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# Vividly Colored Accessories and Mood Changes in Patients Undergoing Breast Surgery

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## Abstract

Few studies have examined the impacts of color stimuli on perioperative mood and quality of recovery; thus, this randomized controlled trial aimed to assess impacts of vividly colored accessories on mood and quality of recovery after breast surgery. This single-center, single-blind randomized controlled trial included 36 participants (all aged ≥ 20 years) who were randomized into intervention (n = 19) and control groups (n = 17). The intervention group received vividly colored accessories. The primary and secondary study outcomes were patient mood, evaluated using a two-dimensional mood scale, and postoperative recovery, evaluated using Quality of Recovery-15, which were assessed on postoperative day 3. There were no statistical intergroup differences in the scores of the Two-Dimensional Mood Scale (11.2 [intervention group] vs. 10.4 [control group], $P = 0.75$) and Quality of Recovery-15 (126.8 [intervention group] vs. 129.3 [control group], $P = 0.73$). Thus, the use of vividly colored accessories by patients undergoing breast surgery was not found to affect patients' mood and quality of recovery.

## Keywords

Vividly Colored Accessories, Perioperative Mood, Quality of Recovery, Breast Surgery

## 1. Introduction

Although breast surgery is not a highly invasive procedure, patients scheduled to

undergo breast surgery are likely to experience changes in their mood, including fear of surgery, during the perioperative period, which contributes to their anxiety and depression, feelings of injustice, and disposition to be pessimistic and expect postsurgical pain [1]. Color psychology studies the effects of color on human behavior and emotions. Color therapy, also known as chromotherapy, is based on the idea that color and colored light may contribute to improving physical and mental health [2]. A study conducted with community-dwelling participants showed that red and green lights improved cognitive function more than white lights [3]. Moreover, different color stimuli have been reported to affect physical attributes such as muscle strength, flexibility, and balance [4]. However, there is little evidence regarding the impact of color stimuli on perioperative mood and the quality of recovery. Based on the hypothesis that wearing colorful accessories improves mood and enhances the quality of postoperative recovery, this randomized controlled trial aimed to assess the effects of vividly colored accessories on mood, quality of recovery, and sleep efficiency after breast surgery.

## 2. Materials and Methods

This was a single-center, single-blind, randomized controlled trial. The study protocol was approved by the local ethics committee (approval number 2950, Chairperson Prof. M. Yoshizumi) on July 8, 2021, and was registered in the UMIN Clinical Trials Registry (UMIN000045091). This study was conducted in accordance with the Consolidated Standards of Reporting Trials guidelines.

This study included female patients aged ≥ 20 years who were scheduled to undergo elective mastectomy for breast cancer under general anesthesia. The exclusion criteria were lack of informed consent, dementia, motor paralysis, and lack of postoperative drainage tubes. Eligible patients underwent routine preoperative evaluation at our institution on the day of surgery and then received an explanation of the study. After obtaining written informed consent from the patients, 36 patients were enrolled and randomized to the intervention and control groups using the "RAND" function in Excel (Microsoft, Redmond, WA, USA). In both groups, researchers assessed preoperative anxiety and depression using the Hospital Anxiety and Depression Scale (HADS) after surgery. The HADS is a self-assessment tool used to evaluate anxiety and depression and consists of seven items each for the anxiety and depression subscales. A total score of ≥8 on each subscale indicates the presence of anxiety or depression symptoms [5]. Individuals' pain experiences were evaluated via telephone using the Pain Catastrophizing Scale (PCS). The PCS consists of 13 items, each of which is scored on a scale from 0 to 4. A total score of ≥30 is considered indicative of a high level of catastrophic thinking [6].

The wGT3X-BT monitor (ActiGraph, Pensacola, FL, USA) was used to measure sleep efficiency from 6 days preoperatively to 4 days postoperatively, except during the operation period, which was highly correlated with polysomnography for

measuring sleep efficiency [7].

After hospital admission, the Quality of Recovery-15 (QoR-15) [8] and Two-Dimensional Mood Scale (TDMS-ST) scores [9] were evaluated. The intervention group received vividly colored accessories, including turbans (b-1), drain bags (b-2), and wristbands (b-3) with five colors such as blue, green, orange, yellow, and pink (**Figure 1**).


