

Effects of Aroma Head Therapy on Stress and Brain Wave Change Using EEG

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Abstract

This research studied aroma head therapy on 15 women to observe stress improvement and brain wave responses using EEG. The experiment lasted for two weeks. The experimental method was conducted by measuring the brain waves using EEG before and after the aroma head therapy. SPSS 20.0 statistical program was used for analysis. The amplitude of alpha waves before and after aroma head therapy decreased in both left and right brains. Compared to the amplitude before the massage, the brain wave amplitude of the right brain notably resulted in a decrease. The physical stress index in both left and right brains decreased after aroma head therapy compared to the level before the massage. There was no difference in the mental stress index before and after the massage therapy of the aroma head therapy. Thus, the experiment proved that aroma head therapy has a close relationship in relieving physical stress and bringing psychological stability to middle-aged women. Based on the results, the appropriate use of aromatherapy on the human body shall contribute to maintaining a healthy life and promoting psychological and physical stability.

Keywords: Aromatherapy, Head therapy, Brain waves, Stress, EEG

Introduction

People have different values and awareness systems in modern society depending on lifestyle, behavioral patterns, and desires. On the one hand, the innovative development of industry provided human beings with mental and material convenience. On the other hand, negative situations such as internal and external conflicts of life are emerging (Ye, 2009). Depending on society's diversity and expertise, people experience stress from interpersonal relationships in school, home, and workplaces (Nappo, 2020). Such stress is classified into three types: psychological stress, physiological stress, and chemical stress (Elizabeth, 2020). Psychological stress comes from social fear, anger, economic instability, and anxiety about unemployment. Physiological stress is caused by lack of sleep, injury, dehydration, and others. Furthermore, chemical stress occurs from pollution, free radicals, fine dusts, carcinogens, SARS, MERS, pneumonia, and others (Flynn et al., 2021).

This occurrence of stresses has been on the rise in modern society's face compared to the past. The repeated stimulus to stress would lead to chronic stress disease due to excessive cortisol release from accumulated and repeated physical fatigue (Hong et al., 2009; Lee et al., 2012). This problem is not unique to an individual anymore. It has arisen as a problem of various age groups of society. To be specific, stress is often observed in middle-aged women who are exposed to the

climacteric syndrome. They show palpitation, flushing, depression, amnesic disorder, insomnia, urinary disorders, arthralgia, and others as symptoms. The incidence of symptoms is four times higher than that of middle-aged men. In other words, the incidence of stress and continued symptoms results in low willingness to work and a decrease in productivity, which in turn downgrades the quality of life and, at the same time, increases medical expenses (Son, 2006).

Diverse solutions are brought up to relieve those stresses. Medical treatment is most commonly used in line with recent physical massage therapy attempts, such as whole-body therapy, hand therapy, head therapy, and face therapy (Helen, 2014; Vickers et al., 2001).

Aroma head therapy massages the scalp using aroma extracts from leaves, roots, flowers, and fruits of aromatic plants (Ali et al., 2015; Kar et al., 2018). Aromatherapy replenishes the body with oxygen to promote blood circulation in the scalp, neck, shoulders, and arms. Thereby, it promotes lymphatic circulation to strengthen hair and the overall body (S. W. Choi, 2014). Besides, it is said to have the following effects: balancing the nervous system and hormones, stabilizing the brain, relieving stress, preventing hair loss, and increasing concentration (Masuo et al., 2021; Sowndhararajan & Kim, 2016). This therapy grafted aroma to scalp massage. It effectively relieves stress and brings psychological relaxation (Ali et al., 2015). It also has a direct influence on the brain activity and changes in the brain waves of humans.

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Brain waves refer to electrical signals using EEG exchanged between brain cells. It is an objective indicator recording brain activity. Brain development, aging brain, stress, mental stability, and others may cause brain wave changes. Brain waves are classified into alpha waves (α , Alpha wave), beta waves (β , Beta wave), theta waves (θ , Theta wave), delta wave (δ , Delta wave), and gamma waves (γ , Gamma wave) (Abhang et al., 2016).

