

ORIGINAL RESEARCH

Improving sleep after open heart surgery—Effectiveness of nursing interventions

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ABSTRACT

Background and Objective: Cardiac surgical patients experience sleep problems in the early post-operative period and after hospital discharged. Restorative sleep is important to be able to handle the challenges of rehabilitation, but often remains untreated. Pharmacological treatment has been preferred, but studies conclude a longer lasting effect of cognitive behavioural therapy (CBT). Few clinical trials have been conducted on nurse led sleep promoting interventions during hospitalization. The hypothesis of this study is that systematic training and education in sleep, sleep anamneses and sleep hygiene enhances nurses' awareness on sleep problems, and as a result makes nurses able to propose appropriate interventions to improve patients' sleep during hospitalization, and after discharged. The aim is to examine the effect on patients' self-reported sleep quality.

Methods: The study design is a controlled intervention study. Patients in the control group received usual care. Patients in the intervention group received nursing focused on improving sleep by use of sleep-anamneses and sleep hygienic principles. Patients' sleep-quality was measured preoperatively, and one and two month post-operatively by use of PSQI-questionnaire and sleep diaries.

Results: There was no significant effect of the intervention, though there were several signs that had some effect after two months in terms of global PSQI, total sleep time, sleep efficiency, sleep medication and sleep quality.

Conclusions: Systematic education and training of nurses in sleep, sleep anamneses and sleep hygienic principles has some effect on patients self-reported sleep quality two months after heart surgery.

Key Words: Sleep problems, Heart surgery, Nursing intervention, PSQI-questionnaire, Sleep hygiene, Sleep anamneses

1. INTRODUCTION

Patients with cardiovascular disease report an especially high frequency of sleep disturbances, and there seems to be some association between sleep problems and coronary events.^[1,2] In a Swedish study, 38.6% of the male patients who were about to undergo coronary artery bypass surgery reported insufficient sleep. Sleep disturbances are common after cardiac surgery.^[3-7] They are reported to occur in 60%-80% of

patients in the immediate post-operative period,^[6] and alterations in sleep pattern seem to continue to occur in 39% to 69% of cardiac surgery patients during the first month after hospital discharge.^[3,5] A lack of sleep can have negative consequences on health, such as immunosuppression, prolonged wound-healing, increased risk of infection, arrhythmias, increased blood pressure, depression and anxiety^[8-10] and thus affect quality of life, physical functioning, morbid-

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ity and mortality.^[2-7, 11-16] Major surgery is known to cause severe changes in sleep patterns with a reduction of deep sleep and a reduction or total lack of REM sleep, but with rebound of REM sleep the following nights and days.^[15, 17] A lack of REM sleep and deep sleep is associated with poor physical functioning, affecting the rehabilitation with decreased cognitive capability and bad remembrance, which is of great importance due to the amount of information given during hospitalization.^[2-7] Sleep problems are subjective complaints encompassing reduced sleep quality, duration or efficiency of sleep. Sleep problems may involve problems with falling asleep, staying asleep, nocturnal awakenings, which subsequently can result in non-restorative sleep, feeling unrefreshed, increased daytime sleep and lack of energy the following day.^[11-14, 18]

1.1 Background

Insomnia is common in elderly patients and somatic problems often emerge in parallel with increasing age.^[3, 11, 19, 20] An increasing number of elderly patients undergo heart-surgery, hence age can be considered as a cause of sleep problems.^[4] Coherence between emotional stress and quality of sleep is well known in other populations as well as in persons who undergo heart surgery.^[21] Environmental conditions like noise, light, temperature or disturbances from a roommate, staff or nurses' monitoring of vital values are thought to be of some importance. In relation to heart surgery, postoperative discomfort, such as incisional pain, positioning, and nocturia are reported to cause disturbances in the early postoperative period.^[3, 16, 20, 22, 23] Restorative sleep is of vital importance for heart surgery patients, as it helps them to handle the demands of rehabilitation, *i.e.*, physical training or nutrition.^[2-4, 11-13] However, insomnia often remains untreated. In hospital settings, pharmacological treatment with sleep-inducing medicine, especially Benzodiazepines, has until now been the preferred treatment, but their effect diminish over time and have some undesirable side-effects like development of tolerance and drug dependency.^[18, 24-26] The last 10-20 years has put focus on psychological and behavioural approaches that can be effective alternatives to sleep medicine. Several reviews^[10, 25-29] and studies^[19, 30-35] conclude that there is a documented effect on primary insomnia, on insomnia in connection with medical illness and a longer lasting effect on sleep latency and sleep quality.^[36] Cognitive behavioural therapy (CBT) consists of several individual components and permutations: relaxation therapy, sleep restriction therapy, stimulus-control therapy and sleep hygiene instructions, *etc.*^[24, 26, 27, 36-39] Research has been conducted particularly on acutely ill cardiac surgery patients, but only a few clinical trials have been designed to study the efficacy of sleep promoting interventions^[2] and on nurse led

