A semi-randomized study determining the psychological and physical effects of three types of eye masks on adult women

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Research

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Abstract

Background: Warm compresses are one of the nursing techniques clinically used to improve patients' comfort and promote the treatment efficacy. Here the effects of eye masks (EM), heated eye masks (HEM), and aroma-scented heated eye masks (AHEM) and their potential as a nursing technique to provide comfort were studied.

Methods: Participants in this study were 42 healthcare professionals (female, 20–60 years of age), who voluntarily consented to participate. They participated in all three interventions with EM, HEM, and AHEM at an interval of at least 1 week between interventions. Indicators used were low frequency to high frequency ratio (LF/HF), blood flow, axillary temperature, pulse rate, blood pressure, the salivary α-amylase activity (SAA), and the Profile of Mood States Second Edition (POMS).

Results: Of 42 participants in total, 32 were included in the analysis. Their mean age was 46.8 years. The blood flow and axillary temperature values significantly increased and the LF/HF values and the pulse rates significantly decreased after the use of EM, HEM, or AHEM. The POMS Total Mood Disturbance (TMD) score and scores for six POMS subscales significantly decreased after the use of EM, HEM, or AHEM.

Comparisons among the three groups showed differences in LF/HF. Scores for subscales of POMS also differed among the three groups.

Conclusions: These results suggest that the use of EM, HEM, or AHEM intervention is safe with no major body burden. Parasympathetic nerves may be dominant after the EM, HEM, or AHEM interventions The TMD score improved after the EM, HEM, or AHEM intervention. The data suggest that the AHEM use is particularly effective in alleviating depression, dejection, and confusion after the intervention. These findings indicates that the EM, HEM, or AHEM use holds potential as a nursing technique to provide comfort.

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Background

The application of warm compresses is one of the nursing techniques to provide patients with comfort. Warm compresses are clinically used to improve patients' comfort and promote treatment efficacy. The effects of warm compresses have been demonstrated. Thermal stimuli owing to warm compresses to the body have been demonstrated to act on the circulatory/nervous/muscular systems and elicit biological reactions, providing relaxation [1], effective pain care [2, 3], sleep induction [4], and other beneficial effects.

The application of warm compresses around the eyes has attracted attention as a means to alleviate visual display terminal (VDT) syndrome [5]; furthermore, relaxation and sleep improving effects have been reported [6, 7]. However, no previous studies have used physiological, biochemical, and psychological indicators to comprehensively test the effects of the application of eye masks (EMs), heated (HEMs), and aroma-scented heated eye masks (AHEM). This was a study to build a body of evidence for the use of an EM, HEM, or AHEM as a nursing technique to provide comfort.

This study aimed to clarify the psychological and somatic effects of the EM, HEM, or AHEM and to examine its potential as a nursing technique to provide comfort.

Methods

Study design

This was a crossover-controlled study, conducted at Kyoto Prefectural University of Medicine in Japan from July 2018 to April 2019. (UMIN-CTR R000021207)

Participants and recruitment

A total of 42 healthcare professionals (female; age, 20–60 years) who could understand the purpose and procedures of the study and provided consent to participation on their own will were included. The additional criteria were as follows: (1) those who required medication on a regular basis, smokers, and pregnant women were excluded; (2) menstruating women were included only when the menstrual cycle was regular and the last menstruation ended no more than 10 days before the study initiation (follicular phase), whereas postmenopausal women were included without any restrictions; (3) participants should have had enough sleep as usual the day before; and (4) they were not allowed to have any meals or caffeine-containing drinks within 2 h before the study participation.

Sample size

The sample size (an effect size of 0.25, an α error of 0.05, and a power of 0.8) calculated employed G*Power version 3.1.97, with 20% extra to compensate for participants who would drop out or be excluded. The study was designed with 42 participants in each intervention arm (total sample size, 126).

Setting

Study period and setting

The study was conducted from August 2018 to March 2019. Experiments were conducted in a private room, where the temperature and humidity were controlled at 24°C and 60%, respectively, in the ward of K University Hospital.

