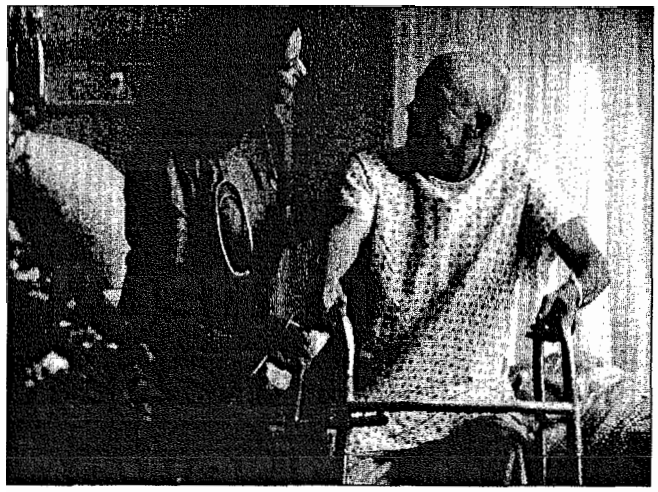
Postural Load of Nurses During Bathing and Showering of Patients: Results of a Laboratory Study

By Nico E. Knibbe and Hanneke J.J. Knibbe

When compared to other occupational groups, nursing personnel have a relatively high prevalence rate of back pain and high incidence rates of workers' compensation (WC) claims for back injuries (Knibbe and Friele 186+; Jensen 38+). According to scientific studies, the primary contributors to this trend are 1) lifting of patients and 2) static (postural) stress (Estryn-Behar 47+). During the last decade, injury prevention programs have focused on the former. For example, based on National Institute for Occupational Safety and Health limits for manual handling, non-lifting policies were widely introduced. Currently, ergonomics is the focus in patient handling—in other words, patient lifting is now more frequently mechanized (Fragala 23+).



Research continues to prove that an ergonomics approach can be beneficial (Knibbe and Knibbe). For example, a controlled longitudinal experiment in home care showed that back pain prevalence among nursing personnel dropped after patient transfers were mechanized via hoists (Knibbe and Friele). This study also revealed that the problem of postural stress (static load) has not yet been adequately assessed—nurses were still bending over while performing routine tasks. This finding is supported by research performed in an institutional care setting, which revealed that during 24 percent of total work time, a nurse's back is in a bent, twisted, or bent and twisted position (Engels, et al 338+).

With respect to static load, bathing and showering patients is one of the most stressful tasks a nurse must perform. To reduce back pain prevalence (more so than can be accomplished solely via a non-lifting policy), more attention should be paid to static stress on the musculoskeletal system.

Currently, however, no reliable data are available concerning the load on a nurse's musculoskeletal system during patient showering or bathing activities. Furthermore, little is known about the extent to which hygiene equipment, the patient or the nurse (attitude, behavior, height) is the source of this load. Therefore, consider this article a first step toward developing such data.

RESEARCH METHODOLOGY

A pilot study in nursing practice revealed that, due to the great number and diversity of confounding factors which influence postural load, these research questions could not be answered via a field study. Therefore, a laboratory study was required. It compared four nurses, who washed, showered or bathed three patients while using seven different pieces of hygiene equipment (Table 1).

Data concerning load on each nurse's musculoskeletal system during these activities were gathered using the Ovako Working Posture Analyzing System (OWAS), which is a widely accepted and reliable observational method for postural analysis (Kahru, et al 1977). This method is based on multi-moment sampling at a fixed interval. In this study, an observation consisting of a back score, arm score, leg score and external weight score was made every 15 seconds. Then, the four scores were combined. Via this process, 252 working postures were identified and grouped into four "action categories" (AC) to indicate the load's degree of harmfulness on the musculoskeletal system. Table 2 describes the ACs.

Three physiotherapists posed as "patients," acting out a range of cooperation. Each of the four nurses possessed a different level of experience, and all were different heights—the shortest being 156 cm, the tallest 184 cm. This variation was chosen due to the possible confounding influence. For example, tall nurses may have problems working on material at a fixed height. "Patients" and nurses were rotated in random order throughout the study.

All other factors were kept constant as much as possible. A washing protocol was established as well. The whole body had to be washed, including the hair, but no dressing/undressing was performed.

PHOTO COURTESY TONY STONE IMAGES

AUTHOR INFORMATION

Nico E. Knibbe, Mcs, is a research associate with Locomotion Research and Health Consultancy in Bennekom, The Netherlands. He holds a Master's in Human Movement Sciences from the Free University of Amsterdam.

