The Crossover trials to determine psychological and somatic effects of eye masks as a nursing technique to provide comfort

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Abstract

Introduction: 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.

Materials and 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 analyses. 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.

Conclusion: 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.

Keywords: eye mask, aroma, warm compress, nursing technique, comfort, relaxation

INTRODUCTION

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)]. On the other hand, aromatherapy is one of the methods that have been reported to have relaxing and sleep improving effects[8), 9)]. And this measure can be used in conjunction with warm compresses around the eyes. However, no previous studies have used physiological, biochemical, and psychological indicators to comprehensively test the effects of the application of eye masks（EM）, heated eye masks（HEM）, 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.

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.

MATERIALS AND METHODS

Study design

This was a crossover-controlled study, conducted from July 2018 to April 2019 in healthy adult female healthcare professionals in A prefecture, Japan.

Definition of term

"Comfort" in this research indicates a state in which the parasympathetic nervous system is physiologically and biochemically dominant, and psychologically indicates a well-being.

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-hour before the study participation. All participants received an explanation about the purpose and contents of the study and submitted written consent before participation in this study.

Sample size

The sample size (an effect size f 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 September 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[10]. The sheet can stably provide a hot compress of about 40 ° C for about 10 minutes, and safety is guaranteed by following the precautions for use.

Randomization

This was a crossover-controlled study, 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 ECG 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[11].

(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[12].

Profile of Mood States 2nd Edition

POMS[13] 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 (Fig. 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 as a washout period.

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 ≤ 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,