Intervention details

Participants wore a conventional EM in the EM group, an unscented heated commercially available EM in the HEM group, and a lavender-scented heated commercially available EM in the AHEM group. These special-purpose EMs have a disposable heat- and steam-generating sheet that safely and easily warms the periocular skin, which is uniquely designed to provide moist heat through the chemical reaction of iron, water, and oxygen when its package is opened [8].

Semi-randomization

Participants were evenly assigned to one of the intervention sequences in the order they agreed to participate in the study, until the predetermined sample size was reached.

Endpoints

Attributes

As attribute information, the participants were asked about age and occupation.

Physiological indicators

LF/HF, blood flow, axillary temperature, pulse rate, systolic blood pressure, and diastolic blood pressure were the physiological indicators.

(1) LF / HF used the analysis program MemCalc / Bonaly Light (GMS, Tokyo, Japan) to calculate electrocardiograph waveforms continuously measured using the AC301 Active Tracer (GMS, Tokyo, Japan). LF/HF, which is a ratio of the low frequency domain (0.04–0.15 Hz) and high frequency domain (0.15–0.40Hz), is generally considered an indicator of the cardiac sympathetic nervous activity [9].

(2) Blood flow in the earlobe was measured using the RBF-101 research laser blood flowmeter (Pioneer, Tokyo, Japan). This blood flowmeter falls into class 1M according to the safety of laser products of the Japanese Industrial Standards and is not dangerous as long as it is used in compliance with the instruction manual.

(3) Axillary temperature was measured with the MC-610HP electronic thermometer (OMRON Healthcare, Kyoto, Japan).

(4) Systolic blood pressure, diastolic blood pressure, and pulse rate were measured with the HEM-642 digital blood pressure monitor (OMRON Healthcare, Kyoto, Japan).

Biochemical indicator

SAA was measured with the Salivary Amylase Monitor (Nipro, Osaka, Japan), a dry clinical chemistry analyzer. The SAA levels correspond to plasma norepinephrine concentrations and are increasingly used as an accessible measure of sympathetic nervous system reactivity to stressors [10].

Profile of Mood States 2nd Edition

POMS [11] was used as the psychological indicator. Scores for the following seven subscales are used to cover a broad range of mood states: Anger–Hostility (AH), Confusion–Bewilderment (CB), Depression–Dejection (DD), Fatigue–Inertia (FI), Tension–Anxiety (TA), Vigor–Activity (VA), and Friendliness (F). In addition, the Total Mood Disturbance (TMD) score was used to assess the participants' "current" mood states.

Procedures

The procedures used to conduct this study are shown below (Figure 1):

(1) Participants were asked to complete the preintervention self-administered questionnaire and POMS, and then they were requested to maintain the same position (sitting position) for 5 min to eliminate the effects of changes in body position on physiological indicators.

(2) Participants underwent measurement of physiological data and biochemical data.

(3) Participants wore any intervention and kept themselves at rest in a sitting position for 10 min.

(4) Physiological data at the end of the intervention were measured.

(5) Participants kept themselves at rest in a sitting position for another 10 min.

(6) Physiological and biochemical data 10 min after the intervention were measured.

(7) After the electrodes for monitoring were removed, participants completed the post intervention POMS. This concluded the study.

Subjects participated in all three interventions at intervals of 1 week or longer.

Analysis methods

Summary statistics were calculated for participants' attributes collected through the self-administered questionnaire survey. The Friedman test was used for intragroup comparisons of repeated measurements, and the Wilcoxon signed-rank sum test was used for multiple comparisons among measurement items showing significant differences with Bonferroni correction. For comparisons among three groups, change 1 = (at the end of intervention – before intervention) and change 2 = (10 min after intervention – before intervention) were calculated and subjected to the Friedman test; measurement items showing significant differences were subjected to the Wilcoxon signed-rank sum test with Bonferroni correction.

