

Comparative Analysis of the Exercise Flow, EEG and PPG Following the Senior Citizens' Yoga Participation Experience

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ABSTRACT

The purpose of this study was to examine and understand the effect on the exercise flow, electroencephalogram (EEG), and the photoplethysmography (PPG) following the senior citizens' yoga participation experience. The subjects of this study were 19 senior citizens living in City I who voluntarily agreed to participate in the study, who were classified into those who are experienced in yoga (n=9) and those who were not experienced in yoga (n=10). The yoga exercise program lasted 60 minutes. After the yoga exercise program was completed, the EEG and PPG were measured, and the exercise flow survey questionnaires were prepared. As for the data processing method, the SPSS 23.0 Version for Windows was used to conduct the independent t-test, and the following results were secured. First, there are differences in the exercise flow depending on whether they were experienced in the yoga participation, yet they were not significant. Second, there were significant differences in L-Beta, M-Beta, H-Beta, Gamma, and the brain health indicators of Brain Stress and Brain Score ($p<.05$), depending on the experience of the senior citizens participating in yoga. Third, there were significant differences in HRV-INDEX, parasympathetic neuronal activities, and autonomic neuronal activities ($p<.05$), depending on the experience of the senior citizens participating in yoga. As a result of this study, it was apparent that there were differences in the EEG and PPG depending on whether the senior citizens were experienced in the yoga participation, and such results can be expected to serve as the basic data for the research of the ways to participate in the sustainable exercise along with the intent to exercise.

1. Introduction

Following the advancement of medical technology and the economic development, the life expectancy of the Koreans has steeply increased from 62.3 years during the 1970s to 76.0 years in 2000, and 82.1 years in 2015, joining the league of the longest living nations (Statistics Korea, 2018). Such a rapid increase in the population of the senior citizens means an increase in the population with the deterioration of physical and mental functions, leading to social issues. As for the characteristics of the senior citizens, their physical functions deteriorate due to the physiological changes such as a decrease in the muscle mass as aging progresses (Chen et al., 2016), while chronic diseases such as diabetes, arthritis, high blood pressure, and disc are caused. The chronic diseases of the senior citizens affect the quality of life (Jung et al., 2011), and as the ability to perform daily activities is restricted, their mental and physical functions deteriorate rapidly, further leading to the deterioration of mental functions such as depression, cognitive dysfunction and dementia (Song et al., 2017). Such a physical and mental deterioration further causes stress related diseases among the senior citizens. The stress related diseases of the senior citizens are deeply related to the autonomic nerve system (ANS). Chronic stress activates the sympathetic nerve, and causes various adverse effects on the human body, such as cardiovascular diseases and the immune function declines (Lovallo & Buchanan, 2017; Kang, 2020).

In general, the senior citizens' participation in exercise helps them prevent and manage major chronic diseases, reduce cardiovascular diseases and strokes, and improve the level of individual health, such as by improving cognitive function (Jung, 2014). It is also known as a factor required for reducing medical expenses in the society as a whole, thereby overcoming a sense of social isolation and alienation, and enhancing the satisfaction of life (Ko, 2015). Furthermore, the exercise flow is a very positive factor for the senior citizens as a system of reinforcing factors and the possibility of continuing the exercises (Kim & Chung, 2015).

Various studies have been reported on the effects of the senior citizens' participation in exercise on such physiological variables as the EEG, heart rate variability, and the autonomic nervous system. It was claimed that the senior citizens' participation in resistance movements decreased the Theta waves and increased the Alpha and SMR waves (Hong, 2013). Furthermore, it turned out that the function activation and the balance of the autonomic nervous system increased following the increase in the heart rate variability following the underwater exercise among the obese women senior citizens (Kim et al., 2017).

