A Pilot Study on Daylight, View and Stress in Operating Room Personnel: the DasOK Study

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Samenvatting

Een Pilot Studie over Daglicht, Uitzicht en Stress in Operatiekamermedewerkers: de DasOK studie

Achtergrond: Gezonde werkomgeving is van groeiend belang in de gezondheidszorg. Daglicht en uitzicht kan een verbetering zijn om stress te verlagen en humeur te verbeteren. Eerder onderzoek heeft met name plaatsgevonden in labs of zich gericht op kantoormedewerkers, en in veel mindere mate op de gezondheidszorg. Weinig onderzoek heeft zich gericht op operatiekamermedewerkers. Daarnaast dienen de onderzoeken die gedaan zijn in andere beroepsgroepen gevalideerd te worden voor operatiekamermedewerkers.

Doel: Het doel van deze pilotstudie is het verzamelen van wetenschappelijk bewijs van het effect van toegang tot daglicht en uitzicht naar buiten op de stress ervaren door operatiekamermedewerkers.

Methode: Deze studie bevat een cross-sectionele survey en een crossover studie met herhaalde metingen in het veld.

Resultaten: Ervaren stress was significant lager bij participanten werkzaam in een omgeving met daglicht en uitzicht. Uitzicht naar buiten verminderde de slaapbehoefte in de lente en het aantal keren dat participanten wakker werden gedurende de nacht ervaarden. In objectieve metingen in het veld werden deze bevindingen niet waargenomen.

Conclusie: Hoewel deze studie geen significante verschillen in hartslagvariabiliteit, als objectieve maat van stress, liet zien, werd de subjectieve ervaring van stress wel beïnvloed door toegang tot daglicht en uitzicht naar buiten in de werkomgeving. Dit dient erkend te worden en passende maatregelen moeten worden genomen om verpleegkundigen minder gestrest en gezond te houden en hen te helpen een hoge kwaliteit van zorg te bieden.

Aanbevelingen: Toekomstig onderzoek dient te proberen het effect van uitzicht naar buiten op stress te scheiden van het effect van daglicht op stress. Virtuele Ramen moeten ook onderzocht worden, om te bekijken welke mogelijkheden deze bieden in een omgeving waar gewone ramen niet toepasbaar zijn.

Abstract

A Pilot Study on Daylight, View and Stress in Operating Room Personnel: the DasOK Study

Background: Healthy work environments are important in healthcare, to maintain happy staff and to prevent turnover. Access to daylight and exterior view (e.g. nature, air, buildings etc.) in the workplace could lead to a decrease in stress and improvement in mood. Previous research has predominantly been performed labs or office settings, and substantially less in healthcare. Very few studies have focussed on operating room personnel. Furthermore, the studies performed in other occupations need to be validated for operating room personnel.

Aim: The aim of this pilot study is to find scientific evidence for the effect of access to daylight and exterior view on stress and wellbeing in operating room personnel.

Methods: This study comprises a cross-sectional survey and a within-subjects repeated-measures crossover trial in the field.

Results: Perceived stress is found to be significantly lower in an environment with access to daylight and an exterior view. Access to such a view reduced the number of hours of sleep needed in spring and the number of occasions participants awoke during the night. These results were not confirmed by data from the trial.

Conclusion: Although this study did not show significant differences in heartrate variability as an objective measure of stress, the subjective experience of stress influenced by an exterior view and daylight should be acknowledged and dealt with to help nursing staff lower their stress levels and provide high quality of care.

Implication of key findings: Future research should separate the effect of exterior view on stress from the effect of daylight on stress. Virtual windows should be investigated, to research the possibilities of these windows in facilities where regular windows are not feasible.

Key words: operating room nursing, perioperative nursing, light, occupational stress

1. Introduction

In hospitals, work environments need to be structured carefully. Staff shortages are growing, and it is important to keep current staff healthy and satisfied. Doing so can reduce sick leaves, enhance the health of the staff, and improve quality of care.[1–3]

Work environments may be enhanced through the addition of windows, providing a view of the outdoors or access to daylight, or both. Research has found that regular exposure to daylight has a positive effect on health.[4,5] Exposure to daylight increases physical activity.[4,6] Daylight also has a positive effect on mood, stress and depression.[5] Higher levels of daylight and access to natural surroundings correspond with better mood, higher energy and less tension.[7] Individuals in need of restoration benefit from daylight and nature.[7] Previous studies have also shown that access to an exterior view, (i.e. the outdoor environment: nature, air, buildings etc.; hereafter view) reduces stress.[8] People with reduced access to such a view self-report insufficient sleep.[9]