The Wilcoxon signed-rank sum test was used for intragroup comparisons pre and post intervention values. For comparisons among three groups, change 2 amounts were calculated and subjected to the Friedman test; measurement items showing significant differences were subjected to the Wilcoxon signed-rank sum test with Bonferroni correction. SPSS version 26 was used for statistical analysis. The significance level was $\leq$5%.

Results

A total of 42 healthcare professionals consented to participate in this study and participated in the study. Thirty-two participants who had no missing data were included in the analysis.

Attributes

The mean age of the subjects was 46.8 years (SD = 8.38); 12.5% were physicians, 81.3% were nurses, and nursing assistants and medical office clerks each accounted for 3.1%. The baseline similarities of the three groups were confirmed (Tables 1, 2, and 3).

Table 2
Data on the biochemical measure (intragroup comparison) (n = 32)

Measure	Unit	Group	Before intervention				p value[a]	10 min after intervention				p value[b]
			Mean	Standard deviation		Median		Mean	Standard deviation		Median	
Salivary amylase	kIU/L	EM	19.4	±	17.80	14	0.61	19.6	±	25.87	6	0.44
		HEM	18.5	±	22.02	6		17.3	±	29.02	4	0.28
		AHEM	17.3	±	18.77	11		14.8	±	17.28	7	0.20

[a]Friedman test (comparison before intervention among three groups)

[b]Wilcoxon signed-rank test (before and 10 min after intervention)

Table 3
Psychological measure POMS (intragroup comparison) (n = 32)

Measure		Before intervention				p value[a]	10 min after intervention				p value[b]
		Mean	Standard deviation		Median		Mean	Standard deviation		Median	
TMD Total mood disturbance	Group I	50.9	±	9.89	48	0.10	45.0	±	7.44	44	0.000
	Group II	47.8	±	6.56	47		43.2	±	6.86	42	0.000
	Group III	49.9	±	8.99	50		43.8	±	7.43	42	0.000
AH Anger–Hostility	Group I	47.6	±	9.55	45	0.16	42.4	±	7.72	39	0.000
	Group II	44.9	±	6.67	44		41.7	±	6.77	39	0.000
	Group III	46.5	±	8.89	45		41.4	±	7.13	38	0.000
CB Confusion–Bewilderment	Group I	52.1	±	11.62	50	0.10	47.1	±	8.48	45	0.001
	Group II	48.6	±	8.16	47		44.6	±	7.09	43	0.000
	Group III	51.5	±	11.37	50		45.9	±	8.61	44	0.000
DD Depression–Dejection	Group I	49.0	±	9.50	48	0.23	44.8	±	6.22	44	0.000
	Group II	46.4	±	6.43	45		44.1	±	6.03	43	0.003
	Group III	48.1	±	9.03	46		44.1	±	6.56	42	0.000
FI Fatigue–Inertia	Group I	49.3	±	10.67	45	0.14	44.3	±	8.69	42	0.000
	Group II	47.1	±	7.86	47		42.3	±	7.01	41	0.000
	Group III	50.0	±	10.23	50		42.7	±	8.67	43	0.000
TA Tension–Anxiety	Group I	51.6	±	10.62	50	0.11	43.3	±	8.60	41	0.000
	Group II	48.5	±	7.72	48		42.7	±	8.00	43	0.000
	Group III	50.2	±	9.34	49		41.9	±	8.21	41	0.000
VA Vigor–Activity	Group I	46.0	±	5.87	46	0.34	44.9	±	6.30	45	0.337
	Group II	46.5	±	7.54	45		47.5	±	8.32	45	0.392

[a]Friedman test (comparison before intervention among three groups)

[b]Wilcoxon signed-rank test (before and 10 min after intervention)

	Group III	45.7	±	7.28	46		45.9	±	6.79	46	0.579
F Friendliness	Group I	49.8	±	6.05	50	0.17	46.1	±	5.95	48	0.003
	Group II	49.5	±	6.82	48		45.1	±	7.97	46	0.001
	Group III	49.7	±	6.30	50		47.2	±	7.12	48	0.041