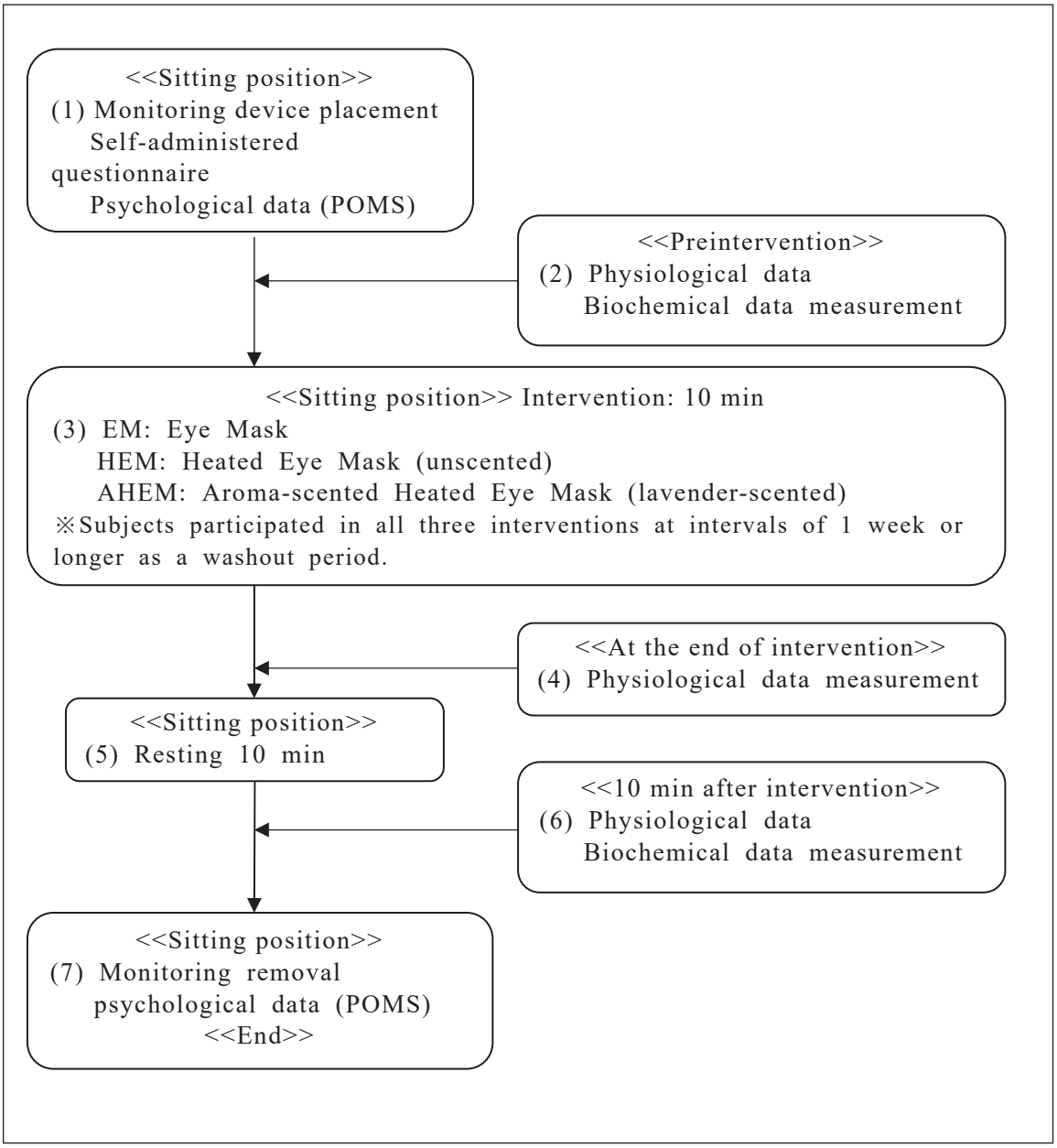

Figure 1：The procedures of this study

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).

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).

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

Table 1. Data on physiological measures (intragroup comparison) (n = 32)

Measure	Unit	Group	Before intervention		p value[a]	End of intervention		10 min after intervention		p value[b]	p value[c]	p value[d]	p value[e]
			Mean	Standard deviation		Mean	Standard deviation	Mean	Standard deviation				
LF/HF		EM	3.5 ±	2.22		1.3 ±	1.09	1.7 ±	1.55	0	0	0	0.35
		HEM	4.5 ±	3.87	0.26	2.4 ±	4.47	2.3 ±	2.72	0	0	0	1
		AHEM	3.1 ±	2.16		1.8 ±	1.26	2 ±	2.29	0	0	0	0.44
Blood flow	mL/min	EM	14.5 ±	15.24		23.1 ±	24.87	24.5 ±	22.4	0	0	0	0.11
		HEM	16.3 ±	16.73	0.06	25.2 ±	23.91	28.2 ±	24.91	0	0	0	0.01
		AHEM	14 ±	9.67		21.7 ±	16.26	26.2 ±	19.63	0	0	0	0
Axillary temperature	℃	EM	36.3 ±	0.65		36.7 ±	0.43	36.8 ±	0.54	0	0.01	0	0.67
		HEM	36.4 ±	0.48	0.74	36.6 ±	0.6	36.8 ±	0.47	0	0.04	0	0.11
		AHEM	36.3 ±	0.56		36.7 ±	0.49	36.7 ±	0.57	0	0	0	0.71
Pulse rate	beats/min	EM	68.9 ±	7.96		66.8 ±	8.18	65.3 ±	7.98	0	0	0	0
		HEM	67.7 ±	6.75	0.43	65.5 ±	6.59	65 ±	6.73	0	0	0.01	0.35
		AHEM	67.2 ±	9.21		65.9 ±	9.92	65.3 ±	9.64	0.02	0.11	0.03	1
Systolic blood pressure	mmHg	EM	114.3 ±	11.64		113.8 ±	11.43	114.6 ±	12.7	0.97	-	-	
		HEM	115.9 ±	15.17	0.31	115.4 ±	14.22	116.7 ±	15.56	0.59	-	-	
		AHEM	112.9 ±	14.03		112.8 ±	12.73	112 ±	11.3	0.8	-	-	
Diastolic blood pressure	mmHg	EM	70.3 ±	8.62		69.47 ±	9.23	70.8 ±	9.27	0.13	-	-	
		HEM	71.1 ±	7.7	0.06	71.72 ±	8.79	72.3 ±	8.12	0.46	-	-	
		AHEM	68.5 ±	9.2		69.16 ±	9.07	69.4 ±	7.45	0.64	-	-	

a:Friedman test (comparison before intervention among three groups)
b:Friedman test (comparison before, at the end of, and 10 min after the intervention)
c:Multiple comparison after Friedman test (with Bonferroni correction) (before and at the end of intervention)
d:Multiple comparison after Friedman test (with Bonferroni correction) (before and 10 min after intervention)
e:Multiple comparison after Friedman test (with Bonferroni correction) (10 min after and at the end of intervention)