**Figure 1.** Caption Suiminkagaku (sleep science) pajamas and vividly colored accessories.

The allocation of colored accessories was determined in advance, and the patients or researchers did not choose the accessories. The QoR-15, a standard tool for assessing postoperative recovery, consists of 15 items and the total score ranges from 0 to 150, with a high score indicating better recovery [8]. TDMS shows a quadrant consisting of high arousal-pleasure (energetic and lively), low arousal-displeasure (lethargic and listless), low arousal-pleasure (relaxed and calm), and high arousal-displeasure (irritated and nervous). Each item was scored on a scale of 0 to 5 points. Vitality, stability, and pleasure scores were calculated using the following formula: vitality score = score of item 4 + score of item 8 − score of item 3 − score of item 7; stability score = score of item 1 + score of item 5 − score of item 2 − score of item 6; pleasure score = vitality score + stability score. The total scores for vitality, stability, and pleasure range from −10 to 10, −10 to 10, and −20 to 20, respectively, and a high total score indicates a better status [9]. Both groups were given Wacoal (Wacoal, Kyoto, Japan) pajamas made of cotton and silk, and the patients wore them postoperatively. These pajamas are marketed as "suiminkagaku (sleep science) pajamas (**Figure 1(a)**)" and were created based on the concept of sleeping comfortably from the time one goes to sleep at night until waking up refreshed in the morning. Perioperative patient management, including anesthetic management, was performed according to the institutional protocol, and the attending anesthesiologist was not informed of the group assignment.

### 2.1. Outcome

The primary outcome was mood change, which was evaluated using the TDMS on the day before surgery and postoperative day 3. The secondary outcomes in this study were postoperative recovery, which was evaluated using the QoR-15 on the day before surgery and postoperative day 3, and sleep efficiency, measured using the wGT3X-BT monitor.

### 2.2. Collected Data

In the preoperative anesthesia clinic, age, body mass index, comorbidities (symptomatic stroke, ischemic heart disease, hypertension, diabetes, and American Society of Anesthesiologists physical status), and serum albumin and creatinine levels were routinely assessed. In addition, intraoperative data, including anesthetics (intravenous anesthetics or inhalation anesthetics), fentanyl and remifentanil doses, fluid volume, and surgical duration, were collected.

### 2.3. Statistical Analysis

Categorical and continuous data are presented as numbers (%) and means (standard deviations), respectively. Statistical analyses between the two groups were performed using Fisher's exact test or unpaired t-test for categorical and continuous variables, respectively. Sleep efficiency was compared between the two groups using a linear mixed model. To our knowledge, no previous study has evaluated mood changes in surgical settings. Thus, it was estimated that each TDMS item would change by 1; that is, there would be a difference of 8 in the pleasure score between the intervention and control groups (alpha = 0.05, beta = 0.80, standard deviation = 10). After considering 10% of the data to be missing, enrollment of 28 patients in each group was planned. All data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA), and statistical significance was set at $P < 0.05$.

## 3. Results

Before beginning this study, we planned to obtain consent from 58 patients; however, the study had to be terminated when 36 patients were included because of the coronavirus disease pandemic. The patients were randomly assigned to the intervention group (n = 19) or the control group (n = 17); however, three patients (two in the intervention group and one in the control group) withdrew their consent during the follow-up period (**Figure 2**).

**Table 1** shows the patient demographics and intraoperative data. The mean age and BMI in both groups were 62 years and 23 kg/m$^2$, respectively. One patient in the intervention group had diabetes. There was a high prevalence of depression and anxiety in both groups. There appears to be no significant difference between the two groups in terms of intraoperative factors.