Daylight and view are thus associated with better workplace performance, lower burnout rates and greater job satisfaction.[8–10]

Little research on exposure to daylight, view, and occupational health has been performed on nurses working in hospitals, but the extant studies report positive effects. With increased exposure to daylight, nurses have been found less likely to experience job stress and job dissatisfaction, reducing levels of burnout.[6] Most nurses also felt that an increase in natural daylight had a positive impact on their work life.[6] Although windows produce glare, most nurses still preferred to be located near a window.[6] Sleepiness was reduced and mood was improved in nurses who had access to daylight.[11] Communication between nurses also improved.[11] Nurses reported higher job satisfaction and, better workplace performance, and safety in hospitals increased.[6,12] Nurses working in daylight three hours per day also experienced less work-related stress in comparison to nurses working in daylight less than three hours a day.[13] Further research is required to confirm prior findings, to develop methods feasible for field studies on the effect of daylight and view on occupational stress, and to find practical applications for the results.

Previous research has often been performed in a lab or has focussed on office workers or nurses working in regular nursing departments. These studies' findings cannot be transferred to other situations and occupations due to divergent environments and job functions. Furthermore, lab research has been conducted in a controlled setting with clear instructions and has ignored factors present in the field.[14] This research in operating room (OR) personnel (OR-nurse, anaesthesiology nurse) can offer more practical implications and

recommendations for their specific employment settings, regarding lighting and environment, mood and job satisfaction, and quality of care.

This exploration offers an opportunity to investigate the effect of daylight and exterior view on stress in OR-personnel and to create work environments to help staff to lower stress levels and to increase quality of care.

2. Aims

The aim of this pilot study is to find scientific evidence for the effect of access to daylight and exterior view on stress and wellbeing in OR-personnel.

3. Methods

This section discusses the methods of this pilot study's two parts: the survey and the field research.

Survey

Design

The survey was a cross-sectional study focussing on the effect of access to daylight and view in the work environment of OR-personnel; it inquired after participants' health and mental state and sought insight into respondents' preferences and experiences concerning aforementioned access. Participants were also asked to answer questions about their physical work environment concerning windows, exterior view and daylight. In cross-sectional studies, determinant and outcome data are collected at the same time, to study the effect of the determinant (in this case access to daylight and view) on the outcome (in this case stress and wellbeing).[15,16]

Population and Domain

Population of the survey was OR-personnel. Subjects were eligible when working as OR-nurse or anaesthesiology nurse.

A sample size of 196 was calculated using GPower, with an effect size of 0.25 (based on a previous study),[7] an alpha of 0.05 and a power of 0.8.

Data Collection and Procedures

The survey used several subscales of validated questionnaires: the Activation-Deactivation Adjective Checklist, the Seasonal Pattern Assessment Questionnaire and the Dutch Questionnaire on the Experience and Evaluation of Work.[17–19] It involved questions about stress at work, seasonal symptoms, recovery from work, tiredness at work and sleep quality. Responses ranged from (0) never to (4) always. Figure 1 provides the validity and reliability of the subscales.

Insert Figure 1

Questions about respondents' experiences and preferences concerning daylight in the work environment were added. The survey was sent to three general hospitals and one university hospital in the Netherlands using the online tool SurveyMonkey. Two OR-departments had access only to interior views (e.g. hallways) and two departments had access to exterior views. After one week, two weeks and four weeks reminders to complete the survey were sent.

Data Analysis

The survey resulted were analysed using an ANOVA. Scores for the different subscales were calculated, a higher score indicating more health or mental-health symptoms. A Shapiro-Wilk test showed the data are normally distributed. Listwise deletion of missing data was performed. The added questions regarding preferences and experiences were summarized. Calculations were performed using IBM SPSS Statistics Version 23 (Armork, New York, USA, 2015).

Field research

Design

The field study was a within-subjects repeated-measures crossover trial, focussing on examining the difference in stress between access to daylight and a view and no access to daylight and a view in OR's. This design reduces bias introduced by a differences in the characteristics between two groups.[16,20] The intervention in this study was daylight, defined as the natural light during daytime.[4] Daylight through windows is also called indirect or refracted daylight.[10] The exposure to daylight in this trial was mostly refracted, since participants spend most of the time indoors. The second intervention in this trial was exterior view, defined as a view of the outdoor environment (e.g. nature, air, buildings etc.).

