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Less Quick Returns — Greater Well-being

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Abstract: The aim of this study was to design ergonomically improved shift schedules for nurses in primary health care shift work in order to enhance their health and well-being. The main change made was the reduction of quick returns (i.e., no more morning shifts immediately after an evening shift) in order to ensure more recovery time between work shifts. Six municipal hospital units participated in the intervention. Our aim was to maintain or improve the well-being and work ability of aged workers. The subjects (n=75) were divided into three age groups: 20–40, 41–52, and 53–62 yr. The introduction of more recovery time between evening and morning shifts significantly improved the subjects' sleep and alertness, well-being at work, perceived health, and leisure-time activities independently of their age. The effect on social and family life was also positive. Working in shifts was the most disruptive for the youngest group of nurses. The Work Ability Index score depended on the age group: it was lowest among the oldest age group, and did not change during the intervention. Ergonomic working time arrangements show positive effects on the well-being of health care workers of all ages.

Key words: Shift work, Recovery, Ageing, Intervention

Introduction

The shift systems of Finnish hospitals are irregular. Schedules rotate backward with quick returns. Working to in an irregular, changing schedule is associated with diminished well-being[1)]. Quick returns seem to affect the duration of sleep, and are related to increased sleep problems[2, 3)]. The mental strain of work decreased during an intervention for reducing the number of quick returns, especially among elderly midwives. Despite the positive effects, midwives preferred backward rotation with longer continuous free time[4)]. Satisfaction with the shift system seemed to reflect how well the shift workers are coping with the schedule[3)].

Good working time control means that workers can influence their shift scheduling, which in turn leads to positive effects on their well-being. The moderate results of older workers' benefits from participatory planning showed that they also need other means to maintain their work ability[5)]. In an intervention study among steel workers, a change from a slower backward rotating shift system to a more rapid forward system increased sleep length and was experienced positively by older workers[6)]. A very quickly forward rotating shift system with longer free time between shifts increased sleep length and improved alertness with positive effects on the well-being of older maintenance workers in particular[7)].

The aim of this Healthy Working Hours Research and Development Project was to implement work-shift arrangements in primary health care that comply with current ergonomic guidelines[8)]. The goal was to introduce healthier shift arrangements to the highly irregular shift work of nurses, and to measure the effectiveness of these changes.

Stress factors in the rotas include excessive weekly working hours, recurrent rotations of morning shifts following evening shifts with intervals of only nine hours in between, and long stretches of working shifts (even ten consecutive shifts). In practice, the reduction of quick returns (transitions from evening shift to morning shift) was the key change made in two- and three-shift work. This aimed to ensure optimal recovery from

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work by increasing the time off between shifts.

Subjects and Methods

A total of six acute and long-term wards from municipal hospitals participated in the intervention. The nurses (n=75) filled in a questionnaire both before the implementation of any changes to their shift arrangements (baseline in 2005), and after the intervention (follow-up in 2006). Ninety-five per cent of the nurses were women, and their mean age was 46 ± 10 yr. Table 1 shows the characteristics of the subjects. All of the subjects participated voluntarily. The company management had no knowledge of the individual results. The study design was approved by the Ethics Committee of HUS and the Research Committee of Health Centre, Helsinki (HUS 265/E0/05).

A questionnaire study included both the shift work (modified SSI[9]) and the work ability[10] questionnaires. To study the effects of the shift system on general well-being, we asked direct questions "How does the current shift system affect your a) sleep and vigilance, b) well-being at work, c) general health, d) social life, e) family life, and f) hobbies?" Each item was rated on a five-point scale ranging from "improves considerably" to "disturb considerably". Circadian type was assessed with a single question of five-point scale from the evening active to the morning active individual.

The change in shift scheduling aimed to avoid short recovery times (i.e., nine hours between evening and morning shifts). The actual change was from backward to forward rotation e. g. –EMEMM– or –EEMMM– to –MMMEE– in two-shift work, and –EMEMNN– to MMEENN in three-shift work (M=morning shift 7.00–14.30, E=evening shift 13.00–21.00, N=night shift 21.30–7.30, and – =day off). Total working hours and the amount of weekend, evening, and night work remained the same.