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 ±	17.8	14		19.6 ±	25.87	6	0.44
		HEM	18.5 ±	22.02	6	0.61	17.3 ±	29.02	4	0.28
		AHEM	17.3 ±	18.77	11		14.8 ±	17.28	7	0.2

a:Friedman test (comparison before intervention among three groups)
b:Wilcoxon signed-rank test (before and 10 min after intervention)

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

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

Measure	Group	Before intervention			p value[a]	10 min after intervention			p value[b]
		Mean	Standard deviation	Median		Mean	Standard deviation	Median	
TMD	EM	50.9 ±	9.89	48		45 ±	7.44	44	0
Total mood	HEM	47.8 ±	6.56	47	0.1	43.2 ±	6.86	42	0
disturbance	AEHM	49.9 ±	8.99	50		43.8 ±	7.43	42	0
AH	EM	47.6 ±	9.55	45		42.4 ±	7.72	39	0
Anger–	HEM	44.9 ±	6.67	44	0.16	41.7 ±	6.77	39	0
Hostility	AEHM	46.5 ±	8.89	45		41.4 ±	7.13	38	0
CB	EM	52.1 ±	11.62	50		47.1 ±	8.48	45	0.001
Confusion–	HEM	48.6 ±	8.16	47	0.1	44.6 ±	7.09	43	0
Bewilderment	AEHM	51.5 ±	11.37	50		45.9 ±	8.61	44	0
DD	EM	49 ±	9.5	48		44.8 ±	6.22	44	0
Depression–	HEM	46.4 ±	6.43	45	0.23	44.1 ±	6.03	43	0.003
Dejection	AEHM	48.1 ±	9.03	46		44.1 ±	6.56	42	0
FI	EM	49.3 ±	10.67	45		44.3 ±	8.69	42	0
Fatigue–	HEM	47.1 ±	7.86	47	0.14	42.3 ±	7.01	41	0
Inertia	AEHM	50 ±	10.23	50		42.7 ±	8.67	43	0
TA	EM	51.6 ±	10.62	50		43.3 ±	8.6	41	0
Tension–	HEM	48.5 ±	7.72	48	0.11	42.7 ±	8	43	0
Anxiety	AEHM	50.2 ±	9.34	49		41.9 ±	8.21	41	0
VA	EM	46 ±	5.87	46		44.9 ±	6.3	45	0.337
Vigor–	HEM	46.5 ±	7.54	45	0.34	47.5 ±	8.32	45	0.392
Activity	AEHM	45.7 ±	7.28	46		45.9 ±	6.79	46	0.579
F	EM	49.8 ±	6.05	50		46.1 ±	5.95	48	0.003
Friendliness	HEM	49.5 ±	6.82	48	0.17	45.1 ±	7.97	46	0.001
	AEHM	49.7 ±	6.3	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)

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).

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 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]	EM × HEM	EM ×AHEM	HEM ×AHEM	Mean	Standard deviation	p value[e]
LF/HF		EM	−2.2	1.9					−1.8	2.28	
		HEM	−2.1	5.63	0.05	1	0.1	0.23	−2.2	4.35	0.26
		AHEM	−1.3	1.71					−1.1	2.47	
Blood flow	mL/min	EM	8.6	11.33					10	9.35	
		HEM	8.8	14.65	0.91	–	–	–	11.8	17.07	0.97
		AHEM	7.7	11.25					12.1	14.77	
Axillary temperature	° C	EM	0.4	0.58					0.5	0.67	
		HEM	0.3	0.56	0.93	–	–	–	0.5	0.56	0.97
		AHEM	0.4	0.54					0.5	0.67	
Pulse rate	beats/min	EM	−2.0	2.83					−3.6	3.13	
		HEM	−2.2	3.15	0.14	–	–	–	−2.7	3.95	0.61
		AHEM	−1.3	3.18					−1.8	3.62	
Systolic blood pressure	mmHg	EM	−0.5	9.7					0.3	6.45	
		HEM	−0.5	11.41	0.9	–	–	–	0.8	5.46	0.38
		AHEM	0	6.14					−0.8	6.44	
Diastolic blood pressure	mmHg	EM	−0.8	8.1					0.5	6.82	
		HEM	0.7	6.5	0.63	–	–	–	1.3	5.47	0.9
		AHEM	0.7	4.97					0.9	3.9	