interventions during hospitalization.^[3, 4, 9, 16] It is argued that nurses play an important role in enhancing quality of sleep. However, this requires that nurses have knowledge about sleep, sleep problems and relevant nursing assessments in order to tailor individual interventions to promote sleep hygiene and sleep anamneses. This may affect patients' perceived sleep quality positively and diminish the consequences of bad sleep.^[3, 8, 14, 32, 33, 40-44] No studies on the effect of this were found.

1.2 Hypothesis

The hypothesis of this study is that if nurses in a hospital setting have improved knowledge, receive systematic training and education on sleep, sleep anamneses and sleep hygiene, nurses' awareness on sleep problems would similarly be enhanced. As a result, nurses would be able to propose appropriate solutions (interventions) for the benefit of patients' sleep during their hospitalization as well as one and two months after discharged from hospital.

The aim of the study is to examine the effect of a nursing intervention based on sleep anamneses and sleep hygienic principles on patients' self-reported sleep quality, measured by changes in sleep duration, sleep efficiency and sleep onset latency as well as the use of sleep medicine.

2. METHOD

The study includes heart surgery patients from the cardiothoracic centre at Copenhagen University Hospital in Denmark. Patients aged 18 years or older, admitted electively for all kinds of open cardiac surgery and able to read and understand written information and questionnaires were included. Patients who were admitted acutely or who suffered from primary insomnia, psychiatric or dementia diagnosis were excluded. Patients, who did not read or understand Danish, who spent more than two nights in the intensive care unit or were readmitted in the intensive care unit were excluded.

2.1 Design

The study was conducted as a controlled intervention study. First, the control group was included, hereafter the nurses were trained to carry out the intervention, then the inclusion to the intervention group began. Patients in the control group received usual care. As for the patients in the intervention group, sleep anamnesis were obtained. Based on the sleep anamnesis information, advice and guidance was given in relation to sleep hygiene. Patients who fulfilled the inclusion criteria were enrolled consecutively. Due to the nature of the intervention, the participants were not blinded.

2.2 Measuring instruments

To gain knowledge about the patients' sleep-pattern during hospitalization and at home, all patients in both the control- and intervention group completed the following two questionnaires.

2.2.1 Pittsburgh sleep quality index

PSQI is a self-rated questionnaire, developed and validated by Dr. Buysse *et al.*^[45] It assesses participants' perception of global habitual sleep quality and disturbances retrospectively over a one-month interval. The 19 items in the questionnaire are summed up in seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The global score from these components range from 0-21 points. PSQI is tested for intern reliability (Cronbach's alpha 0.83) and validity, finding that a global score over 5 has diagnostic sensitivity on 89.6% and specificity of 86.5%, thus suitable for identifying patients with sleep disturbances. A global PSQI score > 5 indicates that a person can have severe sleep problems within at least two components or moderate within three.^[45]

The PSQI questionnaire is considered the most suitable instrument as it contains valuable information that helps to compare certain aspects of sleep quality before and after an intervention. Furthermore, it is one of the most used instruments in sleep research for evaluating the severity of insomnia.^[46] It is a well-validated questionnaire, which is also available in Danish. Dr. Buysse kindly gave his permission to use the questionnaire. The Danish version was face-validated on five patients.

2.2.2 Sleep diaries

A sleep diary or sleep log provides knowledge about sleep habits during a shorter period and is a useful tool for identifying circadian sleep disturbances or bad sleep hygiene.^[8,46] In this study, it was used to identify bad sleep hygiene and provide a more detailed day-to-day overview of sleep problems contrary to the questionnaire. Comments from a sleep diary help to identify the sleep problems emerged postoperatively and may contribute to patients becoming more aware of their improvements.^[10] Knowledge from sleep diaries gives nurses the opportunity to target and individualize care to each patient.