To study possible age-related differences in the effect of intervention the subjects were divided into three age groups (20–40, 41–52, and 53–62 yr). We used a linear mixed model for repeated measurements containing the baseline and follow-up ratings of general well-being and work ability with age-group as the between-subjects factor. Analyses were made separate for the indicators: sleep and vigilance, well-being at work, general health, social life, family life, hobbies, the Work Ability Index, and WAI items. In addition, we tested whether the influences of intervention were independent on the health care sector, ward, occupation, family status and circadian type by adding them as covariates each separately in the initial measurement model. Tests were carried out through the analysis of variance with repeated measurements, using the Statistical Analysis System (SAS, ver. 9.1).

Results

Increasing the recovery time between evening and morning shifts brought significant improvements to the subjects (Table 2). Their sleep time was longer, and interference of the shift system was less disturbing to their sleep and alertness, well-being at work, and general health, regardless of age (Table 3). The subjects

Table 1. Characteristics of subjects (n=75) in three age groups before intervention (Mean, SD)

		20–40 n=23	41–52 n=26	53–62 n=26
Age (yr)		31.6 ± 5.9	47.2 ± 3.3	56.2 ± 1.9
Work experience (yr)	Total	8.0 ± 6.0	23.9 ± 6.2	33.5 ± 6.1
	Working shifts	7.2 ± 5.2	20.4 ± 6.2	23.7 ± 9.8
Shift system (%)	Two-shift schedule	50	61	59
	Three-shift schedule	50	39	41
Occupation (%)	Nurse	53	40	45
	Vocational nurse	47	60	55
Family size		2.0 ± 1.0	2.9 ± 1.4	1.8 ± 0.6
Marital status (%)	Single	35	17	30
	Married	48	23	60
	Married (with children)	17	60	10
Circadian type (%)	Evening active	55	46	40
	Neither	26	20	10
	Morning active	19	34	50

Table 2. Sleep, scores of general well-being, and work ability (Mean, SD) among three age groups (yr) before and after intervention of ergonomic shift schedule

		Age group		
		20–40	41–52	53–62
Sleep length (h)	Before	7.1 ± 0.95	6.6 ± 1.46	6.0 ± 2.57
	After	7.0 ± 1.00	6.8 ± 1.06	7.2 ± 1.02
Sleep and alertness	Before	2.3 ± 0.97	2.6 ± 0.88	2.4 ± 1.09
	After	2.8 ± 1.02	2.9 ± 1.00	2.9 ± 1.14
Well-being at work	Before	2.5 ± 1.02	2.6 ± 1.04	2.5 ± 1.25
	After	2.8 ± 1.01	3.1 ± 1.03	3.0 ± 1.31
General health	Before	3.0 ± 0.76	2.7 ± 0.98	2.7 ± 1.20
	After	2.9 ± 0.65	3.3 ± 0.79	3.2 ± 1.03
Social life	Before	2.0 ± 1.08	2.5 ± 1.17	2.5 ± 1.46
	After	2.2 ± 1.06	2.6 ± 1.14	2.8 ± 1.30
Family life	Before	2.1 ± 1.06	2.3 ± 1.22	2.7 ± 1.36
	After	2.3 ± 1.10	2.7 ± 1.15	2.9 ± 1.20
Leisure time activities	Before	2.2 ± 1.00	2.5 ± 1.17	2.5 ± 1.43
	After	2.6 ± 1.24	2.9 ± 1.13	3.0 ± 1.24
Work ability index	Before	40.58 ± 4.67	38.83 ± 6.10	32.78 ± 8.22
	After	40.45 ± 5.92	40.58 ± 4.05	34.57 ± 7.75
Present work ability	Before	8.2 ± 1.1	7.8 ± 1.7	6.8 ± 1.9
	After	8.2 ± 1.3	8.4 ± 1.1	7.3 ± 1.9
Physical work ability	Before	4.0 ± 0.6	3.6 ± 0.9	3.1 ± 1.0
	After	4.0 ± 0.8	4.0 ± 0.7	3.2 ± 1.1
Mental work ability	Before	4.0 ± 0.6	4.1 ± 0.7	3.5 ± 0.7
	After	4.0 ± 0.7	4.2 ± 0.6	3.9 ± 0.6
Diseases	Before	5.7 ± 1.4	4.9 ± 1.6	4.0 ± 1.6
	After	5.7 ± 1.3	5.7 ± 1.5	4.2 ± 1.5
Impairment	Before	5.4 ± 0.8	4.7 ± 1.3	4.4 ± 1.4
	After	5.5 ± 1.0	5.0 ± 0.9	4.3 ± 1.4
Sickness absence	Before	3.8 ± 0.7	3.5 ± 1.1	3.4 ± 1.1
	After	3.8 ± 0.1	3.6 ± 0.9	3.5 ± 1.1
Own prognosis	Before	6.4 ± 1.4	6.3 ± 1.5	4.9 ± 1.9
	After	6.3 ± 1.5	6.5 ± 1.1	5.3 ± 2.1
Mental resources	Before	8.8 ± 2.1	9.1 ± 2.2	7.7 ± 2.5
	After	8.3 ± 2.5	9.0 ± 2.0	7.9 ± 2.3