[a]Friedman test (comparison before intervention among three groups)

[b]Wilcoxon signed-rank test (before and 10 min after intervention)

Physiological indicators

LF/HF

Intragroup comparisons in all three groups showed that the LF/HF at the end of the intervention was significantly lower than that before the intervention (EM $p = 0.000$, HEM $p = 0.000$, AHEM $p = 0.000$), and the LF/HF 10 min after the intervention was significantly lower than that before the intervention (EM $p = 0.000$, HEM $p = 0.000$, AHEM $p = 0.000$) (Table 1).

The comparison in change 1 among the three groups showed a significant difference ($p = 0.048$); change 1 amounts in the EM, HEM, and AHEM groups were −2.2 (SD 1.90), −2.1 (SD 5.63), and −1.3 (SD 1.71), respectively (Table 4).

Table 4
Data on physiological measures (intergroup comparison) (n = 32)

Measure	Unit	Group	Difference 1[a]				p value[c]			Difference 2[d]			
			Mean	Standard deviation		p value[b]	Group I × Group II	Group I × Group III	Group II × Group III	Mean	Standard deviation		p value[e]
LF/HF		EM	−2.2	±	1.90	0.05	1.00	0.10	0.23	−1.8	±	2.28	0.26
		HEM	−2.1	±	5.63					−2.2	±	4.35	
		AHEM	−1.3	±	1.71					−1.1	±	2.47	
Blood flow	mL/min	EM	8.6	±	11.33	0.91	–	–	–	10.0	±	9.35	0.97
		HEM	8.8	±	14.65					11.8	±	17.07	
		AHEM	7.7	±	11.25					12.1	±	14.77	
Axillary temperature	°C	EM	0.4	±	0.58	0.93	–	–	–	0.5	±	0.67	0.97
		HEM	0.3	±	0.56					0.5	±	0.56	
		AHEM	0.4	±	0.54					0.5	±	0.67	
Pulse rate	beats/min	EM	−2.0	±	2.83	0.14	–	–	–	−3.6	±	3.13	0.61
		HEM	−2.2	±	3.15					−2.7	±	3.95	
		AHEM	−1.3	±	3.18					−1.8	±	3.62	
Systolic blood pressure	mmHg	EM	−0.5	±	9.70	0.90	–	–	–	0.3	±	6.45	0.38
		HEM	−0.5	±	11.41					0.8	±	5.46	
		AHEM	0.0	±	6.14					−0.8	±	6.44	
Diastolic blood pressure	mmHg	EM	−0.8	±	8.10	0.63	–	–	–	0.5	±	6.82	0.90
		HEM	0.7	±	6.50					1.3	±	5.47	
		AHEM	0.7	±	4.97					0.9	±	3.90	

[a](At the end of intervention) − (Before intervention)

[b]Friedman test (comparison of difference 1 among three groups)

[c]Multiple comparison after Friedman test (with Bonferroni correction)

[d](10 min after intervention) − (Before intervention)

[e]Friedman test (comparison of difference 2 among three groups)

Blood flow

Intragroup comparisons in all three groups showed that the blood flow at the end of the intervention was significantly greater than that before the intervention (EM p = 0.000, HEM p = 0.000, AHEM p = 0.000), and the blood flow 10 min after the intervention was significantly greater than that before the intervention (EM p = 0.000, HEM p = 0.000, AHEM p = 0.000) (Table 1). In the HEM and AHEM groups, the blood flow 10 min after the intervention was significantly faster than that at the end of the intervention (HEM p = 0.006, AHEM p = 0.000). No differences were noted among the three groups (Table 4).

Axillary temperature

Intragroup comparisons revealed that the axillary temperature 10 min after the intervention was significantly higher than that before the intervention in all three groups (EM p = 0.000, HEM p = 0.000, AHEM p = 0.003) (Table 1). No differences were noted among the three groups (Table 4).