The EEG is an electrical signal generated when an information is exchanged by and between the brain cells, and also has important information demonstrating the brain's active state and activated state. The EEG demonstrates a specific pattern which changes according to the state of consciousness and mental activities (Seo, 2010), and is also classified according to the range of the vibrating frequency. It is classified into the Delta wave (-3.99 Hz) which emerges during a deep sleep, Theta wave (4-7.99 Hz) related to emotions, thought activities, and meditation, Alpha wave (8-12.99 Hz) related to concentration and memory, stress relief, SMR wave or Low-Beta wave (Sensory-Motor Rhythm, 12-14.99Hz) related to wakefulness preparation and attention concentration, M-Beta wave (15-19.99H) which is an indicator of conscious activity, H-Beta wave (20-29.99H) related to stress,

and the Gamma wave (30-49.99H) related to concentration (Lee et al., 2019). Of which, the EEG related to physical activities is the Alpha wave and the Beta wave (Moraes et al., 2007). The Heart Rate Variability (HRV) refers to the heart rate variability. The HRV demonstrates the activities and balance of the autonomic nervous system, which is consisted of the sympathetic and parasympathetic nervous systems through the changes in the heart rate (Kim et al., 2015). Furthermore, the larger the HRV, and the more irregular the rhythm, the more physiologically healthy (Shim, 2019), and in the state of stress, it emerges as a simple rhythm. Through which, the HRV is used as a measuring equipment for the mental disorder and stress in Korea (Kim et al., 2005).

Among the various exercises, yoga brings about a positive effect on the health related physical elements and psychological stability, and hence, it is applied as a most appropriate exercise for the senior citizens with a low level of activities (Kim, 2013). The application of yoga for the senior citizens has an excellent effect on the stress relief, and in particular, it was reported that such stress also influences the EEG (Kim et al., 2005).

As such, the studies related to such physiological variables as the EEG and the PPG according to physical activities have been reported. However, the studies on the responses of the EEG to the senior citizens according to whether they are experienced in exercises are very inadequately conducted. Therefore, this study seeks to articulate the differences in the exercise flow, EEG, and PPG changes according to the experiences of the yoga participation after a one-time yoga exercise for the senior citizens in order to expand the participation in the exercise for maintaining health at an old age, thereby providing the basic data for the study of the ways of participation in the exercise.

2. Research Method

2.1 Research subjects

In this study, to recruit the senior citizens aged 65 or older, phone calls were placed to the subjects with the intention to participate in conjunction with the Senior Citizens Welfare Center in District Y, City I, and their consent was secured to proceed. The sample size of this study was calculated by using the G-Power 3.1 program. Since the α level, test power, and the effect size were set to 0.05, 0.80 and 0.80, each respectively, 19 subjects were studied. The subjects of the study were selected among those who could communicate, had no mental or cognitive impairments, and did not have any impediments to the physical activities.

The subjects participated in the experiment by refraining from smoking, alcohol, and caffeine, which could stimulate nerves, from the day before the experiment. They were consisted of 9 people of the group who were experienced in yoga, and 10 people of the group who were experienced in yoga. The general characteristics of the study subjects are as illustrated in Table 1. As a result of testing the homogeneity of the age, height, weight, EEG, and the PPG of the two groups, the significance probability turned out to be greater than 0.05, and hence, there was no difference between the groups.

Table 1. General Characteristics of the Research Subjects

Classification	Group with the yoga participation experience (n=9)	Group without the yoga participation experience (N=10)
	M±SD	M±SD
Age (years)	72.67±6.51	72.50±4.17
Height (cm)	153.83±6.99	153.75±3.71
Weight (kg)	58±11.04	59.76±5.67

2.2 Research procedures

This study was conducted by securing the approval of the Gachon University's Research Ethics Committee to examine the effects on the exercise flow, EEG and the PPG following the senior citizens' yoga participation (1044396-202007-HR-124-01). For this study, the details, purpose, and research procedures were adequately explained to all subjects before the commencement of the study, and the experiment began after securing their consent to participate in the experiment. On the day of the experiment, the subjects arrived at the location of experiment, completed the general characteristics questionnaire, and after proceeding with the yoga exercise program for approximately 60 minutes, the EEG and the PPG were measured, and the exercise flow questionnaire was completed.

2.3 Structure of the yoga exercise program

The yoga exercise program was consisted of 10 minutes of the meditation and warm-up, 40 minutes of the main exercise, and 10 minutes of the cool-down and meditation. The meditation and warm-up was consisted of 10 movements by making reference to the warm-up program recorded in the senior citizens' physical education for leaders (Lee et al., 2010). The main exercise and the cool-down and meditation were restructured into 11 movements based on the previous studies on the effects of yoga on the senior citizens and the related reference of Kwon (2020), Shin (2019), Song (2014), and Jeong et al. (2006). All movements were made to be performed up to the range they could move, alternating left and right, twice each, respectively.