also found it easier to participate in leisure-time activities. Working in shifts was the most disruptive for the youngest group of subjects as regards their social and family life. There was a difference in the results between the two occupation groups. The nurses slept longer and benefitted more from the ergonomic scheduling than the vocational nurses. There were no differences in results between the six wards, the two sectors (acute vs. chronic), or family status (single, married or married with children). Morning active subjects enjoyed better well-being at work than evening active subjects (Table 3).

The mean Work Ability Index (WAI) was 37.5 ± 7 before and 38.1 ± 7 after the intervention. The WAI score depended on the age group: it was lowest among the oldest age group (Table 2). There were no differences in the WAI results between the six wards, the two sectors, the two occupations, the family status or circadian type (Table 4). The separate WAI items also differed according to the age groups. Subjective work ability in relation to the mental demands of the work was better after intervention, and there was a differ-

Table 3. Effects of intervention and age on sleep, well-being, and private life, and effects of health care sector, ward, occupation, family status, and circadian type as covariates

	Intervention		Age		Health care sector		Ward		Occupation		Family status		Circadian type	
	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Sleep length (h)	4.2	0.04	1.5	ns	1.4	ns	0.9	ns	4.5	0.04	1.8	ns	2.2	ns
Sleep and alertness	9.8	0.003	1.0	ns	2.1	ns	0.8	ns	2.0	ns	1.3	ns	2.2	ns
Well-being at work	9.0	0.004	0.7	ns	2.4	ns	1.0	ns	1.0	ns	3.1	ns	3.3	0.04
General health	5.6	0.02	0.1	ns	0.9	ns	0.5	ns	4.6	0.03	1.6	ns	0.8	ns
Social life	1.8	ns	2.4	ns	0.3	ns	0.3	ns	4.2	0.04	1.8	ns	0.4	ns
Family life	2.4	ns	3.0	ns	0.0	ns	0.5	ns	5.9	0.02	2.3	ns	0.1	ns
Leisure time activities	6.4	0.01	1.1	ns	0.1	ns	0.8	ns	4.0	0.05	1.5	ns	0.1	ns

Table 4. Effects of intervention and age on Work Ability Index and items, and effects of health care sector, ward, occupation, family status, and circadian type as covariates

	Intervention		Age		Health care sector		Ward		Occupation		Family status		Circadian type	
	F	p	F	p	F	p	F	p	F	p	F	p	F	p
Work ability index	1.2	ns	10.9	0.04	0.3	ns	1.4	ns	1.9	ns	3.5	ns	1.2	ns
Present work ability	2.0	ns	7.5	0.04	1.6	ns	1.6	ns	2.8	ns	2.4	ns	1.7	ns
Physical work ability	2.2	ns	9.8	0.03	1.3	ns	0.9	ns	0.6	ns	1.0	ns	1.8	ns
Mental work ability	4.2	0.04	3.4	ns	0.0	ns	0.4	ns	4.5	0.04	2.2	ns	1.7	ns
Diseases	2.0	ns	13.7	0.02	0.0	ns	0.8	ns	1.5	ns	0.3	ns	0.6	ns
Impairment	0.0	ns	9.8	0.05	0.1	ns	0.7	ns	0.1	ns	4.2	0.04	2.1	ns
Sickness absence	0.8	ns	7.4	0.05	5.7	ns	1.5	ns	0.8	ns	0.1	ns	0.5	ns
Own prognosis	0.8	ns	7.4	0.04	0.2	ns	1.2	ns	1.2	ns	3.6	ns	1.0	ns
Mental resources	0.3	ns	2.2	ns	0.9	ns	1.5	ns	5.7	0.02	1.6	ns	3.3	0.04

ence between the two occupations. The nurses also had better psychological resources than vocational nurses; the same was also true of the morning active subjects. Subjective estimation of work impairment due to disease differed according to the marital status, single subjects having more problems than married subjects with or without children (Table 4).

