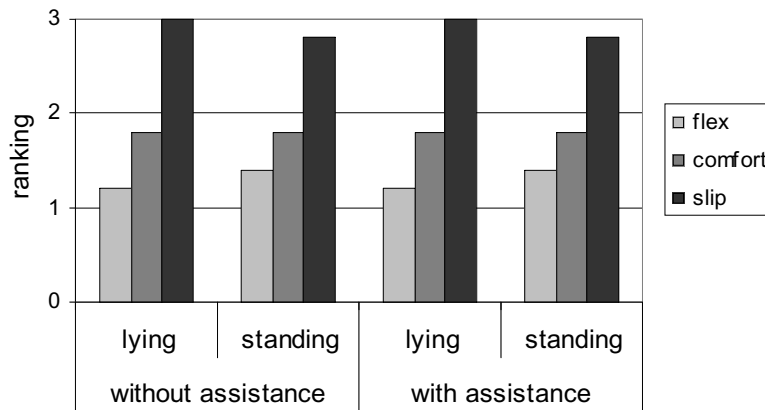


Figure 5. Mean of ranks of pad design by way of rating of perceived exertion.

## 4 DISCUSSION

Changing pads on patients is a routine work task performed by nursing personnel several times, both at regular and irregular time points, during the work day. Based on the current knowledge of the risk factors involved in the incidence and prevalence of MSD:s in nursing personnel work, it would be logical to assume that work situations involving changing of pads may constitute a risk for the caregiver, especially for the lower back. The body postures assumed by the caregiver during pad change is ruled by the patient position and the movements required by the hands, arms, head, torso and legs in order to take off the old pad and to mount and secure the new pad. If the caregiver(s) performing the work are not adequately educated and trained in an optimal working technique this may lead them to perform the work in a more disadvantageous way. The care for the patient is a factor that sometimes may lead the caregiver to sacrifice his own well-being while performing the work, especially in situations where unexpected events occur.

The results show that in particular pad design and patient position have a significant effect on cycle time and lower back variables. The big gap in cycle time between

slip and the other two pad designs is probably an effect of the far more complex fixating procedure of the four tape slips of this design. Slip in particular benefits from being handled by two care givers while especially flex was perceived by the subjects as being as easy to handle when the work was performed without assistance. Pad change with the patient in standing resulted in an increase in the time duration for lower back combined flexion/rotation compared with the patient lying down. This is believed to be an effect of an impairment in visibility and free viewing angles requiring the caregiver to bend and rotate the torso thus imposing a disadvantageous position for the back. During pad change with the patient standing up work movements also get more complicated just before the pad is preliminary secured. In order to keep the pad in place the subjects were often required to lock the pad with the thigh while they at the same time were reaching for the fastening devices on the other side of the patient. Very often the subjects were standing on one leg while this was performed. This was in particular pronounced with both slip and comfort. Fastening of the pad in this way most often requires additional readjustments which make the time spells of flexion/rotation longer. The more straight forward fastening procedure entailed using the integrated waist belt of the flex design is believed to explain the better results for this design.

Pad design is an important issue for patients suffering from incontinence problems. Modern pad designs are complex constructions incorporating a lot of advanced technology and requiring modern production facilities. This has resulted in a product that can both absorb and contain large quantities of fluid together with improved odour control while at the same time giving improved user (patient) comfort and dignity. The results from this study shows, however, that pad design also is an important issue for the caregiver by making pad change easier, less time consuming and with improved work postures for the lower back (Cederqvist et al, 2002). When designing pads, it is also important to consider that the perception of comfort and quality using pads, is not only a matter for the patient, but also for the caregiver (Axelsson et al, 2002).

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