The yoga exercise program of this study was carried out by the professional guidance. The structure of the yoga exercise program conducted in this study is as illustrated in Table 2.

Table 2. Structure of the Yoga Exercise Program

Classification	Details		Time	
Meditation & warm-up	Meditation	Suckasana	10 minutes	
	Warm-up	Sitting		Chest extension, Wrist exercise, Low back exercise, Ankle exercise, Achilles' tendon extension
		Standing		Chest extension, Arms exercise, Trunk exercise, Back exercise, Achilles' tendon extension

Classification	Details		Time
Main exercise	Standing	Utthita Trikonasana, Downward-facing dog	40 minutes
	Sitting	Ardha-Matsyendrasana, Paschoimottanasana, Janusirasana, Bhujangasana	
	Prone & Supine	Setu-Bandha Sarvangasana, Jathara Parivartanasana, Pavanmuktasana	
Cool-down & meditation	Cool-down	Ananda Balasana	10 minutes
	Meditation	Savasana	

2.4 Research measurement and method

2.4.1 Exercise flow

The exercise flow is an immersive experience questionnaire, which was developed based on the immersive experience factors, and the status was measured across 5 stages according to the characteristics of each immersive experience factor. The factors of immersive experience are consisted of a total of 20 questions, of which 4 questions on the Clear Goals, 4 questions on the Sense of Control, 4 questions on the Loss of self-consciousness, 4 questions on the Time Transformation, and 4 questions on the Autotelic Experience (Seo, 2005). In this study, the effects of the exercise participation experience on the senior citizens' exercise flow was examined.

2.4.2 The EEG and PPG measurements

As illustrated in Figure 1, the EEG and PPG measurements of the subjects were taken by using the Omnitfit mindcare (OMNI C&S, South Korea). This measuring instruments measures the EEG with a frontal 2-channel system and also measures the PPG via a headset earlobe sensor. As for the place of measurement, the measurement was taken in a laboratory environment where external visual and auditory stimuli were maximally controlled, while the measurement time was taken with the eyes closed for a minute after resting immediately following the participation in the yoga exercise program. During the measurement, the subjects were not allowed to move or speak to ensure that the EEG and PPG measurement is not influenced. If the subjects were exposed to any uncontrolled situations during the measurement, the measurement was remeasured after resting for a minute.

As for the measurement variables, the basic EEGs of Theta wave, Alpha wave, Low-Beta wave, M-Beta wave, H-Beta wave, and Gamma wave were measured. The Brain Score, which is the sum of the brain stress and the basic EEGs which emerge according to the relative comparative value of the H-Beta wave, and the Peak SEF, which is a value equivalent to the point of peak of the sum of the entire EEGs by frequency, were measured. Furthermore, the average pulse, HRV index, parasympathetic nerve activities, sympathetic nerve activities, and the autonomic nervous

system activities were measured via the PPG measured by the heart rate.



Fig. 1. EEG and PPG measurements taken

2.5 Data analysis

Mean and standard deviation were calculated by using the SPSS 23.0 Version (IBM Co., Armonk, NY, USA) for the data analysis measured in and for this study. Both groups satisfied the normality for the exercise flow, EEG, and the PPG according to the senior citizens' yoga participation experience. Accordingly, an independent t-test was conducted for the comparative analysis of the exercise flow, EEG, and the PPG according to the senior citizens' yoga participation experience. All statistical levels of significance were set to 0.05, then tested.

3. Research Results

3.1 Comparative analysis of the exercise flow according to the senior citizens' yoga participation experience

Table 3 illustrates the results of the independent t-test conducted for a comparative analysis of the exercise flow according to the presence or absence of the senior citizens' yoga participation experience. As a result of comparing each sub-factor, the average value of the group without the yoga participation experienced tended to be approximately 11.76% higher than that of the group with the yoga participation experience in the factor of the Time Transformation among the exercise flow variables. However, there was no statistically significant level. There were also no statistically significant levels for the other factors of Clear Goals, Sense of Control, Loss of self-consciousness and Autotelic Experience.