Discussion

The total working time per week is longer in the municipal than in the industrial sector in Finland. The traditional way of shift planning is to apply quick returns between the shifts. However, we found that it is possible to simultaneously cover the need of the nursing staff, the total weekly working hours, and sufficient periods of free times for personnel. The strain of nursing work depends greatly on their shift systems, and one way to diminish this is to reduce the number of quick returns per schedule.

Many internal and external circumstances affected the actual planning of schedules in the wards, such as the number of nurses available, long and short sick-leaves, and seasonal holidays etc. The head nurse of the ward had to understand the health effects of the shift work and to commit herself to ergonomic changes in the shift scheduling. Application of the ergonomic planning was ward-specific, and implementation also depended on changes of staff or other functions. Despite this, the results were positive in all six wards, and in both the acute and long-term wards.

The reduction of quick returns had both positive and negative consequences. The irregularity of shift schedules was reduced, but single days-off were shortened, which was not desirable and created a new challenge for shift planning. The periods of successive shift periods were also shortened, which influenced the periods of consecutive days-off.

The difference in results between the two occupations of the nurses and vocational nurses is mainly due to both the shift system and the workload. The vocational nurses more often had three-shift schedules and perceived more physical strain than the nurses.

This development project was a prospective study, using the same subjects in both measurements before and after intervention. The lack of a control group is a shortcoming, but in real life situations such as these it is not possible to find similar wards on a voluntary

basis.

The slight increase in the WAI index among the older subjects in particular can be interpreted as a good result. A one year follow-up is too short a period for the WAI index to improve, for example sickness absences and the number of diagnosed diseases are emphasized in the index, compared to the relatively slight chance of reducing quick returns and making a difference in shift work.

In conclusion, it seems that ergonomic working time arrangements have positive effects on the physical, mental and social well-being of nurses of all ages and that a healthier work rhythm can be implemented in nursing work. Modifying shift arrangements can promote well-being at work and improve the health of nursing staff. Our results indicate that ergonomic shift planning is a model to be recommended for nursing work, as it supports healthy careers and the overall well-being of staff members. Providing and ensuring adequate rest and recovery periods are of crucial importance.

Shift planning is a human resource management tool which at best can be used to increase well-being amidst the demanding work of nursing. Ergonomic shift arrangements are standard in modern shift planning, and planners need more information and education on this subject. The practices of shift planning must be developed together with the head nurse and the staff. The commitment of staff can be supported by combining ergonomic guidelines and participatory planning.

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References

1) Costa G, Sartori S (2005) Flexible work hours, ageing and well-being. Int Congr Ser **1280**, 23–8.
2) Tucker P, Smith L, Macdonald I, Folkard S (2000) Effects of direction of rotation in continuous and discontinuous 8 hour shift systems. Occup Environ Med **57**, 678–84.
3) Axelsson J, Åkerstedt T, Kecklund G, Lowden A (2004) Tolerance to shift work-how does it relate to sleep and wakefulness? Int Arch Occup Environ Health **77**, 121–9.
4) Kandolin I, Huida O (1996) Individual flexibility: an essential prerequisite in arranging shift schedules for midwives. J Nurs Manag **4**, 213–7.
5) Hakola T, Koivumäki M, Sinivaara M, Kasanen R (2007) Working time autonomy and age in health care. Ergonomia IJE&HF **29**, 241–5.
6) Hakola T, Härmä M (2001) Evaluation of a fast forward rotating shift schedule in the steel industry with special focus on ageing and sleep. J Hum Ergol **30**, 35–40.
7) Härmä M, Hakola T, Kandolin I, Sallinen M, Virkkala J, Bonnefond A, Mutanen P (2006) A controlled intervention study on the effects of a very rapidly forward rotating shift system on sleep-wakefulness and well-being among young and elderly shift workers. Int J Psychophysiol **59**, 70–9.
8) Knauth P, Hornberger S (2003) Preventive and compensatory measures for shift workers. Occup Med **53**, 109–66.
9) Barton J, Costa G, Smith L, Spelten E, Totterdell P, Folkard S (1995) The standard shiftwork index: A Battery of questionnaires for assessing shiftwork related problems. Work Stress **9**, 4–30.
10) Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A (1998) Work ability index, 2nd Ed., Finnish Institute of Occupational Health, Helsinki.