Hanneke J.J. Knibbe, Mcs, PT, is also a research associate with Locomotion Research and Health Consultancy and with the Netherlands Institute of Research in Primary Healthcare. She holds a Master's in Human Movement Science from the Free University of Amsterdam and is a registered physical therapist from the Jan van Essen Institute, Amsterdam. They can be reached at Brinkerpad 29, 6721 WJ Bennekom, The Netherlands; phone +31 0318 413734.

STUDY RESULTS

A total of 1,624 OWAS scores were gathered. Table 3 presents AC classification for the seven pieces of equipment. Note that the higher the percentage of observations in AC1, the less harmful the activity is to the musculoskeletal system. As Table 3 shows, working with the hi-lo shower chair, bath and shower trolley produces less physical stress than does working with other equipment. Also note that 37.7 percent of observations concerning the fixed shower chair is categorized in AC3 (meaning action should be taken as soon as possible).

Based on the OWAS scores, a "top seven of harmfulness" list was devised (Figure 1). The sequence points to three groupings, which differ significantly (α=.01). In order of least harmful, the first group consists of the hi-lo shower chair, bath and shower trolley. The second group contains the fixed bath, hi-lo bed and fixed shower trolley. The fixed shower chair was found to be most harmful to the musculoskeletal system.

DISCUSSION

OWAS Method

The OWAS method has proven to be useful in dynamic work situations (Burdorf). In 1994, however, De Looze and Toussaint stated that this type of direct observation of activities (such as nursing) is not a valid method for assessing postural load; they believed the practice of nursing to be an example of dynamic work (De Looze and Toussaint 2+). The study discussed here reduced "nursing" to "washing," however, and was performed in a laboratory situation. As a result, the activity can be considered less dynamic.

Douwes and Dul's research substantiates this belief. They proved that a valid postural assessment can be made in a laboratory setting. Thus, under ideal circumstances (i.e., this study), an observation method such as OWAS can, indeed, produce valid results. To further increase reliability, the number of items to be scored by each observer was reduced (De Looze and Toussaint). Two observers were used, each assessing one-half of the items required for one OWAS score.

Now, a critical comment on the way scores were categorized in the four ACs. Several experts analyzed and ranked the 252 postures according to four degrees of harmfulness (ACs) (Von Stoffert 31+). Although a few studies have found a relationship between poor working postures and musculoskeletal disorders, the scientific operationalization of "harmfulness" remains open to interpretation (Genaidy 77+). In our opinion, it may be helpful to replace the word "harmfulness" with "stressfulness."

Hygiene Equipment

Based on this study's results, working with hi-lo adjustable equipment is the preferred choice with respect to postural load placed on the musculoskeletal system. The fact that the fixed bath was scored "least harmful" among the non-adjustable equipment may be due to the fact that it was used in conjunction with the hi-lo bath trolley. It is interesting to note that the fixed shower chair, which is commonly used in hospitals and nursing homes, places the highest load on the nurse's musculoskeletal system. With respect to the prevention of back pain, these findings can have serious implications for nursing practice.

Individual Differences

A fundamental question for nursing practice is: What exactly is the source of postural load on the musculoskeletal system? Beyond equipment, the degree of a patient's self-activity may be a factor, as may be the nurse's attitude with respect to back care. To answer this question, three factors that may determine postural load were analyzed: 1) equipment used, 2) nurse and 3) patient. Based on a Kruskal-Wallis test (α=.01), it appears that the harmful load has a relationship with the nurse (height, posture preference, working speed) and type of equipment (Table 1), but no clear relationship with the amount of patient cooperation.

For example, some nurses bend over more frequently and for longer durations than others. Let's examine some potential reason(s) for this behavior.

Height is one factor. Initially, one might think being short would have advantages (i.e., fixed hygiene equipment is often at a suitable height for shorter people). However, this study revealed that being short also requires one to stretch the upper body more when working at the same horizontal distance. For example, when a patient is lying in a bed or on a trolley, a short nurse must stretch the trunk and arms, which places postural stress on the musculoskeletal system. For tall nurses, the angle between their trunk and arms remains smaller.

Based on this study, width of material is crucial for short nurses, while height is crucial for tall nurses. This does not mean, however, that narrow material is not beneficial for tall nurses as well, nor that hi-lo equipment would not be beneficial for short nurses. To ensure that a nurse can maintain an upright position as much as possible, both narrow and hi-lo adjustable equipment should be considered.

Personal posture preference is another reason why the "nurse" variable strongly influences total load. In this study, one nurse remained in a stooped position even though she was only soaping the washing glove, while another nurse stretched her back whenever possible. For nursing practice, this implies that training and awareness of postural stress can be a necessary component of injury prevention programs.