Alpha waves (α , Alpha wave) occur as mentally excited when people open their eyes and relax when people close their eyes and meditate (S. W. Choi, 2014). Beta waves (β waves) are located in the sinciput. It appears when people are either awake or talking. It works in a state under stress or awakened state. Gamma waves (γ waves) affect when people are in a state of tension during mental activities like memorizing, concentrating, and learning. It is related to extreme excitement, awakenedness, emotional nervousness, and recognition and data processing such as reasoning and decision making (Y. Choi, 2014; Kim, 2014). Delta waves (δ waves) appear as irregular brain waves when people are nervous or people's muscles tense (Lee et al., 2012; Vickers et al., 2001). Theta waves (θ waves) occur when people are emotionally stable or sleeping. The waves occur during creative activities (Ha & Song, 2005; Hwang, 2012).

For quantitative assessment on the effectiveness of aromatherapy and head therapy in relieving stress, changes in α waves and β waves are often observed because it shows the level of arousal in the cerebrum activity and central nervous activity of brain waves. In a mentally tensed state, the β waves increases. In relaxed state, the α waves appear (T. Jang, 2000; Lorig, 1989). Meaning, observation on change in α waves could estimate stress.

The following are on research related to therapy and brain waves. In research done by Hur et al. (2019), middle-aged women's stress was relieved when inhaling aroma oil. It revealed that hand and arm massages decreased stress and sense of crisis in middle-aged women (H. J. Jang, 2000). Facial, scalp, and decollete massages on middle-aged women effectively reduce physical and emotional stress in the research done (H. J. Park et al., 2013).

As seen in previous studies, massage and aroma therapy have been proven to be effective in reducing stress throughout the body, and at the same time affect changes in the wavelength of brain waves. This study aims to analyze EEG changes in response to stress before and after aroma head therapy for middle-aged women, and to objectively identify the effect of aroma head therapy application through EEG measurement results. Through these analysis data, we intend to provide basic data to the skin care industry related to the stress relief of middle-aged women.

Theoretical basis

Aroma oil is absorbed into the human body and affects the pituitary gland, generates neurochemical substances, and has the effect of giving a healthy body and psychological stability (Son, 2006). Inhalation of aroma oil has effects of skin regeneration, inhibition of skin aging, and brain stabilization (Seo & Chang, 2009). The psychological stabilization effect of these aroma oils has also been suggested in various previous studies. The stimulation of the scalp of aroma oil promotes blood circulation, and thus it has been shown to have the effect of releasing toxins from the scalp, preventing pore contraction and hair loss, and relieving stress. Results were suggested to be effective in recovering from fatigue, relieving stress, and calming unstable psychological states (Bae & Hur, 2016; Kim, 2012). As such, basic studies on the efficacy of aroma were referred to, and in this study, head therapy massages were performed using aroma oil. After performing therapy massages, we want to analyze EEG changes to see how it affects physical and mental stress relieving effects on the human body.

Method

Research Objects and Study Period

15 healthy subjects (15 females) with no history of Regular menstruation for three months before the experiment, Normal blood pressure, No long-term use of medications, cardiovascular, neurological, and musculoskeletal disorders, volunteered for this study. This research was conducted on 15 women residing in Chungju, Chungcheongbuk-do, between 40 and 60. Aroma head therapy was conducted in the following order: a preliminary study, preliminary experiment, experimental treatment, and post-study. The demographic characteristics of the test subjects are shown in Table 1. The selection considered the following conditions.

Table 1

Demographic characteristics

NO.	Gender	Age	Height	Weight
A	Females	50	161	61
B	Females	52	166	58
C	Females	42	162	62
D	Females	51	165	49
E	Females	51	159	60
F	Females	46	160	66
G	Females	46	161	58
H	Females	43	156	57
I	Females	44	168	59
J	Females	48	168	62
K	Females	48	167	63
L	Females	50	152	53
M	Females	49	160	56
N	Females	49	165	49
O	Females	50	157	57

Research procedure

Subjects should avoid ingestion of meals that may affect brain waves and caffeine-containing coffee or green tea 1 hour before the experiment. After resting for 5 minutes, pre-measurement was performed with an EEG meter.