There is modest to poor correlation between subjective self-reporting and objective findings, as there is a tendency to underestimate total sleep time and exaggerate sleep latency in objective findings. Subjective self-reporting therefore seems to be a better indicator of a patient's experience of sleep disturbances than quantitative instruments.^[10] Hence, a number of studies on sleep include both self-reported questionnaires

and diaries to measure the results from the following criteria: time going to sleep, sleep latency, numbers and duration of awakenings, wake-up time and assessment of sleep quality. In this diary, the patients were additionally asked to record situations, which influenced their sleep and their use of sleep medication and to write comments on their sleep, which they found could be of interest.^[22, 32, 42, 43]

2.3 Data collection

Participants on the waiting list for heart surgery received the PSQI questionnaire before hospital admission together with the admission letter and written information. One and two months after discharged from hospital, the PSQI questionnaires were mailed to the participants again.

The principal author met each patient in the cardiac surgery ward on the first day of their admission prior to enrolment to obtain written informed consent, include patients consecutively and collect the completed questionnaire. The patients were instructed to use the sleep diary in order to catch sleep problems encountered during and after their hospitalization and to record information about their subjective sleep patterns.^[8,38] The diaries were completed each morning from the second postoperative (PO) night until discharge from hospital. The principal author visited each participant every morning except for the weekends to ensure that they answered the questions in the diary or to help them complete it. After being discharged from hospital, the patients were asked to continue their diary on a certain week day (weekends excepted) each week, for example each Thursday during a two month period.

2.4 Ethical considerations

Patients were informed that they at any time could withdraw their consent to participate. The questionnaires and diaries were coded with a number in order to ensure anonymity. The protocol was approved by the Science Committee in the Capital Region of Denmark, jn.2007-58-0015.

2.5 Sampling size

In 2010, approximately 1,200 patients underwent heart surgery at the department. The primary outcome was changes in overall sleep quality, measured with PSQI. Power calculation showed that a sample size of 69 patients in each group would have 90% power to show a 0.5 SD difference between treatment and control group. With an expected drop-out rate at 20%, at least 83 patients should be included in the control- and in the intervention- group, respectively.

2.6 Intervention

The nursing interventions in this study are based on literature describing sleep patterns and non-pharmacologic treatment

of sleep problems, which are essential knowledge for nurses, as well as suggestions on how to obtain sleep anamneses, how to improve sleep hygiene and how to assess a patient's sleep quality.^[3, 8, 14, 21, 30, 32, 39, 42, 43, 46]

The training of nurses consisted of the following theoretic and practical education on sleep:

- Educate the nurses in smaller groups on sleep, sleep problems, sleep anamneses and sleep hygienic factors in order to increase their awareness on the problems and enable them to improve nursing practice.
- Train the nurses in making sleep anamneses and to identify patients' sleep habits, sleep patterns and problems.
- Share viewpoints on present practice and quality of care.

The content of the intervention was as follows:

- To help patients into a comfortable position;
- To relieve pain sufficiently;
- To decrease routine controls during the night;
- Not to disturb patients' sleep by placing a newly operated patient next to them;
- To help patients out of bed if they cannot sleep and to set aside time for a conversation to be able to put concerns into words or perhaps offer something to drink like hot milk;
- To consider the possibility of offering sleep medicine in a small dose and only for a short period to patients who were unable to fall asleep;
- To avoid noise from the staff (small talk, routine tasks that are usually made at night like emptying the dishwasher, cleaning up, putting items in their right places, etc.).

Each session ended up with discussions and viewpoints on present practice and agreements on how to qualify it, based on assessment of the sleep anamneses and sleep hygiene and the patient's information thereon.

2.6.1 Educational content

(1) Theoretical content about sleep General knowledge about normal sleep and sleep patterns, characteristics in Non-REM sleep and Rem-sleep, sleep and heart-disease, sleep and surgery, and consequences of a lack of sleep.

(2) Sleep anamneses For evaluation to be effective, it is important to obtain a patient's personal assessment of his sleep. This can be achieved by asking open-ended questions about his sleep, *i.e.*, when he usually goes to bed, how long time it takes from the time he turns off the light until he actually sleeps, when he usually gets up in the morning, and if he

usually takes a nap during daytime. If these questions reveal that a patient has major sleep problems, one may question the patient in depth. In such case, it is interesting to assess how the every-day life is affected, and how the patient usually handles these problems.^[31, 42, 43]

(3) Sleep hygiene Sleep hygiene includes a loosely defined set of recommendations, targeting life style changes and environmental factors. Nurses teach patients about healthy sleep behaviours and sleep-conducive environmental conditions, for example not to go to bed if not sleepy, not to stay in bed if unable to sleep or do not want to sleep, not to drink coffee before bed time, to sleep in a dark and quiet room with no light, no noise, and the right temperature—not too hot nor too cold.^[8, 14, 32]