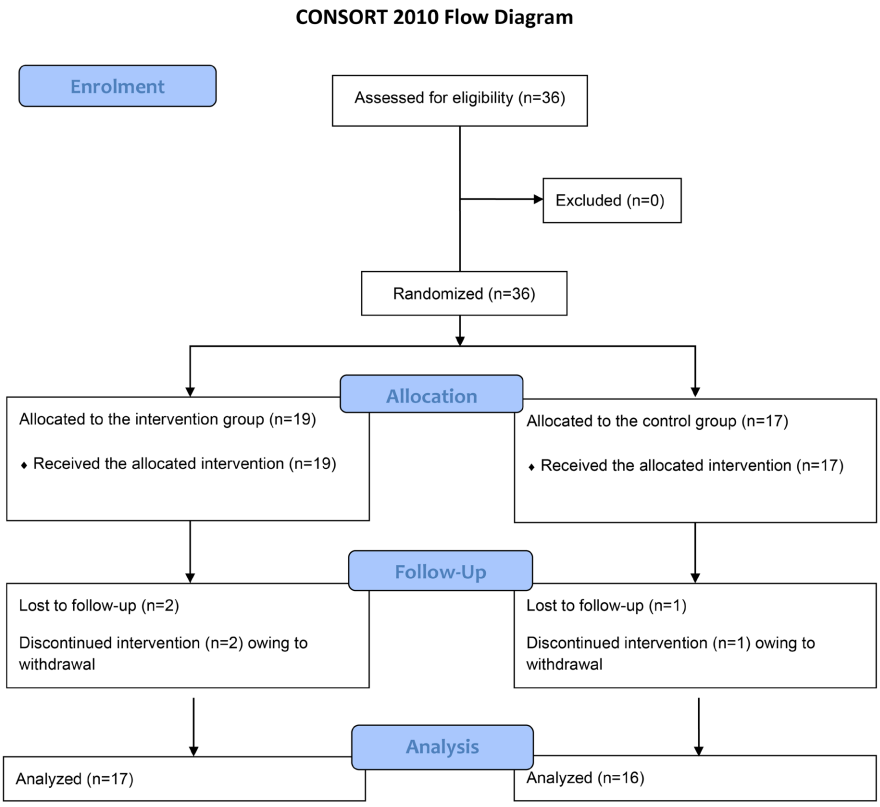



**Figure 2.** Consort 2010 flow diagram.

**Table 1.** Patient demographics and intraoperative data.

| | Control group (n = 16) | Intervention group (n = 17) |
|---|---|---|
| Age (years) | 62.2 (14.6) | 62.1 (14.4) |
| Body mass index (kg/m$^2$) | 23.5 (3.7) | 23.2 (3.1) |
| Symptomatic stroke | 1 (6.2) | 0 (0.0) |
| Ischemic heart disease | 0 (0.0) | 0 (0.0) |
| Hypertension | 2 (12.5) | 2 (11.8) |
| Diabetes | 0 (0.0) | 1 (5.9) |
| ASA Physical Status | | |
| 1 | 7 (43.8) | 5 (29.4) |
| 2 | 9 (56.2) | 12 (70.6) |
| Depression | 15 (93.8) | 17 (100.0) |
| Anxiety | 14 (87.5) | 17 (100.0) |
| Pain catastrophizing | 1 (6.2) | 4 (23.5) |
| Serum albumin (g/dL) | 4.0 (0.4) | 4.3 (0.3) |
| Serum creatinine (mg/dL) | 0.59 (0.1) | 0.59 (0.1) |

**Continued**

| | | |
|---|---|---|
| Intraoperative data | | |
| Intravenous anesthetics | 6 (37.5) | 7 (41.2) |
| Fentanyl dose (mcg) | 215 (126) | 170 (77) |
| Remifentanil dose (mg) | 1.01 (0.6) | 0.98 (0.3) |
| Fluid volume (mL) | 837 (217) | 824 (151) |
| Surgical duration (min) | 131 (40) | 128 (37) |

Mean (standard deviation) or number (%); ASA, American Society of Anesthesiologists; TDMS-ST, Two-dimensional Mood Scale-Short Term.