Pulse rate

Intragroup comparisons revealed that the pulse rate 10 min after the intervention was significantly lower than that before the intervention in all three groups (EM p = 0.000, HEM p = 0.01, AHEM p = 0.030). In the EM and HEM groups, the pulse rate at the end of the intervention was significantly lower than that before the intervention (EM p = 0.000, HEM=0.000); in the EM group, the pulse rate 10 min after the intervention was significantly lower than that at the end of the intervention (p = 0.000) (Table 1). No differences among the three groups were noted (Table 4).

Blood pressure

No differences in blood pressure were noted.

Biochemical indicator

No differences in SAA were found (Tables 2 and 5).

Table 5
Data on the biochemical measure (intergroup comparison) n = 32

Measure	Unit	Group	Difference 2[a]			
			Mean	Standard deviation		p value[b]
Salivary amylase	kIU/L	EM	0.2	±	32.55	0.46
		HEM	−1.2	±	33.13	
		AHEM	−2.6	±	21.91	

[a](10 min after intervention) − (Before intervention)

[b]Friedman test (comparison of difference 2 among three groups)

Psychological indicator

Intragroup comparisons showed that the TMD score was significantly reduced in all three groups (EM p = 0.000, HEM p = 0.000, AHEM p = 0.000). However, no differences among the three groups were noted (p = 0.270).

Scores for the six subscales, i.e., (AH), (CB), (DD), (FI), (TA), and (F), were significantly decreased in all three groups (AH: EM p = 0.000, HEM p = 0.000, AHEM p = 0.000, CB: EM p = 0.001, HEM p = 0.000, AHEM p = 0.000, DD: EM p = 0.000, HEM p = 0.003, AHEM p = 0.000, FI: EM p = 0.000, HEM p = 0.003, AHEM p = 0.000, TA: EM p = 0.000, HEM p = 0.000, AHEM p = 0.000, and F: EM p = 0.003, HEM p = 0.001, AHEM p = 0.041) (Table 3).

Furthermore, significant differences among the three groups were found in comparisons of the change 2 amounts in (DD) and (FI) scores (DD p = 0.014, FI p = 0.013). Significant differences were also noted between the HEM and AHEM groups in comparisons of the change 2 amounts in both (DD) and (FI) scores (DD p = 0.012, FI p = 0.021) (Table 6).

Table 6
Psychological measure POMS (intergroup comparison) n = 32

Measure		Difference 2[a]					p value[c]		
		Mean	Standard deviation		Median	p value[b]	Group I/Group II	Group I/Group III	Group II/Group III
TMD Total mood disturbance	Group I	−5.9	±	6.70	−4	0.27			
	Group II	−4.7	±	4.99	−3		-	-	-
	Group III	−6.1	±	6.39	−3				
AH Anger−Hostility	Group I	−5.2	±	7.91	−3	0.16			
	Group II	−3.2	±	4.67	−2		-	-	-
	Group III	−5.0	±	6.03	−3				
CB Confusion−Bewilderment	Group I	−5.0	±	7.25	−2	0.79			
	Group II	−4.0	±	5.37	−3		-	-	-
	Group III	−5.6	±	6.58	−5				
DD Depression−Dejection	Group I	−4.2	±	5.90	−3	0.01	0.21	1.00	0.01
	Group II	−2.3	±	4.83	−1				
	Group III	−4.1	±	4.74	−2				
FI Fatigue−Inertia	Group I	−5.0	±	7.00	−4	0.01	1.00	0.14	0.02
	Group II	−4.8	±	6.15	−3				
	Group III	−7.3	±	7.06	−5				
TA Tension−Anxiety	Group I	−8.3	±	6.22	−8	0.14			
	Group II	−5.8	±	6.84	−4		-	-	-
	Group III	−8.3	±	8.25	−7				
VA Vigor−Activity	Group I	−1.1	±	4.98	−1	0.33			

[a](10 min after intervention) − (Before intervention)

[b]Friedman test (comparison of difference 2 among three groups)