The experimental environment conditions are maintained at a constant temperature and humidity of 20~22°C, 50~60% humidity, and maintain illumination with quiet and well-ventilated indirect lighting. Aroma head therapy management took a total of 50 minutes including preparation and finishing steps

- (1) Drop a drop of 'Gray Flower' aroma oil on the palm of the researcher and rub it in, and then ask the subject to breathe deeply through their nose 3 times.
- (2) Using 'Brown Flower' and 'Gray Flower' aroma oil, massage the sternocleidomastoid muscle, clavicle, and shoulder area for 5 minutes using stroking and kneading techniques.
- (3) First, apply the aroma oil in the direction of the scalp texture with a cotton swab. Afterwards, the scalp is stimulated by hand rubbing and stroking techniques. Using

a scalp massage tool, the lymphatic massage was performed by stroking the crown of the head, below the ears, and stroking the shoulders and head.

Research Design

The subjects' surveys were initially drafted along with consultation on the experiment and consent forms by priority (Jeong, 2019). The subjects then received aroma head therapy massage once a week, twice in total for the experiment.

The experiment proceeded first with explaining the purpose of the experiment to the subjects. The subjects then sat on a chair comfortably for 5 minutes to remain relaxed. Afterward, three electrodes (Fp1, Fpz, Fp2) of the hairband were attached to measure brainwaves starting from opened eye state to closed eye state. Next, the subject was asked to lie down on the bed. The subject was massaged in the order of aroma head therapy for 30 minutes. After the massage, the subject took a break by comfortably sitting on a chair for 5 minutes. The brain wave was measured after. The overall procedure is the same as the Fig. 1 below.

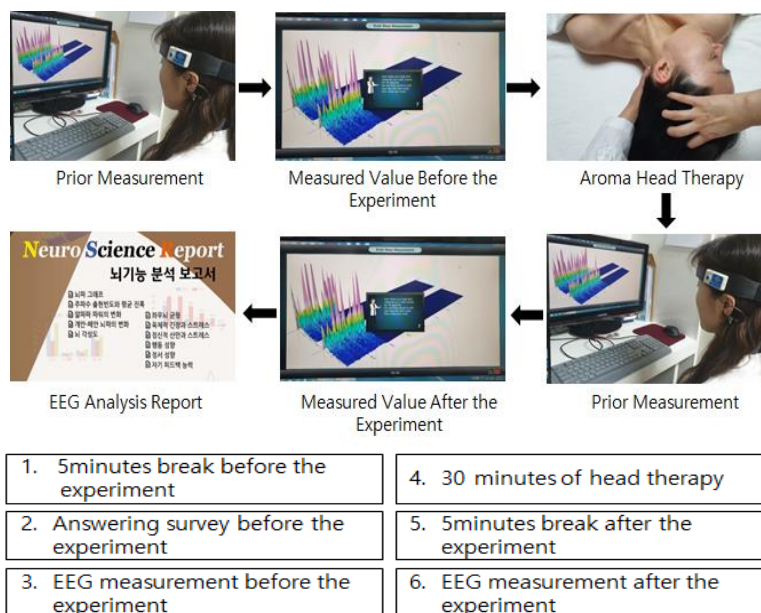


Figure 1. EEG measurement and analysis procedure

Experiment Equipment

Brain Wave Measurement Device

The measurement device used for the research is the two channeled brain wave measurement device program, Neuro Brain. This measurement device uses sequential bipolar montage to simultaneously measure the prefrontal lobe's left and right brain waves at Fp1 and Fp2. Simultaneously, Fp1, Fpz, and Fp2 electrodes were tightly attached to the prefrontal lobe together with the Fpz of the

unipolar induction method. The ground electrode was additionally attached to the left earlobe.

The benefits of using the Neuro Brain as the brain wave measurement device is that it has higher temporal resolution than other measurement devices, quickly showing the brain's changes and the low cost of measurement and analysis. The reliability and validity were proved in the United States. The correlation coefficient to the brain wave value of the left and right alpha wave, beta wave, and theta wave was 916(p<.001), demonstrating its reliability.