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)

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	
		HEM	−1.2	33.13	0.46
		AHEM	−2.6	21.91	

a:(10 min after intervention) − (Before intervention)
b:Friedman test (comparison of difference 2 among three groups)

DISCUSSION

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

Visual information stimulates the brain and influences the circadian rhythm and the emotional system of the limbic system, which in turn influences the control of the autonomic nervous system. When the subject wears an eye mask, information from vision is blocked and the reaction to visual stimuli ceases. And this is considered to be one of the reasons why the parasympathetic nerves are in a dominant state. On the other hand, with thermal stimulation at 37-39 degrees Celsius, the superficial blood vessels instantaneously contract under the control of the sympathetic nerves, blood pressure rises, and blood flow decreases. However, the peripheral capillaries on the body surface soon dilate

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

Measure	Group	Difference 2[a]				p value[c]		
		Mean	Standard deviation	Median	p value[b]	EM × HEM	EM ×AHEM	HEM ×AHEM
TMD	EM	−5.9	± 6.7	−4				
Total mood	HEM	−4.7	± 4.99	−3	0.27	-	-	-
disturbance	AHEM	−6.1	± 6.39	−3				
AH	EM	−5.2	± 7.91	−3				
Anger–	HEM	−3.2	± 4.67	−2	0.16	-	-	-
Hostility	AHEM	−5.0	± 6.03	−3				
CB	EM	−5.0	± 7.25	−2				
Confusion–	HEM	−4.0	± 5.37	−3	0.79	-	-	-
Bewilderment	AHEM	−5.6	± 6.58	−5				
DD	EM	−4.2	± 5.9	−3				
Depression–	HEM	−2.3	± 4.83	−1	0.01	0.21	1	0.01
Dejection	AHEM	−4.1	± 4.74	−2				
FI	EM	−5.0	± 7	−4				
Fatigue–	HEM	−4.8	± 6.15	−3	0.01	1	0.14	0.02
Inertia	AHEM	−7.3	± 7.06	−5				
TA	EM	−8.3	± 6.22	−8				
Tension–	HEM	−5.8	± 6.84	−4	0.14	-	-	-
Anxiety	AHEM	−8.3	± 8.25	−7				
VA	EM	−1.1	± 4.98	−1				
Vigor–	HEM	1	± 4.9	1	0.33	-	-	-
Activity	AHEM	0.2	± 6.57	1				
F Friendliness	EM	−3.6	± 6.08	−3				
	HEM	−4.4	± 7.01	−2	0.54	-	-	-
	AHEM	−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)

and the blood temperature rises. Blood pressure is lowered, resulting in an increase in organ blood flow. Thermal stimulation also acts on sensory nerves to relieve muscle tension and spasms. Based on the physiological mechanism of action of such blocking of visual information and thermal stimulation, we discussed the results.

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[14]. 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) [15], 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[16]. 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. 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[17)] 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[18)], 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[19)] and warm foot bath[17)] 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) [20], and the findings using the brain activities provided evidence the relaxing effect of inhaling lavender oil[21]. 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.

CONCLUSION

Intragroup comparisons in all three groups showed that the LF/HF and pulse rate 10 min after the intervention was significantly lower than that before the intervention. And the blood flow and axillary temperature 10 min after the intervention was significantly greater than that before the intervention. The TMD score 10 min after the intervention improved significantly compared with that before the intervention in each group.

The comparison in POMS subscales (DD) and (FI) among the three groups showed a significant difference. AHEM groups were most degraded.

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.

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