[c]Multiple comparison after Friedman test (with Bonferroni correction)

	Group II	1.0	±	4.90	1		-	-	-
	Group III	0.2	±	6.57	1				
F Friendliness	Group I	−3.6	±	6.08	−3	0.54			
	Group II	−4.4	±	7.01	−2		-	-	-
	Group III	−2.4	±	7.98	−2				

[a](10 min after intervention) − (Before intervention)

[b]Friedman test (comparison of difference 2 among three groups)

[c]Multiple comparison after Friedman test (with Bonferroni correction)

Discussion

The collected data were analyzed to examine psychological and somatic effects of the use of EM, HEM, and AHEM.

Physiological indicators

Studies have reported that the LF/HF in the very calm state is <2.0; ordinary state, 2–3; and excited state, >4.0 [12]. In this study, the LF/HF values in all three groups were decreased at the end of the intervention and showed no changes after the intervention was completed. However, the LF/HF values 10 min after the intervention remained to be lower than those before the intervention. These results indicate that the use of EM, HEM, and AHEM can be expected to decrease the sympathetic nervous activity at the end of the intervention, and the effect remains for 10 min after the intervention is completed. The EM use brought about the largest LF/HF decrease at the end of the intervention, followed by the HEM use and the AHEM use. Since inhalation of essential oils communicates signals to the olfactory system and stimulates the brain to exert neurotransmitters (e.g., serotonin and dopamine) [13], the observed weaker effect of the AHEM may be attributable to the “scent”.

The earlobe is a standard measurement site for the research laser blood flowmeter because of an abundance of capillaries. No differences in the blood flow among the three groups were found in this study. The blood flow at the end of the intervention was increased in all three groups. AHEM use brought about an additional increase in the blood flow after the intervention was completed. A previous study has reported that a hot pack was able to increase the eyelid tissue blood flow in eyes significantly and that these effects can be sustained until 20 min [14]. The present study demonstrated the effect of using EM, HEM, or AHEM to increase the blood flow in earlobe tissue at the end of the intervention and the continuance of the effect for 10 min after the intervention was completed. Additionally, the HEM and AHEM data showed that the blood flow in earlobe tissue increased further after the intervention was completed, suggesting that the “heat” and “scent” stimuli may remain effective even after removal of the stimuli.

The LF/HF values and blood flow measurements in earlobe tissue suggest the dominance of the parasympathetic nerves at the end of and 10 min after the intervention in all three groups. The activated parasympathetic nerves induce dilation of peripheral blood vessels, which likely results in increases in blood flow and axillary temperature. This explains the observed elevation of axillary temperature at the end of and 10 min after the intervention compared with that before the intervention in all three groups. Previous studies using the warming EM have reported that the warming EM significantly increased the distal skin temperatures (hands and feet) without affecting the proximal skin temperature (infraclavicular region) or core body temperatures and provoked physiological heat loss [6, 7]. The elevation of axillary temperature in the present study may not be attributable to the heat stimuli only and is consistent with a previous study showing that neither the truncal skin temperature nor the core body temperature was influenced by the periocular warming [6].

In the EM group, the pulse rate at the end of the intervention was lower than that before the intervention, and the pulse rate 10 min after the intervention was even lower than that at the end of the intervention. The “scent” stimulus may have prevented the pulse rate from decreasing. In the HEM and AHEM groups, no changes were observed after the intervention was completed. The removal of the heat source may have prevented further decreases in the pulse rate. The effects of the three interventions on the pulse rate were similar to the effect of the warming EM observed in a previous study [7], with no appreciable differences among the three groups.

Blood pressure values have never used as indicators to see the effects of warm compresses around the eyes in previous studies. Our results are consistent with a previous study [15] on warm foot bath as an intervention applying a heat stimulus showing that, compared to the base values, systolic and diastolic blood pressures did not change.