Population and Domain

The population in this study was OR- personnel. Eligible participants worked as OR-nurses or anaesthesiology nurses. Participants with mental health problems were excluded from the sample. All participants completed the Beck Depression Inventory (BDI) before the study began, to exclude participants with signs of depression. A sample size of 27 participants was calculated, with an average of 18 completed short questionnaires per participant per condition, an intraclass coefficient of 0.287 (based on a previous study),[7] an alpha of 0.05 and a power of 0.95. The average of 18 completed questionnaires was based on a feasibility study performed in advance of this pilot study. Participants in this feasibility study did not experience the questionnaires as a burden, since it contained only nine questions and took under two minutes to complete. Thus, the method was further pursued in the current study. The research was performed at the OR-department of a general hospital in the Netherlands. The department had OR's with windows with a view, through which daylight could reach the room. These windows could be blinded by closing a screen, which made it possible for each OR to be either with or without daylight.

Procedures and Data Collection

The field study was performed from February through April of 2018. Arrangements for the researcher to visit the department for recruitment of subjects were made. The board of directors gave permission for the research. The department was frequently visited for recruitment of participants, through presentations, posters and discussion with prospective participants.

Participating subjects completed a demographics questionnaire, the BDI and the Munich Chronotype Questionnaire (MCTQ) at the start of the trial.[17,18] During the trial, participants were exposed to two circumstances: a work environment with daylight and view and a work environment without daylight and view. All participants started with access to daylight and view and, after completing data collection in this condition, moved to a working environment without this access.

Data on stress were collected using Experience Sampling Method (ESM).[21] This is useful for collecting the experiences of participants as well as moment-to-moment changes in mood and affect.[21] ESM requires participants to complete multiple short questionnaires during the day.[21]

Over a period of 72h in each condition, both at the workplace and at home, participants answered questionnaires and had their heartrate variability (HRV) and light exposure measured.

An app for the questionnaires (figures 2 and 3) was developed, and participants were provided with a smartphone containing the app. At the start of each day, participants completed a short questionnaire of nine questions concerning sleep. The questionnaire was based on the MCTQ.[22] Throughout the day, participants were asked to complete a questionnaire of nine questions concerning momentary stress. The questionnaire, based on the Activation-Deactivation Adjective Checklist, was tested in a feasibility study.[17] It involved questions about energy, tension, calmness and stress. Responses ranged from (0) not at all to (6) a lot. The questionnaire also asked what scenery participants could view at that moment and whether an acute situation had occurred since completing the previous questionnaire. Every 1,5h, from 7:00am to 9:30pm, a notification was send to remind participants to complete a stress questionnaire. This resulted in 10 notifications per day. Participants were instructed to try to complete as many questionnaires as possible, but when the questionnaire interfered with patientcare, participants were not obligated to answer.

Insert Figure 2

Insert Figure 3

Participants wore a LightLog device (figure 4), containing four light sensors, on the left or right shoulder to measure individual light exposure.[23] The LightLog was calibrated to the OR-department lighting to guarantee correct measures.

Insert Figure 4

Furthermore, participants carried a heartrate meter (ActiHeart 4, Camntech, UK; figure 5) for 72h consecutively per condition to assess HRV, a measure often used as an indicator for stress.[24–27]

Insert Figure 5

Finally, subjects were asked to complete a diary at the end of each day, to gain information about other factors that could affect stress (alcohol, coffee, temperature).

Data Analysis

For the questionnaires, a score was calculated for analysis. A higher score indicated more stress. For HRV, three variables were used: square root of the mean squared differences of successive normal intervals (RMSDD), standard deviation of normal intervals (SDNN) and standard deviation of the average normal intervals (SDANN). Low values indicate an increase in heartbeats and thus an increase in stress.[26–28]

These data were combined and analysed using IBM SPSS Statistics Version 23 (Armork, New York, USA, 2015). The Shapiro-Wilks test showed the data had a non-normal distribution. As a result of this distribution and a small sample size, non-parametric analyses (Wilcoxon-signed rank and Friedman's ANOVA) were performed instead of a Hierarchical Linear Model as is common in ESM-research.[29] This change resulted in missing data. Little's missing completely at random (MCAR) test showed that the missing data were MCAR. Listwise deletion was used in handling these missing data, due to the pattern of MCAR and a limited loss of power (0.77 vs. 0.67).[30,31]

Ethical Issues

The Medical Ethical Committee of the University Medical Centre Utrecht has deemed this study not obligatory to the Medical Research Involving Human Subjects Act. The study followed the regulations of the Dutch Personal Data Protection Act, the Declaration of Helsinki and the guidelines of Good Clinical Practice.[32–34] Informed consent was signed in advance of the study. The study imparted no risks to participants.