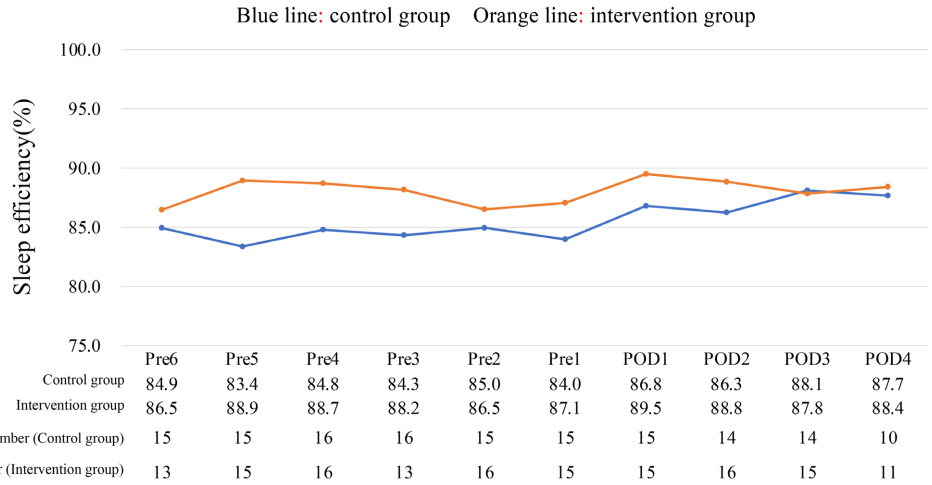
As shown in Table 2 and Supplementary Table 1, there were no statistical differences in the TDMS and QoR-15 scores between the two groups.

Table 2. Outcomes.

| | Control group (n = 16) | Intervention group (n = 17) | *P* value |
|---|---|---|---|
| TDMS-ST | | | |
| Preoperative score | | | |
| Vitality | 3.2 (4.1) | 3.4 (3.4) | 0.86 |
| Stability | 4.4 (3.7) | 6.6 (3.0) | 0.07 |
| Pleasure | 7.6 (6.9) | 10.0 (5.3) | 0.27 |
| Postoperative score | | | |
| Vitality | 4.1 (3.5) | 3.6 (4.7) | 0.77 |
| Stability | 6.4 (4.2) | 7.6 (2.7) | 0.32 |
| Pleasure | 10.4 (7.3) | 11.2 (7.1) | 0.75 |
| QoR-15 | | | |
| Preoperative score | 138.3 (8.1) | 137.1 (16.3) | 0.79 |
| Postoperative score | 129.3 (17.2) | 126.8 (23.6) | 0.73 |

Mean (standard deviation); QoR-15, Quality of Recovery-15; TDMS-ST, Two-dimensional Mood Scale-Short Term.

One patient in the intervention group refrained from wearing ActiGraph. Of the remaining 36 patients (intervention group, n = 16; control group, n = 16), those for whom valid data were available were included in the analysis. Sleep efficiency increased with time ($P = 0.04$), and was higher in the intervention group than in the control group ($P = 0.02$). However, no significant interaction was observed ($P = 0.12$) (Figure 3).




| | Pre6 | Pre5 | Pre4 | Pre3 | Pre2 | Pre1 | POD1 | POD2 | POD3 | POD4 |
|---|---|---|---|---|---|---|---|---|---|---|
| Control group | 84.9 | 83.4 | 84.8 | 84.3 | 85.0 | 84.0 | 86.8 | 86.3 | 88.1 | 87.7 |
| Intervention group | 86.5 | 88.9 | 88.7 | 88.2 | 86.5 | 87.1 | 89.5 | 88.8 | 87.8 | 88.4 |
| Number (Control group) | 15 | 15 | 16 | 16 | 15 | 15 | 15 | 14 | 14 | 10 |
| Number (Intervention group) | 13 | 15 | 16 | 13 | 16 | 15 | 15 | 16 | 15 | 11 |

**Figure 3.** Trajectory of sleep efficiency.

## 4. Discussion

This randomized controlled trial, which included 37 patients scheduled to undergo breast surgery, did not show any differences in mood or quality of recovery between the two study groups. Additionally, the intervention group had higher sleep efficiency than the control group did. However, no interaction or sleep efficiency was observed between the two groups.

Effective medical creation is a concept based on the theme of "Art of Medicine," a project to create a comfortable space for patients, their families, and medical professionals by ensuring collaboration between the five senses (sight, hearing, touch, taste, and smell) and thinking (compassion and wisdom) [10]. This project aims to create a comfortable space for patients, their family members, and medical professionals [10]. In medical environments wherein EMC has been applied. An ornamental hospital room was created in the intensive care unit, and false windows were installed in general wards without windows [10] [11]. However, because of the expense involved in installing and maintaining these fixtures, this study focused on color.