As described above, physiological indicators were used to discuss the effects of the EM, HEM, or AHEM use. The changes in the LF/HF, blood flow in the earlobe tissue, axillary temperature, and pulse rate suggest that parasympathetic nerves were dominant at the end of and 10 min after the EM or HEM intervention and 10 min after the AHEM intervention. The data on some measurement items suggest that parasympathetic nerves became further dominant after the EM intervention. With the AHEM use, no changes at the end of the intervention were observed for some items, and the data on some other items suggested that parasympathetic nerves became further dominant after the intervention was completed. Removal of the source of thermal stimulus or stimulation by the “scent” may interfere with the rapid decrease of sympathetic nerve activities. These data suggest that “scent” can exert its effects even after the intervention is completed.

Biochemical indicator

While a previous study has reported that SAA is sensitive to psychosocial stress [16], no SAA changes were observed after the EM, HEM, and AHEM intervention in this study. The authors of previous studies using SAA to assess the effects of back massage [17] and warm foot bath [15] have concluded that changes in the salivary biomarkers tested here may not indicate changes in psychological status following intervention. Similar results were obtained in the present study.

Psychological indicator

The TMD score 10 min after the intervention improved compared with that before the intervention in the EM, HEM, and AHEM groups. The EM, HEM, and AHEM interventions also showed improvements in scores for (AH), (CB), (DD), (FI), (TA), and (F) subscales. In particular, the AHEM use resulted in more decreases in (DD) and (FI) scores than the HEM use.

In previous studies, POMS tests revealed that inhalation of the aromatic lavender oil significantly decreased two POMS subscales, (DD) and (CB) [18], and the findings using the brain activities provided evidence the relaxing effect of inhaling lavender oil [19]. The results of the present study suggest that the lavender “scent” stimulus tends to alleviate negative moods, in particular, depression, dejection, fatigue, and inertia.

Limitations of the study

In this study, the short-term effects of the EM, HEM, and AHEM interventions immediately and 10 min after the intervention were evaluated. Therefore, the findings obtained refer to the short-term effects of these interventions. Moreover, participants in this study were female healthcare professionals; studies including diverse participants are necessary to generalize the findings of this study.

Conclusions

These findings indicate that the EM, HEM, or AHEM use can be expected to bring about the parasympathetic dominance, with the AHEM use being particularly effective to provide tranquility and comfort and may find application as a nursing technique to provide comfort.

Abbreviations

AH Anger–Hostility

AHEM Aroma-scented heated eye mask

CB Confusion–Bewilderment

CNS Central nerve system

DD Depression–Dejection

EM Eye mask

F Friendliness

FI Fatigue–Inertia

HEM heated eye mask

POMS Profile of mood states

TA Tension–Anxiety

TMD Total mood disturbance

VA Vigor–Activity

VDT Visual display terminal

Declarations

Ethics approval and consent to participate

This study was approved by the Medical Ethics Review Board of the Kyoto Prefectural University of Medicine (approval number, ERB-E-309-1) and reported according to observational study guidelines. All participants received an explanation about the purpose and contents of the study and submitted written consent before participation in this study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MM contributed toward study design, data collection, article drafting, article and figures/tables review/editing, and article submission. IK contributed toward study design, data collection, data analysis, and literature search. TY, KT, TK, and SA performed data collection and literature search. YY contributed toward study design and data analysis, and IY contributed toward study design and article and figures/tables review/editing. All authors read and approved the final manuscript.

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Tables

Due to technical limitations, Table 1 is only available as a download in the Supplemental Files section.