Essential Oils

The following essential oils were used for head therapy: Brown flower oil blended with marjoram, balm, geranium, carrot extract, and bees pollen extract. It effectively improves lymphatic circulation at the same time hydrating the skin and the scalp. It also removes toxins from sclerotized tissues.

Gray flower oil blended with petitgrain, valerian, basil, chamomile, wheat germ, marigold, and bee's pollen extract was used. It is effective on stiff muscles, skin exposed to neural stimulation, constricted skin, and scalp. It calms and relaxed the tensed nerves of the human body.

Data Analysis

For statistical processing of the data, SPSS 20.0 statistical package program was employed. The Shapiro-Wilks test was conducted to test for normality on the alpha wave amplitude

Table 2

Normal distribution test for normality

Category	Index	Experiment	N	Shapiro-Wilks	p
Alpha Wave	Amplitude of alpha wave (Left brain)	Before massage	15	.850	.019
		After massage	15	.844	.012
	Amplitude of alpha wave (Right brain)	Before massage	15	.905	.113
		After massage	15	.806	.004
Stress	Physical stress (Left)	Before massage	15	.852	.032
		After massage	15	.800	.001
	Physical stress (Right)	Before massage	15	.882	.111
		After massage	15	.751	.000
	Mental stress (Left)	Before massage	15	.899	.117
		After massage	15	.744	.000
Mental stress (Right)	Before massage	15	.890	.049	
	After massage	15	.650	.000	

Descriptive Statistics on Experiment Variables

The result of descriptive statistics on the alpha wave and stress index before and after aroma head therapy massage drew the following conclusion in Table 3. It is showed to the alpha wave in the following Fig. 2 and the stress index in the following Fig. 3.

Table 3

Descriptive Statistics on Alpha Wave Amplitude and Stress Index

Category	Index	Experiment	N	M(SD)	Min. value	Max. value
Alpha Wave	Amplitude of alpha wave (Left brain)	Before massage	15	4.21(2.45)	1.43	10.92
		After massage	15	3.17(1.47)	1.52	5.80
	Amplitude of alpha wave (Right brain)	Before massage	15	4.55(2.55)	1.69	9.47
		After massage	15	2.79(1.31)	1.68	6.35
Stress	Physical stress (Left brain)	Before massage	15	23.47(14.43)	3.96	49.38
		After massage	15	14.63(11.00)	4.81	49.99
	Physical stress (Right brain)	Before massage	15	21.64(14.01)	5.38	52.25
		After massage	15	12.61(7.66)	6.81	37.77
	Mental stress (Left brain)	Before massage	15	2.26(0.79)	1.07	3.79
		After massage	15	1.99(1.34)	1.09	5.29
Mental stress (Right brain)	Before massage	15	2.42(1.21)	0.94	4.04	
	After massage	15	1.88(1.19)	1.17	5.06	

and stress index. Technical statistical analysis was undertaken on the alpha wave amplitude and stress index. Depending on the normality, the Wilcoxon rank-sum test was conducted to analyze the difference before and after massage; and compared the difference in brain waves on the alpha wave amplitude and stress index before and after the massage.

Result

Test for Normality on Before and After the Experiment

Wilcoxon Signed-Ranks Test for normality was conducted to alpha wave amplitude and stress before and after aroma head therapy massage. The result is shown in the following Table 2. A nonparametric method of Wilcoxon Signed-Ranks Test's confirmation was implemented of Shpiro-Wilks results of normality test. Since the p value appeared to be less than 5%, it is statistically significant.

The alpha wave of left and right brains through the massage had a lower amplitude value after the massage than the value before the massage. Additionally, the physical and mental stress indexes on left and right brains generally decreased after the massage compared to the index before the massage.