2.6.2 Implementation of the intervention

The education and training of the 42 nurses employed in the ward, all of whom had changing shifts, lasted almost half a year. As soon as the nurses were educated, they started to practise their knowledge. In a hospital, sleep hygiene can be challenging, but nurses asked patients politely to turn off the TV or radio and not to disturb their fellow patient. They tried to assess their patients' need for monitoring blood-pressure and other observations when they started their night shift, and they tried to match patients with the same needs. The nursing interventions were planned according to the patients' individual needs. This could for example be to assist the patients in getting out of bed or to a better positioning in bed, to offer warm drinks like milk or cocoa, to provide personal support through talks or to relieve pain if patients had difficulties in falling asleep or frequently woke up during the night. The ward used to be rather restrictive in terms of distributing sleeping pills. After several discussions about sleep interventions and sleep medicine during the implementation of the intervention, the nurses were aware that sleeping pills in some cases could be a solution to avoid permanent sleep problems. The medicine was only used in a smaller dose and for a short period of time. The discussions among the nurses about interventions and new habits worked as feed-back and were discussed further as possible interactions in the ward and during the educational sessions.

2.7 Intervention fidelity

The principal author followed each nurse once and/or checked the patient-record to ensure that patients were interviewed about sleep anamneses, were guided according to the intervention, and that the interventions for improving sleep or solving sleep problems were planned and effectuated. When comparing the comments on sleep disturbances from the sleep diaries of the participants in the control- and intervention-group during hospitalization, it became clear

that the intervention led to some changes in the nurses' normal night procedures. Thus, observational disturbances on the first night in the ward after operation due to vital monitoring changed from 12 times in the control group to 6 in the intervention group, and decreased even further later into the hospital stay. On day 4, a small change in positioning in bed due to the intervention procedure occurred (7 resp. 2), and disturbances caused by the fellow-patient decreased from 9 in the control group to 3 in the intervention group.

2.8 Data analysis

This study presents data and results from the PSQI-questionnaires. Data from the sleep diaries is in this article only used to assess intervention fidelity.

Quantitative data

Quantitative data from the questionnaire and the sleep diaries were analysed by means of the statistics programme Statistical Package for Social Sciences SPSS version 19. The results are given as means + SD. Data from both groups were tested by *f*-test for normal distribution. Normally distributed data is compared by using parametric methods, students independent samples *t*-test, otherwise Mann-Whitney was used. *P*-value was set to be below .05.

2.9 Qualitative data

Qualitative data from the sleep diaries are the patients' comments on their inability to sleep. The amount of comments were written literally and counted. Each comment could contain several statements, and each statement was counted. Thereafter, the author read the comments thoroughly several times to find categories or headings. The statements were

then categorized under these headings.

3. RESULTS

3.1 Quantitative data

This article describes the results gained from the PSQI-questionnaire preoperatively (preop), one month after discharge and two months postoperatively (PO) after cardiac surgery.

A total of 90 patients were included in the control group (CG), and 87 in the intervention group (IG). After discharge from the hospital, there were still 90 patients in the CG, but a drop out of 12 during the whole study, whereas there was a reduction of 18 in the IG during hospitalization, and after discharge a further reduction of 5, ending up with 69. The groups were equivalent concerning gender, age ($p = .11$) and operation ($p = .71$). Total drop out analysis showed no difference between the drop out patients and the patients in the study related to demographic data and type of operation. 6 males and 6 females in the control group dropped out after discharge from hospital, 4 males and 1 female in the intervention group. The mean age among the drop outs was 62.53 years.

Table 1 presents demographic data and surgical procedures. The mean age of the patients in the IG were 67.3 (SD 24-81) which is 5 years older than the mean age of the patients in the CG. There were no differences in age between men and female in the CG, yet a difference of 4 years in favour of the women in the IG. Age and the distribution on sex, where approximately one quarter was female, represent the general population regarding cardiac surgery.

Table 1. Demographic data and surgical procedures

	Control				Intervention				P value
	N	%	Age	SD	N	%	Age	SD	
Demographic Characteristics									
Male	69	76.6			50	74.6			.85
Female	21	23.3			17	25.4			
Total	90	99.9			67	100.0			
Age all			62.4	12.5			67.3	11.1	.011
Surgical procedures									
Valve	26	28.9			34	50.7			
Aorta aneurysm	9	10.0			2	3.0			
CABG*	33	36.7			19	28.4			
Double procedure*	15	16.7			9	13.4			
GUCH*	7	7.8			2	3.0			
Missing	0				3	1.5			.071
Total	90				67				

*CABG: Coronary artery bypass graft, Double procedure: Both valve- and coronary artery bypass graft procedure, GUCH: grown up congenitive heart disease.