The postoperative TDMS scores were higher in the intervention group, but the difference was not statistically significant. The TDMS is a relatively new assessment tool and has been used in a limited number of studies [12]-[14]. Furthermore, a minimally clinically important difference (MCID) for the TDMS has not yet been reported. Thus, we assumed that an increase of 1 point in the score for each of the eight items (*i.e.*, a total increase of 8 points) would represent a significant change. However, our estimates might have been too high. Furthermore, no statistically significant difference was observed in the QoR-15 score, with an MCID of 6.8 [15]. These facts indicate that vividly colored accessories have no impact on mood or quality of recovery after breast surgery. Interestingly, almost all the patients experienced preoperative anxiety (31/33) and depression (32/33). Although patients with anxiety and depression were not investigated, it is possible that relief from surgery completion significantly affected patients' mood and

quality of recovery.

In contrast to our previous study showing that sleep efficiency decreased temporarily after lung cancer surgery, sleep efficiency increased over time after breast cancer surgery [16]. Additionally, in both groups, sleep efficiency after surgery was >85%, which is thought to indicate better sleep conditions [17]. Possible explanations for this may be the degree of invasiveness of the surgery, wearing of comfortable pajamas, and relief of anxiety associated with the surgery.

This study had some limitations. First, because this study had to be terminated early, it lacked sufficient power; therefore, the results should be interpreted with caution.

We calculated the effect size, which is an index independent of the number of samples, for the postoperative TDMS-ST subscales. As a result, the effect sizes for vitality, stability, and pleasure were 0.12, 0.23, and 0.11, respectively, which could not be said to be high. This may indicate that not only is there no statistically significant difference, but also that the clinical significance is weak. Second, the generalizability is limited because this was a single-center study. Third, the color of the accessories used by the patient was determined in advance, and could not be selected by the patient. However, the accessories used in this study were created specifically for this study, and were limited in number. Therefore, we thought that if we used colors that matched the patients' preferences, there was a possibility that we would run out of accessories midway through the study. Therefore, we provided accessories of predetermined colors in the order in which they were included in the study. The results could have been different if the patients had chosen the colors they preferred. Fourth, this study adopted three items: turban, wristband, and drain bag; however, the use of other items might have yielded different results.

## 5. Conclusion

In conclusion, the use of vividly colored accessories by patients undergoing breast surgery in hospitals did not affect their mood or recovery after surgery. However, color adjustments are costly and cannot cause adverse events. Thus, future studies are needed to explore the impact of color on the postoperative outcomes.

## Acknowledgements

The authors are grateful to Keiko Furusawa (Bonrich, Osaka, Japan), who designed the vividly colored accessories.

## Ethical Approval

The ethical approval for this study (approval number 2950; Chairperson: Prof. M. Yoshizumi) was obtained on July 8, 2021.

## Informed Consent

All the included patients provided written informed consent.

## Financial Support

The pajamas used by the study participants were provided by Wacoal (Kyoto, Japan).

## Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Supplementary

**Table S1.** Scores for each item of the TDMS-ST.

| | Intervention group | | Control group | |
|---|---|---|---|---|
| Item | Before surgery | After surgery | Before surgery | After surgery |
| TDMS-ST 1 | 3.7 (1.3) | 4.1 (1.1) | 2.8 (1.6) | 3.7 (1.5) |
| TDMS-ST 2 | 4.7 (0.5) | 4.8 (0.3) | 4.6 (0.7) | 4.6 (1.0) |
| TDMS-ST 3 | 4.3 (1.3) | 4.5 (1.0) | 4.8 (0.3) | 4.6 (0.4) |
| TDMS-ST 4 | 2.7 (1.3) | 2.8 (1.5) | 1.9 (1.7) | 3.0 (1.5) |
| TDMS-ST 5 | 3.4 (1.2) | 3.7 (1.2) | 2.4 (1.5) | 3.3 (1.3) |
| TDMS-ST 6 | 4.7 (0.7) | 4.7 (0.5) | 4.4 (1.0) | 4.6 (0.8) |
| TDMS-ST 7 | 4.4 (1.0) | 3.5 (1.6) | 4.0 (1.4) | 3.9 (1.1) |
| TDMS-ST 8 | 1.8 (1.3) | 2.6 (1.7) | 2.3 (1.7) | 2.3 (1.7) |

Mean (standard deviation); TDMS-ST: Two-dimensional Mood Scale-Short Term.