The third reason for these individual differences may involve how each nurse balances patient comfort with personal comfort. For example, when using the fixed bath, one nurse removed soap from the patient's body while he was lying in the bath. She considered this process to be more comfortable for the patient. The other nurses removed soap while the patient was lying on the trolley, above water level. This choice was based on back load—one must bend over when removing soap while the patient is *in* the bath.

CATEGORY	DESCRIPTION
1	Washing the patient on a conventional powered hi-lo bed.
2	Showering the patient on a hi-low shower chair.
3	Showering the patient on a conventional shower chair at a fixed height.
4	Bathing the patient in a hi-lo bath.
5	Bathing the patient in a fixed bath.
6	Showering the patient on a hi-lo shower trolley.
7	Showering the patient on a conventional shower trolley at a fixed height.

TABLE 1. Ways of washing, showering and bathing. Note: In activities 4 and 5, baths were used in conjunction with a lift trolley in order to lower the patient into the bath.

ACTION CATEGORY	DESCRIPTION
AC1	Normal posture, no action required.
AC2	Load of posture is slightly harmful. Action to change posture should be taken in near future.
AC3	Load of posture is distinctly harmful. Action to change posture should be taken as soon as possible.
AC4	Load of posture is extremely harmful. Action to change posture should be taken immediately.

TABLE 2. OWAS action categories.

EQUIPMENT	AC1	AC2	AC3	AC4
Hi-lo bed	39.4	41.7	17.3	1.0
Hi-lo shower chair	58.8	19.8	19.4	1.3
Fixed shower chair	31.4	26.0	37.7	4.0
Hi-lo bath	56.3	23.7	17.4	0.5
Fixed bath	41.6	37.1	20.4	0.8
Hi-lo shower trolley	53.0	27.9	18.8	0.5
Fixed shower trolley	38.6	42.4	19.0	0.0

TABLE 3. Classification of ACs (by percent) for the seven types of equipment used in this study.

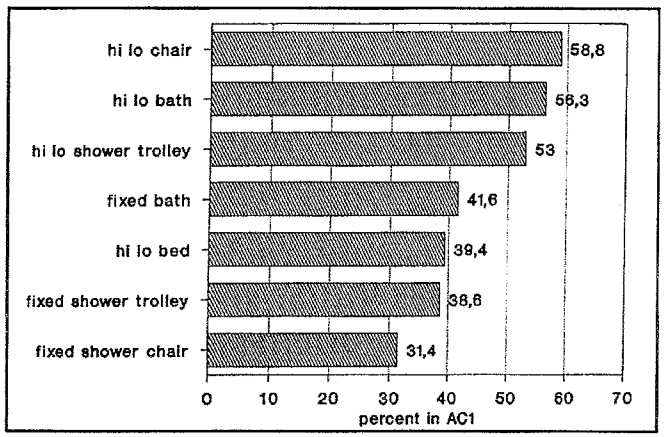


FIGURE 1. Top seven of harmfulness in terms of the percentage of OWAS scores in AC1 (normal posture). The higher the score, the less harmful it is.

Time Consumingness

As noted, adjustable equipment is the preferred option. However, its use raises the question of "time consumingness." How much time does it take to bathe or shower a patient on such equipment? A total of 67 washing activities were observed during this study. Using the fixed shower chair took the least time, 346 seconds, while using the hi-lo bed took the most, 474 seconds. Average time required was 382 seconds (median = 370, standard deviation ±105).

Based on these averages, three main groups were identified. The first group, which required the least time, included the fixed shower chair, hi-lo shower trolley, fixed shower trolley and hi-lo shower chair. Differences within this group were small. The second group, also with small differences, was formed by both baths. Taking the most time was the hi-lo bed, the third group. Only the differences between the first group and the last group are significant.

When comparing the differences within the first group, it should be noted that the bottom of the patient was not washed when using the two shower chairs. Observers also noted that nurses hurried when working with the fixed shower chair; they felt this could be related to the fact that it was the most harmful.

It was also noted that washing on the bed took the most time. However, when asked about this, all the nurses responded that no transfers were required—a patient washed on bed can remain there. However, when one takes into account the load on the musculoskeletal system, which was found to be quite harmful (Figure 1), one must wonder why this practice remains prevalent.

One note: Patients' hair was washed on the bed, a protocol established in order to make valid comparisons. Although this task may be performed on the bed in some home care settings, it is not a common practice within institutional care settings. Consequently, the additional time needed to wash hair on a hi-lo bed was compared to time needed to wash hair on the hi-lo shower trolley. Washing hair on the bed took an average of 126 seconds, while it took an average of 59 seconds on the trolley. To make an honest comparison, the differences were subtracted from total required time. In other words, washing a patient on a hi-lo shower trolley (without washing the hair) took 290 seconds; on a hi-lo bed, it took 348 seconds. Although differences were smaller, washing on the bed still took nearly one minute (59 seconds) longer.