Table 2 shows a mean global sleep-quality score preoperatively higher than 5 in both groups, where the highest is in the IG (6.23). In both groups the score is higher 1 month PO than preop., and once again it is highest in the IG (7.37). After two months, however, the score in the IG group is lower (5.10) compared to the CG (5.59). The difference between preop and 2 months PO is 1.13 in the IG group and 0.44 in the CG, respectively. No significant difference between the control- and intervention-group was found in terms of global PSQI score. Two months after surgery the PSQI score is lower in both groups than preop, yet the fall in the IG group

is higher than in the CG, and the mean difference is also higher between 1 and 2 months PO in the IG.

Table 2 also presents the SD differences in the mean global score in the control- and intervention-group before and after surgery, showing the same tendency as mentioned before. Again, the score between 1 and 2 month PO is higher in the IG (2.15), $p = .075$ than in the CG (1.18). It is lower between preop. and 2 months PO in the IG than the CG, thus showing a greater mean difference ($p = .546$) between pre-op and 2 months PO.

Table 2. Mean global PSQI-score and differences in mean global PSQI-score

	Control			Intervention			P-value
	N	PSQI	SD	N	PSQI	SD	
Mean Global PSQI score							
Preop	90	6.03	3.7	67	6.23	4.09	.75
1 mth PO	80	6.8	3.63	64	7.37	3.99	.378
2 mth PO	78	5.59	3.64	64	5.10	3.27	.4
Differences in Mean Global PSQI score	Control			Intervention			P-value
	PSQI-diff	SD		PSQI-diff	SD		
Preop - 1 mth PO	-1.00	3.7		1.39	3.8		.546
1 mth PO - 2 mth PO	1.18	2.8		2.15	3.36		.075
Preop - 2 mth PO	0.33	3.5		.66	2.82		.546

Looking at the distribution on global PSQI score on groups of good sleepers, middle sleepers and bad sleepers (see Table 3), the percentage of good sleepers (0-5 pts) in the IG has developed from 53% to 65.7% after two months, but from 54.5% to 61.6% in the CG. In the group of really bad sleepers

(14-21 pts), the percentage is 7.5% in the CG and 3.2% in the IG. The distribution has changed so that the group of good sleepers is larger by 12.7% after two months in the IG but larger by 7.1% in the CG.

Table 3. Groups of good sleepers, middle sleepers and bad sleepers related to PSQI-scores

Allocation to groups in relation to PSQI scores	Preop.				2 month PO			
	Control		Intervention		Control		Intervention	
	N	%	N	%	N	%	N	%
0-5 pts	49	54.5	35	53	48	61.6	42	65.7
6-13 pts	37	41.2	25	39.3	25	32.1	18	28.9
14-21pts	4	4.4	6	7.5	5	6.4	2	3.2
Total	90	100	66	99.8	78	100.1	62	97.8

Note. Preop = preoperative, PO = Postoperative

In Table 4, assessment points from the questionnaire are presented for both groups before, 1 mth and 2 mths after discharged from hospital. In the IG, sleep onset latency (SOL) (minutes) is more than 6 min's higher 1 month PO than before surgery, and then decreases with 5.26 min's in the IG to 20.08 after 2 months compared to the CG. In the CG the

difference between 1 and 2 month is 0.75 min's. In terms of patients' own assessment of their sleep quality, the score in the IG 2 months after surgery is .70 compared to .85 in the CG. The difference between first and second PO month is 0.33 in the IG compared to 0.01 in the CG. In both groups, this is a better score than before operation with a smaller dif-

ference between the groups of 0.10 in favour of the IG. Total nocturnal sleep duration is increasing in both groups after one month and is after 2 months almost equalized (6.88 resp. 6.81). The same trend is found regarding sleep efficiency, where the IG showed improvement in sleep after two months compared to the CG. Sleep efficiency is a bit higher in the IG than in the CG 2 months PO, and better than before hospi-

talization. Regarding the use of sleeping medicine, there is a nearly significant difference between 1st and 2nd PO month with a lower score in the IG (.34) before operation, then a higher score than in the CG on .73 after 1 month, and then again a lower score of .28 and .53, respectively, in the CG 2 months after surgery.