Table 3. Comparative Analysis of the Exercise Flow Following the Senior Citizens' Yoga Participation Experience

Presence or absence of the yoga participation experience	Exercise Flow n	Clear Goals	Sense of Control	Loss of self-consciousness	Time Transformation	Autotelic Experience
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Group with the yoga participation experience	9	3.64±.57	3.67±1.08	3.97±.69	2.89±.77	4.33±.43
Group without the yoga participation experience	10	3.75±.84	3.62±.70	3.88±.38	3.23±.65	4.23±.58
t		-0.332	0.101	0.287	-1.030	0.455
p		0.744	0.921	0.777	0.317	0.655

Values are mean ± S.D., * p<0.05

3.2 Comparative analysis of the EEG according to the senior citizens' yoga participation experience

3.2.1 Comparative analysis of the basic EEG according to the senior citizens' yoga participation experience

Table 4 illustrates the results of the independent t-test conducted for a comparative analysis of the basic EEG according to the presence or absence of the senior citizens' yoga participation experience. Among the basic EEG variables, the L-Beta wave factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.629$, $p < 0.05$). The M-Beta wave factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.629$, $p < 0.05$). The H-Beta wave factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.387$, $p < 0.05$). Furthermore, the Gamma wave factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.264$, $p < .05$). Other Theta and Alpha wave factors tended to be higher in the group with the experience of participating in Yoga. However, there were no statistically significant levels.

Table 4. Comparative Analysis of the Basic EEG Following the Senior Citizens' Yoga Participation Experience

Presence or absence of the yoga participation experience	EEG n	Theta	Alpha	L-Beta	M-Beta	H-Beta	Gamma
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Group with the yoga participation experience	9	5.47±1.79	5.32±1.40	7.29±1.47	7.19±1.63	7.33±1.70	5.74±1.81
Group without the yoga participation experience	10	6.84±1.80	6.33±1.55	8.83±1.07	8.75±1.24	8.86±1.05	7.34±1.24
t		-1.666	-1.484	-2.629	-2.367	-2.387	-2.264
p		0.114	0.156	0.018*	0.030*	0.029*	0.037*

Values are mean ± S.D., * p<0.05

3.2.2 Comparative analysis of the brain health indicators according to the senior citizens' yoga participation experience

Table 5 illustrates the results of the independent t-test conducted for a comparative analysis of the brain health indicators according to the presence or absence of the senior citizens' yoga participation experience. Among the variables of the brain health indicators, the brain stress factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.387$, $p < 0.05$). Furthermore, the Brain Score factors turned out to be significantly lower in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = 2.750$, $p < 0.05$).

Table 5. Comparative Analysis of the Brain Health Indicators Following the Senior Citizens' Yoga Participation Experience

Presence or absence of the yoga participation experience	Brain Health Indicators	n	Brain Stress	Brain Score
			Mean±SD	Mean±SD
Group with the yoga participation experience		9	7.33±1.70	73.22±7.87
Group without the yoga participation experience		10	8.86±1.05	63.70±7.23
	t		-2.387	2.750
	p		0.029*	0.014*

Values are mean ± S.D., * $p < 0.05$

3.3 Comparative analysis of the PPG according to the senior citizens' exercise participation experience

Table 6 illustrates the results of the independent t-test conducted for a comparative analysis of the PPG according to the presence or absence of the senior citizens' yoga participation experience. As illustrated in Table 6, the HRV INDEX factor among the PPG variables turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.604$, $p < 0.05$). The parasympathetic activity factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -2.439$, $p < 0.05$). Furthermore, the autonomic nervous system activity factor turned out to be significantly higher in the group without the experience of participating in yoga relative to the group with the experience of participating in yoga ($t = -3.055$, $p < 0.05$). Other factors of average pulse and sympathetic nerve activities tended to be higher in the group with the experience of participating in yoga. However, there were no statistically significant levels.