4. Results

Survey

Demographics

A total of 170 people (Table 1) participated in this survey, resulting in 119 completed questionnaires. A majority (81,76%) was female. Most participants (31,8%) were between 21 and 30 years old. Most participants (62,9%) were OR-nurses. A majority of 39,4% worked approximately 36 hours per week. One hundred and three participants (38,1%) had more than 10 years of work experience. A total of 99 participants (58,2%) worked at the university hospital. Of the participants, 68 (40%) worked in an OR with windows with an outside view.

Insert Table 1

Perceived Stress

A significant difference was calculated between perceived stress (Table 2) in participants with access to daylight and view and participants without this access ($p<,05$). Participants exposed to daylight and view experienced less stress than those not exposed.

Scores of participants who answered both questions, indicating working in an environment alternating with and without windows, were compared and showed a significant difference in perceived stress between the two conditions ($p<,05$). Participants experienced less stress when exposed to daylight and view in contrast to no exposure.

Insert Table 2

Seasonal Affective Symptoms

A significant difference in the effect of different views (inside, air, nature, buildings, other; Table 3) on hours of sleep needed during spring was calculated ($p<,05$). A view of natural surroundings significantly reduced the number of hours of sleep participants needed during spring, in contrast to the other views ($p<,05$). In the other seasons, no significant difference in effects was found.

A significant difference was found in the effect of number of days with a view of the outside environment (ranging from one to six) on sleep needed during spring ($p<,05$). An outside view of six days resulted in significantly fewer hours of sleep needed during spring ($p<,05$). In the other seasons, no significant difference in effects was found.

No other significant differences in the effects of window types (four types: no OR has windows, some OR's have windows, all OR's have windows, I only work on OR's with no

windows due to my speciality) and the effects of exterior views on SAS, sleeping hours and severity of SAS were determined.

Insert Table 3

Nocturnal Awakening

A significant effect was found between views and their effect on nocturnal awakening (p<,05; Table 4). Access to natural views during the day decreased the amount of time participants experienced insomnia during the night.

Work pleasure, energy during work, recovery after work, emotional reactions during work & tiredness during work

No further significant differences between window types, views, and days with outside view and their effects on work pleasure, energy during work, recovery after work, emotional reactions during work and tiredness during work were found (Table 4).

Insert Table 4

Experiences and Preferences

Most participants stated that having an exterior view at their work has a positive effect on wellbeing (90,7%), health (85,4%) and work performance (74,8%). Most participants also indicated that having no such view at their work has a negative effect on wellbeing (67,7%), health (58,2%) and work performance (41,4%).

Many participants (93,9%) specified a preference for working with access to an exterior view. Frequently expressed reasons were contact with the outside world, the idea of weather and time, and better circadian rhythms. Participants indicated that a view provides a form of relaxation and influences energy levels.

A small majority (59,5%) stated no issues, such as blinding, glare or reflections, with daylight in the OR. Only 35,8% of participants expressed satisfaction with the light conditions in the department, often suggesting more daylight or windows at the OR's or more possibilities to regulate the light at the OR's (e.g. dimming or turning off lights, controlling automated sunscreens).

Field Study

Demographics

Six subjects (Table 5) participated in the field study, resulting in 227 completed questionnaires through the ESM-approach. Four women and two men participated in the field

study. Mean age was 40 years. Mean work hours per week were 34,5 and mean years' work experience was 19 years.

Insert Table 5

Stress

No significant difference between mean stress score in a work environment with daylight and view and a work environment without these characteristics were found (Table 6). Neither a significant difference between scores between the same time points (T1 in condition 1 vs T1 in condition 2 etc.) in the two circumstances was found.

Insert Table 6

No significant difference between several types of view and window (outdoors, indoors-no window, indoors-window-no view, indoors-window-view) and their effect on stress was determined (Table 7). Comparison of the views and windows in pairs also showed no significant difference in scores.

Insert Table 7

Heartrate variability

No significant difference was found between the three mean heartrate variabilities (HRV) over 24h (Table 6) in the two work environments. No significant difference in comparison of the measures per hour on the same time points in the two circumstances (T1 in condition 1 vs T1 in condition 2 etc.) were determined. No significant difference was calculated when comparing HRV per 24h between the two conditions.

No significant difference between several types of view and window and their effect on HRV was found (Table 7). Comparison of the views and windows in pairs also showed no significant difference in scores.

5. Discussion

The survey shows a significant decrease in perceived stress when exposed to daylight and view in the work environment. This study also indicates that access to exterior view has a significant reducing effect on hours of sleep needed in spring and the occasions participants experienced insomnia during the night. The survey, furthermore, shows that participants consider that access to daylight and view at the workplace has a positive effect on wellbeing, health and work performance. The field study, however, does not confirm these results. No significant effects of daylight and view on HRV and momentary stress were found during the field study.