Table 4. Important PSQI assessment points

Important assessment points	Control		Intervention		P-value
	N	Value	N	Value	
<i>Sleep onset latency min</i>					
Baseline	90	20.06 ± 20.13	67	19.28 ± 20.9	.815
1 mth	80	20.81 ± 17.55	64	25.34 ± 28.84	.247
2 mths	78	19.59 ± 16.82	64	20.08 ± 16.49	.862
<i>General assessment of sleep quality (0 is better, 3 worse)</i>					
Baseline	90	1.04 ± .847	67	.99 ± .826	.661
1 mth	80	.86 ± .611	64	1.03 ± .712	.128
2 mths	78	.85 ± .753	64	.70 ± .609	.215
<i>Nocturnal sleep duration, hs</i>					
Baseline	90	6.67 ± 1.188	67	6.54 ± 1.32	.526
1 mth	80	6.83 ± 1.250	64	6.62 ± 1.485	.376
2 mths	78	6.88 ± 1.155	64	6.81 ± 1.384	.736
<i>Sleep efficiency, % of time in bed</i>					
Baseline	90	84.49 ± 14.63	67	82.17 ± 14.26	.323
1 mth	80	79.79 ± 13.38	64	77.29 ± 15.61	.301
2 mths	78	83.12 ± 12.75	64	82.29 ± 14.27	.689
<i>Wake after sleep onset (0-27)</i>					
Baseline	90	8.27 ± 4.2	67	7.85 ± 4.36	.547
1 mth	80	8.91 ± 4.14	64	9.16 ± 4.30	.731
2 mths	78	6.89 ± 3.54	64	6.95 ± 3.84	.914
<i>Use of sleeping medicine (0 is better, 3 worse)</i>					
Baseline	90	.37 ± .87	67	.34 ± .90	.869
1 mth	80	.69 ± 1.13	64	.73 ± 1.10	.803
2 mths	78	.53 ± 1.02	64	.28 ± .70	.098
<i>Problems staying awake in social contexts (0 is better, 3 worse)</i>					
Baseline	90	.26 ± .65	67	.34 ± .79	.459
1 mth	80	.20 ± .46	64	.38 ± .77	.117
2 mths	78	.16 ± .47	64	.13 ± .42	.593

3.2 Qualitative data

In the CG, 75 patients had commented on their sleep during their hospitalization compared to the 58 patients in the IG. During the first 4 nights in the ward, there were 206 comments in the CG and 117 in the IG. The comments turned out to be very brief statements on reasons for patients' inability to sleep, often just two or three words, such as back-pain,

toilet or coughing. Some comments on sleep were more detailed like: "woke up in the middle of the night and scarcely slept afterwards" or "I usually sleep lightly".

After having written all the statements accurately down, they were read carefully several times and the following headings were formed: Nurses' observations, physiological problems, pain, neighbour-patient, positioning in bed, and environmen-

tal conditions. Physiologic problems are for example coughing, arrhythmias, respiratory problems, dizziness, nausea or feeling warm. Environmental conditions are for example noise, light, complaints about the beds or room temperatures. Nurse observations were the most prominent cause of poor sleep; on the first night in the ward, 5.8% in the CG and 5.1% in the IG suffered sleep loss due to nurses' observations. Environmental conditions also played a role in sleep disturbances, as 3.4% in the CG and 2.6% in the IG experienced poor sleep during the first night, while this number changed to 4.9% in the CG and 2.6% in the IG on the fourth night. On the fifth night, however, it increased to 7.3% in the CG and 5.0% in the IG. The same tendencies are seen in the rest of the themes. Qualitative data is only used for assessing intervention fidelity.

4. DISCUSSION

The aim of the study was to examine the effect of a nursing intervention based on sleep anamneses and sleep hygienic principles on patients' self-reported sleep quality, measured by changes in sleep duration, sleep efficiency and sleep onset latency as well as the use of sleep medicine. Even though none of the results in this study are significant, the nursing interventions seem to have had some effect on patients' global PSQI-score, sleep efficiency and use of sleep medicine, especially after two months, as the results from the IG show a generally better sleep among participants than in the CG. A greater population in the intervention group could, however, have made some changes to the outcome.