Table 6. Comparative Analysis of the PPG Following the Senior Citizens' Yoga Participation Experience

Presence or absence of the yoga participation experience	PPG	Average Pulse	HRV INDEX	Parasympathetic Nerve Activities	Sympathetic Nerve Activities	Autonomic Nervous System Activities
	n	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Group with the yoga participation experience	9	77.67±16.51	9.13±3.07	5.07±0.70	4.65±1.44	6.12±0.90
Group without the yoga participation experience	10	81.60±12.50	14.06±4.87	6.01±0.95	5.64±1.10	7.57±1.14
t		-0.589	-2.604	-2.438	-1.694	-3.055
p		0.563	0.019*	0.026*	0.108	0.007*

Values are mean ± S.D., * p<0.05

4. Discussion

The purpose of this study was to prepare the basic data for the study of ways for the intention to exercise and the participation in the sustainable exercise based on the analysis of the exercise flow, EEG, and the PPG, after conducting the one-time yoga exercise program for approximately 60 minutes depending on the presence or absence of the senior citizens' exercise participation experience. The exercise flow is an important factor of influence for the continued performance of exercise (Kim & Chung, 2015). This means the continued rate of participation by which one directly participate in the exercise and regularly performs the activity (Dishman, 1988; Ryu, 1999), and the immersion by the continued participation in the exercise causes influence on the physical strength, stress relief and job, satisfaction of leisure, satisfaction of daily life, and self-realization, among others (Shin, 2014).

In the results of this study, there was no significant difference in the exercise flow according to the experience of participating in yoga. According to the previous study of Jeon & Kim (2018), there was a significant effect on the intention to continuously participate and the exercise flow of the club members who participated in badminton at least once a week, and it was reported that the continued performance of exercise of the senior citizens who participated in golf was deeply related to the exercise flow (Kim & Chung, 2015). However, it is considered that, no significant difference turned out in the exercise flow according to the experience of participating in yoga in this study since the exercise was too short for the subjects to recognize the change in the exercise flow due to their temporary participation.

Yoga exercise activates all the internal resources which exist within the human personality via the practice of not only the body but also the mind and human components through the yoga movements (asanas), breathing (pranayama), and meditation (dhyana) (Shapiro et al., 1977; Park & Kim, 2014). Senior citizens promote the secretion of estrogen through the yoga exercise, which enhances the immune function, prevents osteoporosis and dementia, and influences the aging related hormones (Kim et al., 2017). Aside from which, examining the previous studies on the effects of the yoga movement on the senior citizens, Kim (2007), Kim & Park (2001), Park (2020), Park

& Song (2020), and Choi et al. (2012) reported that yoga exercise has a positive influence on the health related physical strength factors such as the balance, muscular strength, flexibility, and the joints' range of movement for the senior citizens, and at the same time, such social and psychological factors as the depression, quality of life, cognitive function, and the physical stress may be enhanced as a matter of a positive influence.

In a study on the yoga exercise and the EEG for the senior citizens, it was reported that it was effective for the psychological stability, that is, it was effective in reducing the physical fatigue and enhancing the concentration by reducing the Alpha wave activation, Beta waves, and the Gamma waves (Lee et al., 2014). Furthermore, a decrease in the right brain's H-Beta waves after the yoga breathing practice means a decrease in the distraction from the mental stress, and the emotional calm and calmness were felt (Kim & Jo, 2012). While undergoing the recovery process after the yoga exercise with the eyes closed and relaxed, the Alpha waves emerged significantly across the measurement area, whereby the state of relaxation, rest, and concentration were enhanced. To the contrary, when the eyes are opened from a state of rest with the eyes closed, the concentration decreases and the stress increases, and hence, the Alpha waves decreased and the Beta waves increased across a specific area (Kim, 1999). The relative Alpha waves turned out to have increased by channel following the yoga movement only in the moderate-to-intense yoga exercise program. The relative Beta waves turned out to have a statistically significant difference at the point of measurement for each yoga exercise program according to the intensity of the exercise, and it also turned out that only in the moderate-to-intense yoga exercise program, it decreased for each channel after the yoga exercise (Lim & Kim, 2007). As such, in this study, when the EEG was measured with both eyes closed immediately after the one-time yoga exercise program, the L-Beta waves, M-Beta waves, H-Beta waves, and the brain stress were significantly higher in the group with the experience of participating in yoga than in the group without the experience of participating in yoga. It may be interpreted such that the performance of the yoga exercise program helps those with the yoga participation experience more than those without such experience in relieving stress, while the concentration may be further enhanced.