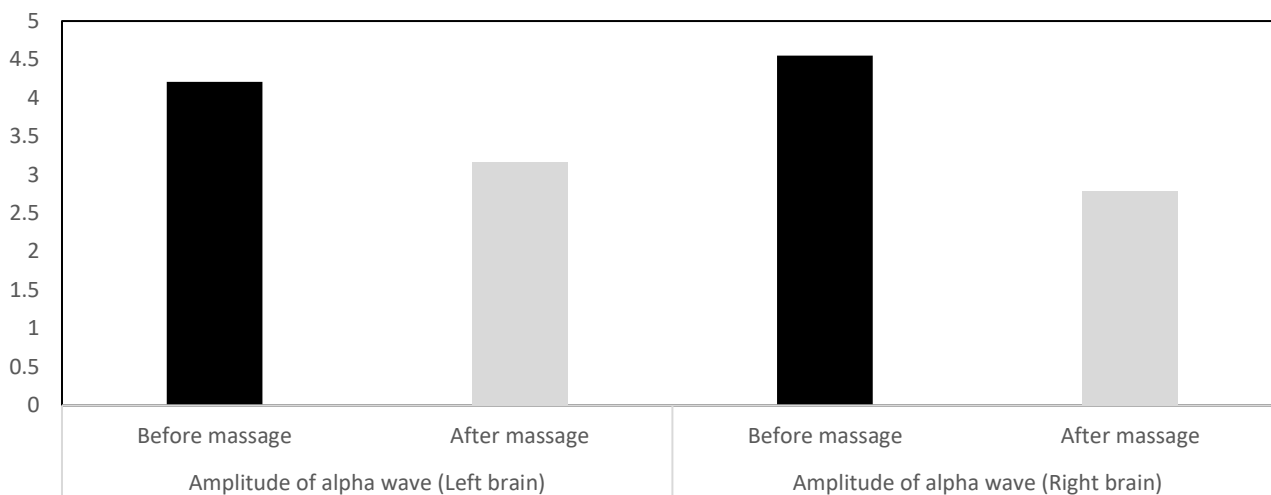


Figure 2 Alpha wave results of before and after massage.

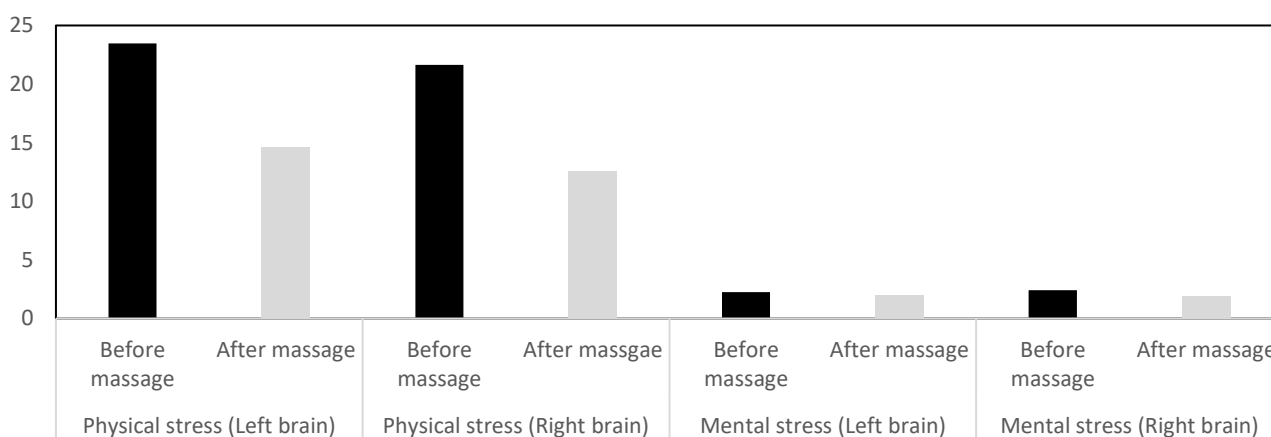


Figure 3. Stress index results of before and after massage.

Changes in Brain Wave and Stress Before and After the Experiment
Change in Alpha Wave Amplitude Before and After the Experiment

Based on the analysis of alpha wave amplitude difference of left and right brains before and after the aroma head therapy massage, a conclusion in the following Table 4 was drawn. And it is showed to Comparison analysis result of Alpha Wave Amplitude in Aroma Head Therapy Experiment in the following Fig. 4.