The groups included were comparable concerning gender, age ($p = .11$) and operation ($p = .71$). The results showed that participants who completed the study were older in the intervention group than in the control group. Generally, the elder aged in the IG can be viewed as confounder. This difference in age can be due to administrative changes in the Heart Centre just before the intervention took place, which led to an opening of a fast track ward. The fast track ward normally operates patients with a "calculated normal trajectory". Patients from fast-track unit were not included in the study. Several patients in the IG, who in the first place agreed to contribute, withdrew their confirmation after some days, possibly because it was a more vulnerable group with a more complex trajectory than the control group. A consequence of this can be that the patients in the ward, where the intervention was carried out, are more affected by their heart disease than the patients in the control group. Redeker, Ruggiero and Hedges^[4] correlated age and severity of cardiac disease with changes in sleep patterns, frequency of awakenings and less nocturnal sleep time.

This study shows no improvement in terms of sleep onset

latency (SOL), which was expected. SOL pre-op is 20.06 and 19.28, respectively, in the IG, but between pre-op and 1 month PO, there is a larger increase in the IG of more than 6 minutes to 25.34 min's., yet followed by a greater decline between 1 and 2 months PO (5.26) compared to the CG (1.22 min's). The general increase in SOL in both groups after 1 month is probably due to the effects of surgical stress.^[15,17] The larger increase in SOL in the IG can be a result of patients that are more elderly and therefore more "bad sleepers", and thus it may imply that the operation is harder to overcome for elderly persons. It may look as if the intervention has had some effect. Total nocturnal sleep duration is throughout the study lower in the IG, but shows a greater increase between the first and second month PO than in the CG, and the difference between the two groups is less two months PO (0.072 h). Preop. it was 0.128 and was after one month 0.202 h, where-after the difference between the groups equalizes. Sleep efficiency (SE) is slightly higher in the IG than in the CG 2 months PO, and better than before hospitalization. One month after the operation, SE was 79.79% and 77.29%, respectively, which is comparable to the findings in a review study conducted by Liao *et al.*^[47] The control- and intervention group had a SE of 83.2% and 82.29%, respectively, at 2 months PO – which was lower than pre-op regarding the CG (84.49%), but higher regarding the IG (82.17%).

Preoperative PSQI-score suggests that all patients have a poor sleep quality (> 5). Two months after surgery both groups show improved results, yet the IG comes out with better results (5.10) than the CG (5.59), and the mean difference over time is higher in the intervention group. This is further confirmed by the distribution on groups (see Table 3), which shows that patients in the IG group have moved up on the scale and become generally better sleepers. Redeker, Ruggiero and Hedges^[4] found that cardiac surgery patients did suffer from sleep problems (PSQI > 5) and that aging and severity of cardiac disease influenced sleep patterns, like less nocturnal sleep time. They presented a global PSQI score pre-op of 6.99, which is higher than in this study (IG: 6.03, CG: 6.23). They found that patients' self-reported sleep quality continued to improve from 4 weeks to 8 weeks PO, where they found a global score of 6.82 and 5.59/5.1, respectively, in this study. The results in other studies concerning reacquisition of normal sleep patterns vary from weeks to months and even up to one year after discharge from hospital.^[1,3,5-7,12]

In contrast to their findings, the results in this study indicate an improvement in sleep pattern variables, especially in the IG after two months PO. This positive progress may continue, since the review study by Liao *et al.*^[47] conclude

that sleep disturbances persist over the course of recovery and it takes about two months for sleep to recover to pre-operational levels. More than 57% of the patients in their study reported sleep disturbances during the first 6 months after surgery. In this study, 65.7% in the IG had a PSQI score between 0-5 after two months, which is associated with good sleep quality. Since the participants in the IG are older and more ill than in the CG, one could expect worse results in this group. However, this is not the case, as the participants' global PSQI score is better in the IG than in the CG. This could indicate that the intervention to some extent can prevent sleep problems or at least prevent sleep problems from escalating further. It looks as if patients achieve a better sleep after two months, and therefore it could be interesting to study sleep and sleep habits over a longer period to see if the effect of the intervention would be longer lasting or if their sleep quality were to keep on improving.

Strength and limitations of the study

Even though the randomized clinical trial is the strongest design when testing interventions, we chose a controlled intervention study design due to the nature of the study. It was not possible to randomize patients to a control group and a treatment group because the nurses take care of all the patients during nighttime, and it would therefore be impossible to ask them to do one intervention to a patient in one bed, but not offer the same to the patient in the neighbor bed. Furthermore, there would be the risk of intervention patients sharing information with control patients, and since most patients share rooms, control patients would then be able to listen to the instructions given to the intervention patients. Consequently, the patients were included consecutively, first in the control-group, and when the intervention was implemented, the inclusion in intervention group then took place to ensure that there were no interactions between the groups, which could contaminate the results. Thus, the nurses had no special attention on sleep in the control group. The teaching and training of nurses ran over half a year, and they were encouraged to use their knowledge at once to make it possible to remember the intervention and to practice their intentions of changing habits. Nurses were taught and trained by the same person who also collected data and during the data collecting period, daily interviewed the participants regarding their sleep. This made it possible to detect whether or not a nurse followed the decisions of the intervention and to clarify the reasons hereof. There were no observations or follow up on the study during nighttime.