Parasympathetic activation means a relaxed state free of stress, and the sympathetic nervous system increases under stressful situations (Choi, 2019). It has been reported that the stress related diseases at an old age are related to the autonomic nervous system, and may also cause various adverse effects on the human body including cardiovascular diseases and the decreased immune function by activating the sympathetic nervous system (Lovallo & Buchanan, 2017). According to a previous study, the parasympathetic function was enhanced when the yoga exercise was performed for 12 weeks for the women aged 65 or older (Choi, 2012). It is also uncovered that there is a positive influence on the autonomic nervous system activities by decreasing the sympathetic nervous system tension and increasing the parasympathetic tension (Lee et al., 2014). Furthermore, when the yoga exercise was performed for 60 minutes for the college students majoring in physical education, the stress index fell, and the average pulse and the balance of autonomic nervous system were even more positively influenced (Kim, 2015). As such, in this study, when the PPG was measured with both eyes closed immediately after the one-time yoga exercise program, the HRV INDEX, parasympathetic activities, and the autonomic activities turned out to be significantly higher in the

group without the yoga participation experience than in the group with the yoga participation experience. Based on which, it may be presumed that the one-time yoga participation caused by this experiment in the group without the yoga participation experience may have caused the stress originated from unfamiliar experiences.

This study has limitations as follows. First, the total number of subjects for this study was 19 people, 9 of whom were the group with the yoga participation experience, and 10 of whom were the group without the yoga participation experience. Since the number of the subjects was small, there was a limitation in making generalization. Second, since the research experiment was conducted as one-time, and the EEG and PPG measurements were taken only immediately after the yoga exercise program was completed, there was a limitation in measuring, comparing, and analyzing the changes in the EEG and the PPG in detail at each point of exercise. Despite such limitations, the significance of this study is that the difference was articulated between the EEG and the PPG after the one-time yoga exercise program according to the senior citizens' exercise participation experience.

Based on the results of this study and the previous studies, and in the future studies, the depression, stress, and the quality of life of the study subjects need to be identified and understood in advance, and the maximum number of study subjects need to be selected, while the changes in the exercise flow, EEG, and the PPG according to their history of exercise need to be analyzed. Through which, an exercise program appropriate for the stage of their exercise career will be prepared to induce the senior citizens to continuously participate in the exercise.

5. Conclusion

This study attempted to comparatively analyze the exercise flow, EEG, and the PPG by carrying out a one-time yoga exercise program for the senior citizens according to their yoga participation experience, and the following conclusions were acquired.

First, the Clear Goals and the Time Transformation, which are the sub-factors of the exercise flow, turned out to be higher in the group without the yoga participation experience relative to the group with the yoga participation experience, yet there was no statistically significant difference. The Sense of Control, Loss of self-consciousness, and Autotelic Experience, which are the sub-factors of the immersion in exercise, turned out to be lower in the group without the yoga participation experience relative to the group with the yoga participation experience, yet there was no statistically significant difference.

Second, the L-Beta waves, M-Beta waves, H-Beta waves, and the Gamma waves, which are the sub-factors of the basic EEG, turned out to have statistically significant differences in the group without the yoga participation experience relative to the group with the yoga participation experience. The brain stress and the Brain Score, which are the sub-factors of the brain health indicators, turned out to have statistically significant differences in the group without the yoga participation experience relative to the group with the yoga participation experience.

Third, the HRV INDEX, parasympathetic activities, and the autonomic nervous system activities, which are the sub-factors of the PPG, turned out to have statistically significant differences in

the group without the yoga participation experience relative to the group with the yoga participation experience. The average pulse and the sympathetic nerve activities turned out to be higher in the group without the yoga participation experience relative to the group with the yoga participation experience, yet there was no statistically significant difference.

In conclusion, through the EEG measurement, it is apparent that the physical fatigue and the physical stress after a one-time yoga exercise program turned out to be lower in the group with the yoga participation experience relative to the group without the yoga participation experience. This is determined to be a result of the group with the exercise participation experience demonstrating a stable effect on the autonomic nervous system activities by decreasing the average pulse and the sympathetic nerve activities, and by increasing the parasympathetic nerve activities relative to the group without the yoga participation experience.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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