The average of the left brain's alpha wave amplitude difference before and after the massage was statistically significant ($Z=-2.321, p<0.05$). Accordingly, a decrease was observed after the massage ($M=3.01, SD=1.37$) compared to the value before the massage ($M=4.30, SD=2.45$). The average alpha wave amplitude difference of the right brain was statistically significant ($Z=-2.538, p<0.01$). Thus, after the massage ($M=2.79, SD=1.32$), a decrease was observed compared to the value before the massage ($M=4.51, SD=2.33$).

Table 4.

Change in Alpha Wave Amplitude Before and After the Experiment

Index	Before the Experiment	After the Experiment	z	p
	M(SD)	M(SD)		
Alpha Wave Amplitude (Left Brain)	4.30(2.45)	3.01(1.37)	-2.321*	.018
Alpha Wave Amplitude (Right Brain)	4.51(2.33)	2.79(1.32)	-2.538**	.004

** : $p<0.01$, * : $p<0.05$.

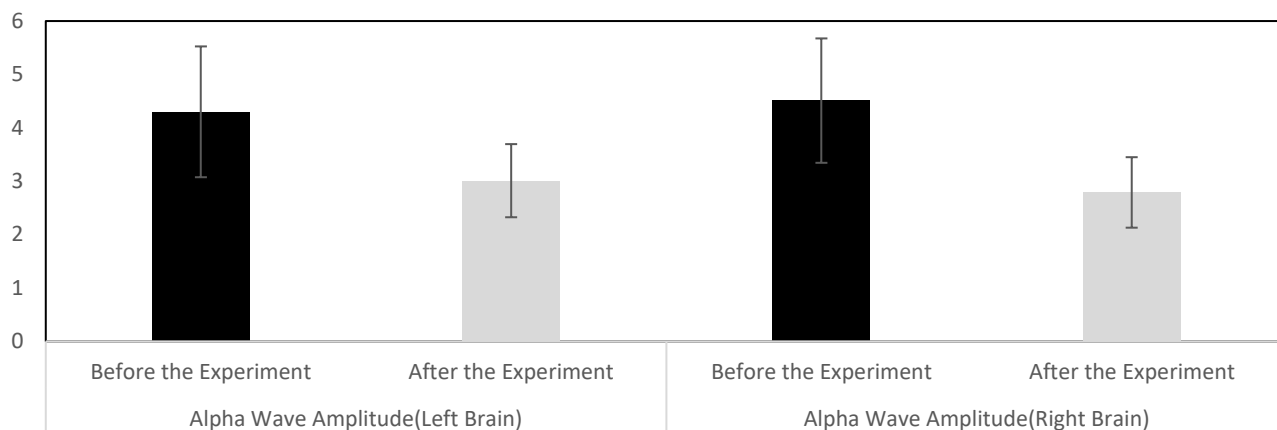


Figure 4. Comparison result in Alpha Wave Amplitude of Aroma Head Therapy Experiment

Change in Stress Before and After the Experiment

Based on the analysis of the stress index differences of left and right brains before and after the aroma head therapy massage, a conclusion in the following Table 5 was drawn. And it is showed to Change result of stress of Aroma Head Therapy Experiment in the following Fig. 5.

The physical stress difference of the left brain before and after the massage was significant statistically ($Z=-2.988$, $p<0.01$). Accordingly, a decrease was observed after the massage ($M=14.98$, $SD=10.79$) compared to the value before the massage ($M=23.45$, $SD=15.16$). The physical stress difference of

the right brain before and after the massage was statistically significant ($Z=-2.647$, $p<0.01$). Thus, after the massage ($M=12.81$, $SD=7.65$), a decrease was observed compared to the value before the massage ($M=21.82$, $SD=14.33$).

In contrast, there was no difference in mental stress of left and right brains before and after the massage. Left brain was observed after the massage ($M=2.01$, $SD=1.26$) compared to the value before the massage ($M=2.26$, $SD=0.98$). Right brain was observed after the massage ($M=1.93$, $SD=1.09$) compared to the value before the massage ($M=2.33$, $SD=1.21$).