The method used in the study is the PSQI questionnaire, which is a well-validated and precise instrument. Several studies use polysomnography, which is considered the "gold

standard" as it objectively measures the quality and quantity of sleep. Subjective methods like nurses or patients' assessment have been used, and each of these instruments has their own advantages and disadvantages.^[47] In this study, patients' self-reported data was preferred, as it displays the patients' own experience and produces a varied picture of the patients' sleep patterns, how the sleep is assessed and whether the sleep was regarded restorative. A disadvantage by using self-reported data is that patients may evaluate their sleep worse than a polysomnograph, but since sleep quality has to do with the subjective feeling of restoration and well-being, this method allows giving a better subjective aspect of sleep.

The data collection in this study ended two months after the operation. Since the positive tendencies only emerge more than one month after the operation it could be interesting to follow the patient for a longer period to see if their sleep quality is still improving. This could be done either by use of the PSQI questionnaire or by making a telephone call to the patients after a four month and half a year. Such a call would have at least two aims: to gain knowledge about the sleep quality and to reinforce the strategies that seemed to work for the patients.

Only a few clinical trials on sleep promoting interventions^[2] and on nurse led interventions during hospitalization has been carried out. A study like this has not been made previously in clinical nursing practice. Wang *et al.*^[26] queries that there has not been described which elements are the most effective in cognitive therapy and sleep hygiene, which could be a point of criticism in this study. As the intervention intends to be based on principles of sleep hygiene, reflective discussions and decisions about sleep and the patients' subjective experience of their sleep and sleep habits, it is not possible to point out the exact elements in the intervention that has had an effect. Yet, some elements were pointed out in the education: maintain a normal sleep pattern and comfortable positioning in bed, release pain sufficiently, decrease routine controls, consider the arrangements of patients and the use of sleep medicine, and avoid noise and disturbances from staff. The patients' sleep diaries give some indication on the actions that have been performed by nurses. This could be *e.g.*, moving a neighbour patient out of a room, assessing patients' physical condition and comparing it to the need of sleep before the night shift, only monitoring when necessary, assisting patients to a better positioning in bed by use of pillows, handing out pain killer morning dose earlier in the morning (or night), having conversations with patients about their concerns, helping patients who are unable to fall asleep out of bed so they can be active until they feel sleepy, or distributing sleep medicine if patients are unable to sleep, which was previously quite unusual. As sleep problems are

being taken more and more seriously, patients may similarly be more positive in their evaluation of their sleep quality.

5. CONCLUSION

Conclusively, it seems as if the systematic effort that included teaching in sleep, training in sleep anamneses and focused nursing based on sleep hygienic principles has affected nurses' understanding of what good sleep means for the individual patient, and to some extent, made nurses change habits and propose individual nursing actions, targeted to patients' needs and wishes. The effect is seen particularly on patients' sleep two months PO in terms of global PSQI, total sleep time, SE, sleep medication, sleep quality and WASO, although no results are significant. However, this could be due to a higher mean age in the intervention group. It seems as if the more subjective feelings about sleep quality has improved, which may be of some importance since sleep quality is characterized as a subjective experience. The difference in age between the groups should be considered when assessing the results.

Implications for practice

Sleep problems is a huge problem in the general population as well as in heart surgery patients. Treatment of insomnia should be individualized as this intervention has been. Nevertheless, studies that clarify the most effective elements in sleep hygiene are needed. Cognitive behavioural therapy addressing dysfunctional beliefs and that are combined to other strategies has shown promising results.^[32,33] This study supports the argument that nurses' increased knowledge about sleep and sleep hygienic principles and the use of sleep anamneses has an effect on patients' perceived sleep quality or may diminish the consequences of bad sleep. The nurses were not educated in cognitive therapy, but in normal sleep and sleep hygienic principles, and even though they were able to advice the patients about sleep, they were not able to change the patients' sleeping habits during a short hospitalization. Other methods could have been chosen and a recent study on CAB surgery patients is exploring the effect of mindfulness.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest.

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