The current study shows similar findings to those of previous research. Participants in a study concerning daylight and electric light had a preference for daylight and had more positive associations with daylight than with electric light.[35] The subjects associated daylight with vitamin D, health, energy and relaxation.[35] The current study shows similar associations: participants think access to daylight and view in the workplace has a positive effect on health, wellbeing and work performance. In a study researching the environmental preferences of healthcare workers, participants stated a preference for access to nature, daylight, and a view of the outdoor environment, because such surrounding provides relaxation and may have a positive effect on their health.[36] A preference for nature views over buildings was also expressed.[36] A study focussing on the relationship between exterior view and stress in nurses indicated that nurses who could view natural setting had lower levels of stress than nurses with a view of the outside that was non-natural.[37] Previous research has shown that perceived stress can have a negative effect on quality of care.[38,39] Access to daylight and view can thus be concluded to have a positive effect on perceived stress and thus on quality of care, based on these studies.

On the contrary, however, a study focussing on environmental quality in Hellenic OR's found that light satisfaction was lower in OR's with daylight, indicating that the prevalence of such symptoms was higher in these OR's.[40] This study stated that acceptable light in the work environment reduced the prevalence of health-related symptoms among OR-nurses to 1,3 symptoms versus 2,6 symptoms without acceptable light.[40] By contrast, the current study shows that light satisfaction increases with daylight in the work environment. Furthermore, the previously mentioned study on the relationship between exterior view and stress in nurses found a positive effect of an outdoor view on acute stress in nurses.[37] During the current study, however, no situations causing acute stress, which explains the difference in findings. The current study was focused more on chronic stress. As another point of contention, a study on the impact of windows and daylight on acute care nurses found a

significant effect of these characteristics on physiological measures of stress.[41] Researchers found a significant decrease of blood pressure, and increase of body temperature, and oxygen saturation of the blood.[41] No significant difference in heart rate was found.[41] Studies have shown that an increase in systolic blood pressure remains over a longer period of time, which makes it more easily measurable.[42,43] HRV is a sensitive measure of stress, that is not always as easily detected and is mostly correlated with acute stress.[42–44] A study focussing on the effect of seeing nature on mood and self-depletion did find a significant effect of natural scenes on heart rate and HRV.[45] Notably, however, this study was performed in a lab in a stylized setting with clear instructions, which could affect its outcomes, because it excludes possible influencing factors and introduces performance bias through directed attention.[14] External validity of lab studies is low.

The current study uses both objective and subjective measures to assess the research aim. Furthermore, the survey was spread over multiple hospitals, limiting bias due to possible experienced issues in work stress specific for one hospital. The survey included subscales of validated questionnaires to address a wide range of aspects associated with daylight and view, and related symptoms. The field research included repeated measures and used a crossover design to limit bias. Data collection was interrupted briefly for one week after daylight savings, to limit bias due to false-negative reports on stress. Lastly, this study is unique in measuring individual light exposure.

The present study admits of a number of limitations. A limitation of the current study is sample size. Due to time limitations, increased work pressure and staff shortages at the OR-departments, it was not possible to reach sample size, even after the design was adjusted to be able to include more participants. An adjustment in analysis (from HLM to non-parametric analysis) limited a loss of power, but the study remained slightly underpowered. The study suggests a direction for future research, but a generalized conclusion cannot be drawn. Another limitation is that in the hospitals participating in the survey, light measures were not performed. Answers could be linked only to what participants indicated as light exposure and view. Lastly, a remarkable finding in this study is the effect of view on the hours of sleep needed during spring. Earlier studies have not reported such a result. A possible explanation for this finding is that the current study was conducted during spring and participants could indicate their hours more accurately for this season than for the other seasons. This could introduce recall bias.

This study shows that exterior view and daylight reduces perceived stress. Future research should further investigate the different effects of exterior view and daylight on stress and should try to separate the effect of exterior view from the effect of daylight, allowing for more

practical implications of these findings. Future research could also focus on the effect of virtual windows.[46] These windows show exterior views on LED screens, providing access to a view without rebuilding facilities. This research could guide implications for these windows in work environments in which a real window is not feasible, but positive effects of view are desirable.

Although this study did not show significant differences in HRV as objective measure of stress, access to view and daylight in work environments is a positive development in building new healthcare facilities. Subjective experience of stress is influenced by access to view and daylight and this should be acknowledged and dealt with to help nursing staff lower stress and provide high quality of care.