Table 5

Change in Stress Before and After the Experiment

Index	Before Experiment	After Experiment	z	p
	M(SD)	M(SD)		
Physical Stress (Left brain)	23.45(15.16)	14.98(10.79)	-2.988**	.001
Physical Stress (Right brain)	21.82(14.33)	12.81(7.65)	-2.647**	.006
Mental Stress (Left brain)	2.26(0.98)	2.01(1.26)	-0.698	.513
Mental Stress (Right brain)	2.33(1.21)	1.93(1.09)	-1.578	.1017

** : $p<0.01$, * : $p<0.05$.

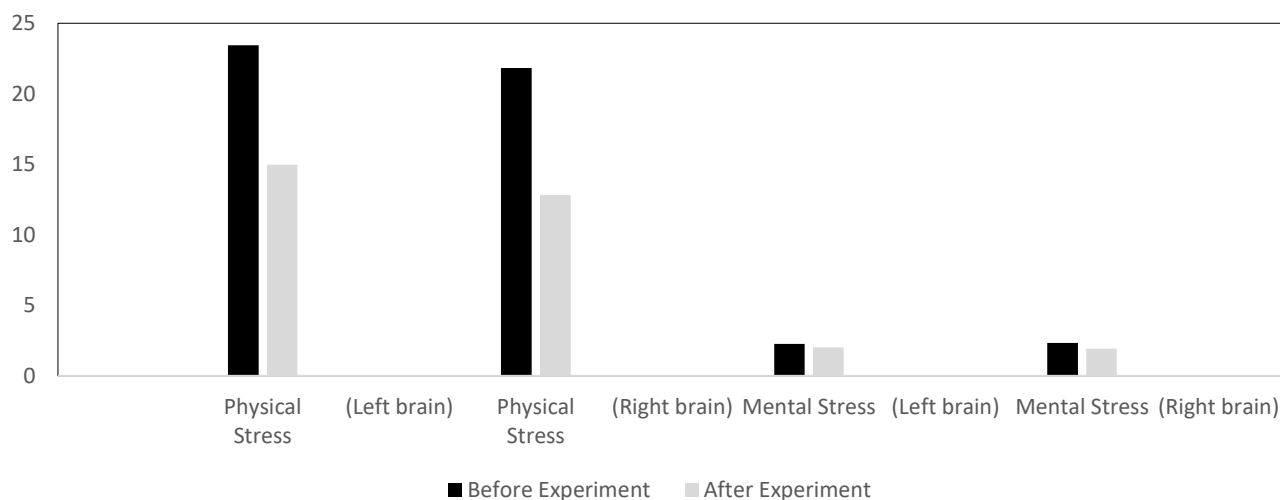


Figure 5. Change result in stress of Aroma Head Therapy Experiment

Conclusion

Based on the theory that aroma head therapy brings improvements to middle-aged women's psychological relaxation and stress, this research conducted an experiment. The experiment took place for two weeks. Brain waves using EEG were measured before and after the aroma head therapy massage. The result of the research is as follows.

First, alpha wave amplitude of left brain and right brain both decreased Before and After the aroma head therapy. The alpha wave amplitude of the right brain decreased after the massage compared to the amplitude before the massage, in particular. Therefore, it was concluded that aroma head therapy has a positive effect on psychological relaxation.

Secondly, the physical stress index difference before and after aroma head therapy primarily decreased after the massage, comparably to the value before the massage, in both left and right brains. These physical stresses in the state of muscle tension are the physiological reaction of human bodies to various causes. Thus, it was found out that aroma head therapy relieves stress in the whole body by relaxing the center of the human body, the head muscles.

Third, both the left and right brains showed no difference in the mental stress index before and after aroma head

therapy.

In conclusion, it was proved that aroma head therapy is closely related to the human body's psychological stability and physical stress. The research's significance lies in providing a solution to psychological stability and stress relief for middle-aged women.

Limitations of Research

The experiment was limited to subjects of a specific age group residing in a particular area. To prove that the result is valid on all woman, it is necessary to expand research by having more experimental groups.

The continued research and experiment of therapy and the brain waves' reaction on various subjects in the future will contribute to maintaining a healthy life and promoting psychological and physical stability.

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Competing interests

The authors declare that they have no competing interests.

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