It is interesting to note that bathing is not as time-consuming as one might presume. Bathing is frequently seen as a luxury, perhaps leading to the perception that it takes too much time. Although relaxing for a few minutes in warm water may have some therapeutic effect, the process does take time. This study was restricted to basic washing activities. Thus, it can be concluded that bathing (when restricted to washing itself) takes an average of 50 seconds more time as compared to shower trolleys and shower chairs.

When total task time is considered, time needed to fill the bathtub with water at the right temperature must be factored in as well. This study did not assess this factor, however, because the hi-lo bath used could be quick-filled at an electronically controlled temperature.

In line with this discussion of total load on the musculoskeletal system, variable(s) that determine total time required were studied as well. This was accomplished using an analysis of variance (ANOVA). This procedure revealed that 43 percent of the variance in time required is explained by the "nurse" factor. Only 16 percent can be attributed to equipment used, and even less (0.2 percent) is related to the "patient" variable. The rest remains unexplained.

Based on these results, it can be stated that the relevance of discussing the efficiency and "time consumingness" of hygiene equipment is limited by the fact that it accounts for 16 percent of the variance in time required to bathe/shower a patient. The nurse is the key factor, since s/he explains 43 percent of that variance.

CONCLUSIONS

With respect to postural load, the hi-lo shower chair, bath and shower trolley place significantly less stress on the musculoskeletal system, especially when compared to the fixed bath, fixed shower trolley, fixed shower chair and hi-lo bed. Since time required to bathe a patient is largely determined by the nurse, any discussion of time consumingness and equipment should focus more on load on the nurse's musculoskeletal system and quality of care.

REFERENCES

Burdorf A. "Assessment of Postural Load on the Back in Occupational Epidemiology." Thesis. Rotterdam, The Netherlands, 1992.

De Looze, M.P. and H.M. Toussaint. Houdingsregistratie door observatie en het Static Strength Prediction Model. *Tijdschrift voor Ergonomie.* April 1994: 2-9.

Douwes M. and J. Dul. "Validity and Reliability of Estimating Body Angles by Direct and Indirect Observations." In *Proceedings of the International Ergonomics Assn.* London: Taylor and Francis, 1991.

Estryn-Behar M., M. Kanminski, E. Peigne, et al. "Strenuous Working Conditions and Musculoskeletal Disorders Among Female Hospital Workers." *International Archives of Occupational Environmental Health.* 62(1990): 47-57.

Engels J.A., J.W.J. van der Gulden, T.F. Senden, C. Hertog, J.J. Kolk and R.A. Binkhorst. "Physical Work Load and Its Assessment Among Nursing Staff in Nursing Homes." *Journal of Occupational Medicine.* 36(1994): 338-345.

Fragala G. "Ergonomics: The Essential Element for Effective Back Injury Prevention for Healthcare Workers." *Professional Safety.* March 1996: 23-25.

Genaidy, A.M., A.A. Al-Shedy and W. Karwowski. "Postural Stress Analysis in Industry." *Applied Ergonomics.* 25(1994): 77-87.

Jensen, R.C. "Back Injuries Among Nursing Personnel Related to Exposure." *Applied Occupational Environmental Hygiene.* 5(1990): 38-45.

Kahru, O., P. Kansi and I. Kuorinka. "Correcting Working Postures in Industry: A Practical Method for Analysis." *Applied Ergonomics.* 8(1977): 199-201.

Knibbe, N.E. and J.J. Knibbe. "Bathing and Showering in Four Dutch Nursing Homes: Results of a Pilot Study." Research conducted by Locomotion Health Consultancy, Bennekom/Barneveld, The Netherlands, 1994.

Knibbe, J.J. and N.E. Knibbe. "Handle With Care: Impact of a Structural Ergonomic Approach to Prevent Back Pain Among Nurses in Institutional Care." Presentation at Second International Conference on Occupational Health for Healthcare Workers, Stockholm, 1994.

Knibbe, J.J. and R.D. Friele. "Backing Home Care: Back Pain Prevention in Home Care: A Controlled Prospective Trial." Presentation at Second International Conference on Occupational Health for Healthcare Workers, Stockholm, 1994.

Knibbe, J.J. and R. Friele. "Back Pain and Characteristics of the Physical Workload of Community Nurses." *Ergonomics.* 39(1996): 186-199.

Von Stoffert, G. "Analyse und Einstufung van K"rperhaltungen bei der Arbeit nach der OWAS-Methode." *Z. Arbeits. Wissensch.* 39(1985): 31-38.