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Figures & Tables

Figure 1 Validity and Reliability of Questionnaires and Subscales in the survey

AD-ACL*	Test-retest Reliability	General Activation	0.89
		High Activation	0.93
		General Deactivation	0.89
SPAQ**	Cronbach's α	Used completely	0.82
QEEW***	Cronbach's α	Pleasure in your work	0.79
		Recovery after work	0.87
		Sleep quality	0.86
		Emotional reactions during work	0.89
		Tiredness during work	0.96

*=Activation-Deactivation Adjective Checklist; **=Seasonal Pattern Assessment Questionnaire;
***=Questionnaire on the Experience and Evaluation of Work

Figure 2 Sleep Questionnaire in app

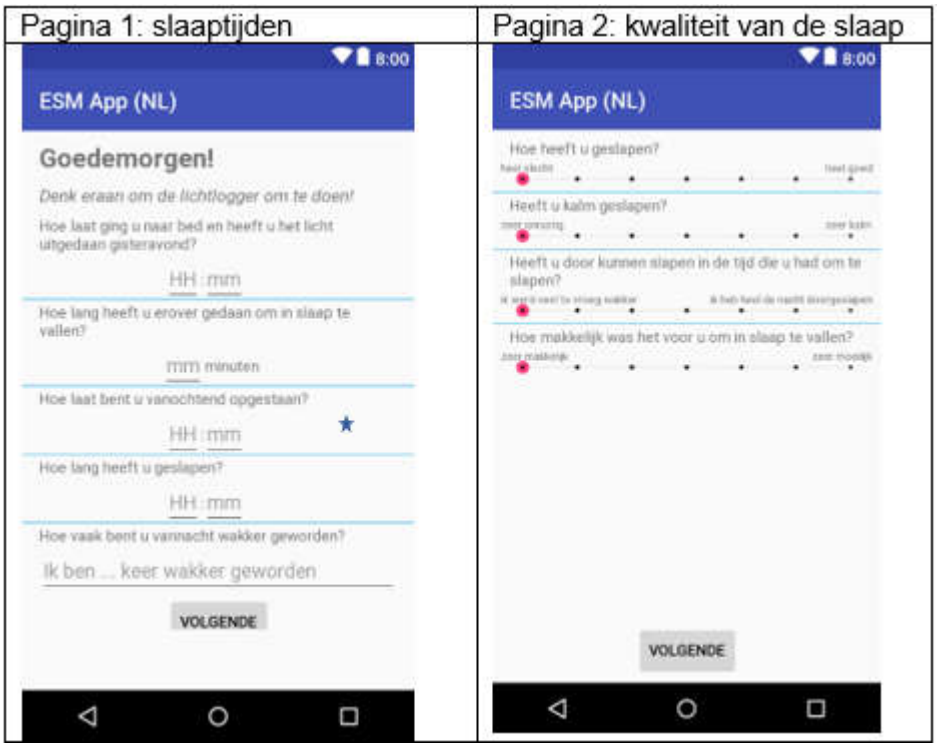

Figure 3 Momentary Stress Questionnaire in app

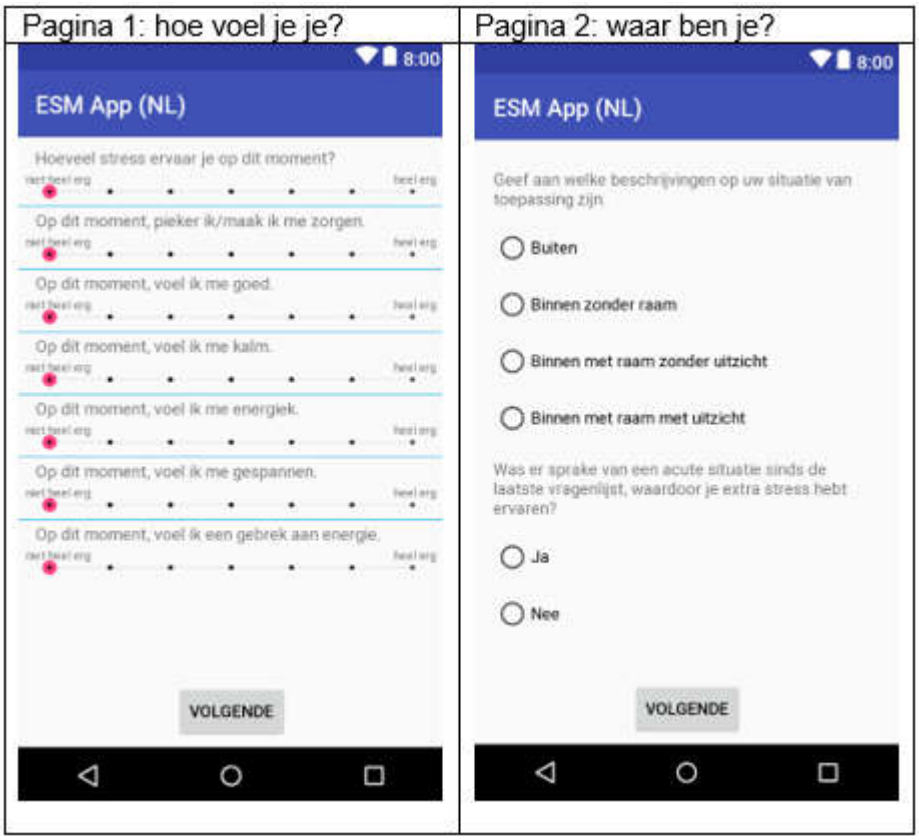

Figure 4 LightLog

Figure 5 ActiHeart

Table 1 Demographics Survey

Demographics	N = 170
Gender	
Male	31 *(18,24%)*
Female	139 *(81,76%)*
Age	
<20	1 *(0,6%)*
21-30	54 *(31,8%)*
31-40	38 *(22,4%)*
41-50	27 *(15,9%)*
51-60	39 *(22,9%)*
>60	11 *(6,5%)*
Function	
OR-Nurse*	107 *(62,9%)*
Student OR-Nurse	6 *(3,5%)*
Ane.-Nurse**	49 *(28,8%)*
Student Ane.-Nurse	4 *(2,4%)*
Other	4 *(2,4%)*
Working hours	
16	3 *(1,8%)*
24	34 *(20%)*
28	14 *(8,2%)*
32	28 *(16,5%)*
36	67 *(39,4%)*
Other	24 *(14,1%)*
Years Experience	
<1	5 *(2,9%)*
1-2	12 *(7,1%)*
2-5	23 *(13,5%)*
5-10	27 *(15,9%)*
>10	103 *(38,1%)*
Hospital	
University Hospital	99 *(58,2%)*
General Hospital	71 *(41,8%)*
OR's	
<7	7 *(4,1%)*
7-10	23 *(13,5%)*
11-15	36 *(21,2%)*
16-20	90 *(52,9%)*
21-25	14 *(8,2%)*
View	
Inside	38 *(22,4%)*
Air	17 *(10%)*
Nature	15 *(8,8%)*
Buildings	25 *(14,7%)*