Figures

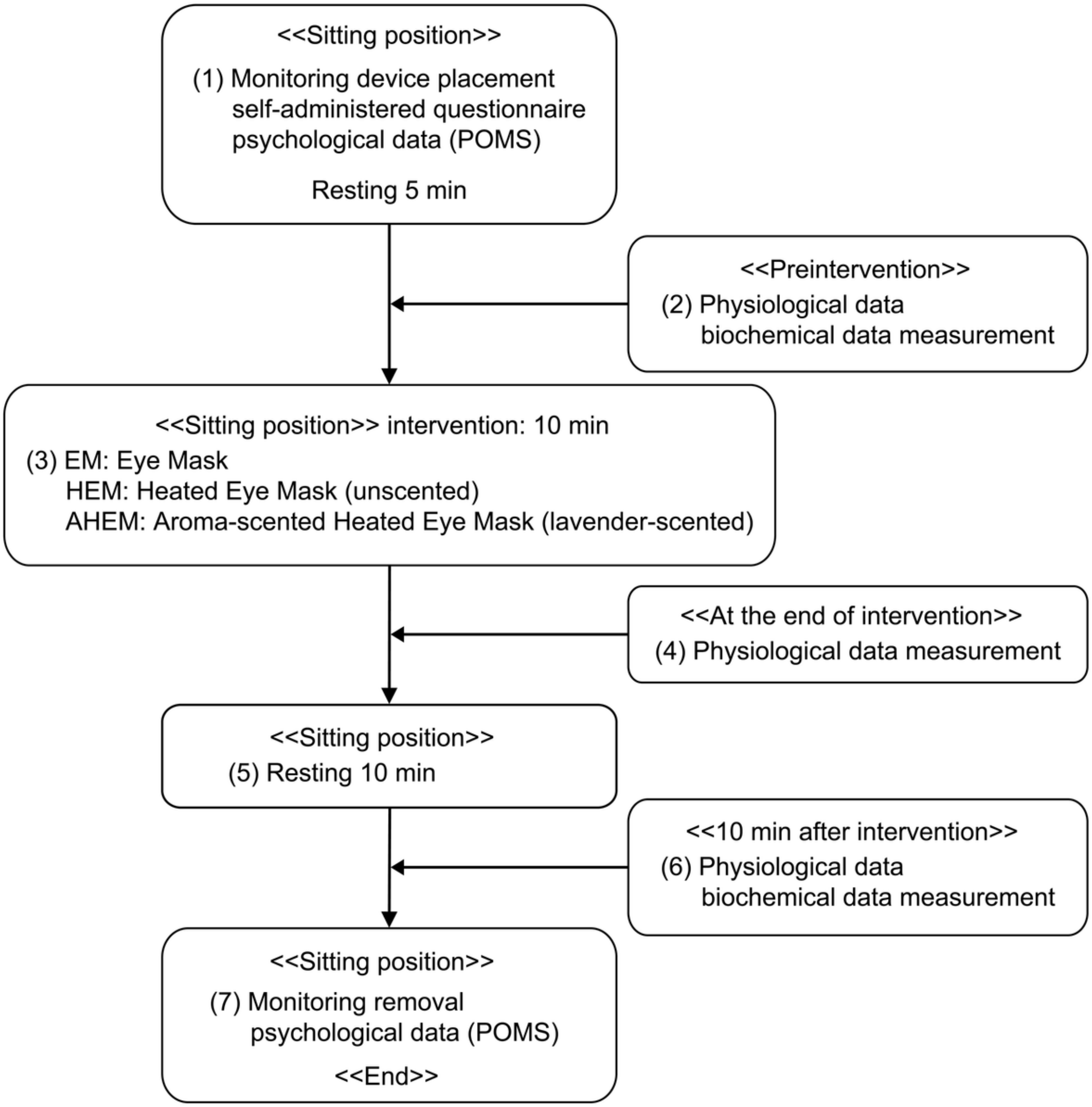

Figure 1

«Sitting position» (a) Monitoring device placement self-administered questionnaire psychological data (POMS) «Sitting position» resting: 5 min (b) Physiological and biochemical data measurement «Sitting position» intervention: 10 min (c) EM: Eye Mask HEM: Heated Eye Mask (unscented) AHEM: Aroma-scented Heated Eye Mask (lavender-scented) «At the end of intervention» (d) Physiological data measurement «Sitting position» (e) Resting: 10 min «10 min after intervention» (f) Physiological and biochemical data measurement «Sitting position» (g) Monitoring removal psychological data (POMS) «End»

Supplementary Files

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