Other outside view	11 *(6,5%)*
Missing	64 *(37,6%)*

*=operating room nurse; **=anaesthesiology nurse

Table 2 T-tests Perceived Stress

Group	N	Mean	SD	SE	t	p
One-sample T-test						
With Windows	98	11,133 *(6-21)*	2,892	0,292	38,108	0,000*
Without Windows	85	13,047 *(1-22)*	3,093	0,336	38,885	0,000*
Paired T-test						
With windows-without windows	57	-1.491	3,333	0,442	-3.377	0,001*

*p<0,05

Table 3 ANOVA SAS, sleeping hours, severity of SAS

Groups	N	Mean	SD	Sum of Squares	df	Mean Square	F	p
SAS*								
Windows	122	15,37	4,800	74,556	3	24,852	1,081	0,360
View Types	97	15,41	4,926	73,061	4	18,265	0,745	0,564
Days with outside view	93	15,46	4,862	118,294	5	23,659	1,001	0,422
Sleeping hours Winter								
Windows	122	2,53	0,645	2,982	3	0,944	2,475	0,065
View Types	97	2,52	0,679	2,094	4	0,523	1,143	0,341
Days with outside view	93	2,52	0,685	2,065	5	0,413	0,873	0,503
Sleeping hours Spring								
Windows	122	2,13	0,497	0,458	3	0,153	0,612	0,608
View Types	97	2,14	0,500	2,486	4	0,622	2,660	0,038**
Days with outside view	93	2,14	0,502	2,879	5	0,576	2,467	0,039**
Sleeping hours Summer								
Windows	122	2,01	0,471	0,086	3	0,029	0,161	0,922
View Types	97	2,01	0,395	1,025	4	0,256	1,688	0,159
Days with outside view	93	2,00	0,390	0,590	5	0,118	0,765	0,577
Sleeping hours Autumn								
Windows	122	2,39	0,567	1,969	3	0,656	2,098	0,104
View Types	97	2,35	0,578	1,174	4	0,294	0,874	0,483
Days with outside view	93	2,34	0,580	1,025	5	0,205	0,595	0,703
Severity of SAS*								
Windows	122	1,52	1,093	1,687	3	0,562	0,465	0,707
View Types	97	1,54	1,100	1,938	4	0,484	0,390	0,815
Days with outside view	93	1,55	1,108	4,752	5	0,950	0,764	0,478

*=Seasonal Affective Symptoms;**p<0,05

Table 4 ANOVA work pleasure, energy during work, recovery after work, nocturnal awakening, emotional reactions during work, tiredness during work

Groups	N	Mean	SD	Sum of Squares	df	Mean Square	F	p
Work Pleasure								
Windows	120	32,593	23,035	1582,419	3	527,473	0,994	0,398
View Types	95	31,461	22,387	3000,191	4	750,048	1,532	0,200
Days with outside view	91	32,234	22,714	1676,203	5	335,241	0,637	0,672
Energy during work								
Windows	120	45,611	14,479	436,538	3	145,513	0,470	0,704
View Types	95	45,965	16,488	1246,523	4	311,631	1,154	0,337
Days with outside view	91	46,081	16,440	769,143	5	153,829	0,555	0,734
Recovery after work								
Windows	120	66,065	17,756	1112,736	3	370,912	1,182	0,320
View Types	95	64,737	17,205	1294,170	4	323,543	1,098	0,363
Days with outside view	91	64,713	17,419	1507,395	5	301,479	0,993	0,427
Nocturnal Awaking								
Windows	120	0,500	0,502	1,517	3	0,506	2,059	0,110
View Types	95	0,490	0,503	2,374	4	0,594	2,500	0,048*
Days with outside view	91	0,490	0,503	0,499	5	0,100	0,381	0,860
Emotional reactions during work								
Windows	119	10,854	18,397	293,696	3	97,899	0,284	0,837
View Types	94	11,259	19,350	1284,924	4	321,231	0,853	0,496
Days with outside view	90	11,296	19,645	1288,367	5	257,673	0,655	0,659
Tiredness during work								
Windows	119	73,343	17,170	649,822	3	216,607	0,730	0,536
View Types	94	72,636	16,898	310,344	4	77,586	0,263	0,901
Days with outside view	90	73,210	17,181	2203,485	5	440,697	1,538	0,187

*p<0,05

Table 5 Demographics Field Study

Demographics	N=6	Mean(sd)
Gender		
Male	2	
Female	4	
Age		40,33 (16,2)
Function		
OR-nurse*	5	
Ane-nurse**	1	
Working hours/week		34,50 (4,72)
Years of work experience		19,17 (16,03)
Chronotype		13:26 (4:22)
BDI* **		4,00 (3,52)

*=operating room nurse; **=anaesthesiology nurse; ***= Beck Depression Inventory

Table 6 Wilcoxon Signed-Rank Tests Field Study

Groups	Z	p
Mean Score	-0,524	0,600
T Score	0,465	0,642
Mean SDNN*	-0,314	0,753
T SDNN	0,120	0,904
Mean SDANN*	0,734	0,463
T SDANN	0,864	0,864
Mean RMSDD*	-0,943	0,345
T RMSDD	1,342	0,180

*=heart rate variability measures

Table 7 Friedman's ANOVA & post-hoc Wilcoxon Signed-Rank tests Field Study

Groups	Z	p
Score		0,560
Indoors No Window - Outdoors	-0,530	0,596
Indoors Windows No view - Outdoors	-0,921	0,352
Indoors Window View - Outdoors	-0,476	0,634
Indoors Window No view - Indoors No window	-1,017	0,309
Indoors Window View - Indoors No window	-0,469	0,639
Indoors Window View - Indoors Window No view	-1,724	0,085
SDNN*		0,145
Indoors No Window - Outdoors	-1,599	0,110
Indoors Windows No view - Outdoors	-1,836	0,086
Indoors Window View - Outdoors	-1,718	0,086
Indoors Window No view - Indoors No window	-0,703	0,482
Indoors Window View - Indoors No window	-0,684	0,494
Indoors Window View - Indoors Window No view	-0.008	0,994
SDANN*		0,120
Indoors No Window - Outdoors	-1,836	0,066
Indoors Windows No view - Outdoors	-1,362	0,173
Indoors Window View - Outdoors	-1,599	0,110
Indoors Window No view - Indoors No window	-0,442	0,658
Indoors Window View - Indoors No window	-1,570	0,116
Indoors Window View - Indoors Window No view	-0,471	0,637
RMSDD*		0,586
Indoors No Window - Outdoors	-0,533	0,594
Indoors Windows No view - Outdoors	-0,889	0,374
Indoors Window View - Outdoors	-0,415	0,678
Indoors Window No view - Indoors No window	-1,225	0,220
Indoors Window View - Indoors No window	-1,415	0,157
Indoors Window View - Indoors Window No view	-1,773	0,076

*=heart rate variability measures