

THE EFFECT OF SHORT-TERM OUTDOOR TAEKWONDO TRAINING ON THE CONCENTRATION AND MOOD OF TAEKWONDO PLAYERS

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ABSTRACT

Background and Objective

This study verified the effect of short-term outdoor taekwondo training on the attention and mood state of taekwondo players.

Material and Methods

Eighteen taekwondo players were divided into an indoor taekwondo group ($n=9$) and an outdoor taekwondo group ($n=9$). Concentration, mood state, and subjective exercise intensity were measured initially and after the training intervention.

Results

The results showed that first, taekwondo training in the natural environment was effective in improving the concentration of the players, rather than the indoor taekwondo training ($F=4.736, p=0.045$). Second, interaction effects were found for the mood states of anger and hostility ($F=19.782, p<0.001$), vigour ($F=36.971, p<0.001$), and fatigue ($F=39.878, p<0.001$). The outdoor taekwondo group showed positive changes as compared to the indoor taekwondo group. Third, although both groups underwent the same training, the group subjected to outdoor taekwondo training considered the training to be lower in intensity than the indoor taekwondo group ($t=5.245, p<0.001$).

Conclusion

The various physical stimuli that one experiences in a natural environment, such as plants, light, sound, and air, provide refreshing sensations that have a positive effect on the concentration and mood state of taekwondo players. We suggest that training in a natural environment can help improve taekwondo performance.

The martial art of taekwondo is performed as a contest between opponents over three two-minute rounds. Therefore, high concentration, fast reactions, and positive mood in a variety of game situations are required. According to previous studies, as physical strength varies among individuals, so does concentration. It has been reported that a certain time needs to elapse to restore concentration after it has been depleted.¹ In addition, fierce competition and the ongoing training that players face have a negative effect on mental health, due to cumulative fatigue.²⁻⁴

Based on these prior studies, a positive mood is important for the taekwondo player, so that they can cope with the concentration demands and the sport-related stresses that they face; such a mood might help improve performance. Therefore, in this respect, basic data are required. That participating in exercise reduces stress and has a positive effect on mental health has been consistently reported by previous studies.²⁻⁴ Additionally, exposure to natural environments has been reported to show the same effects as exercise in this respect.⁵⁻⁷

Studies of exercise and exposure to natural environments have consistently reported positive effects on human physical and mental health.⁸⁻¹¹ As the effects can potentially be maximized by exercising in a natural environment, studies have been conducted on exercise in natural environments, such as forests or parks.⁵ Positive influences on blood pressure, tension, anxiety, mood state, and cognitive function have been reported due to exercise in the natural environment, or seeing a natural environment through a screen while exercising on a treadmill, rather than performing the exercise of the same intensity indoors.^{2,3,5,12}

Thus, previous studies, despite their preliminary nature, have verified the positive effects of exercise when exposed to the natural environment. Specifically, results have shown a positive effect on the physical and mental health of the subjects. In general, skill training of taekwondo players is most often implemented indoors. We propose that training conducted in the natural environment would be more beneficial than that conducted indoors. Nonetheless, there is a shortage of studies verifying the positive effects of outdoor taekwondo training. Therefore, this study addresses a new method of helping the concentration

and mood state of taekwondo players by objectively studying the effects of taekwondo skill training when exposed to the natural environment.

METHODS

Participants

After receiving approval for the study from the clinical trial review committee of the university, 18 taekwondo players (14 men and 4 women, average age 22.55±0.98 years, average taekwondo experience 10.50±1.20 years) attending G University in Gyeonggi Province were selected through random sampling. The purpose and study method were explained to all participants, and they were enrolled after they signed a consent form. All information obtained through the survey was used solely for this study.

To determine an appropriate sample size to assess a 2-way (2 × 2) Randomized Group - Repeated Measure (RG-RM) interaction (effect size=0.50, α=0.05, power=0.95) analysis, G-power program (Version 3.10, Universität Düsseldorf, Germany) was used and a sample size of 16 was obtained. Thus, the 18 participants recruited were sufficient for the analysis conducted in this study.

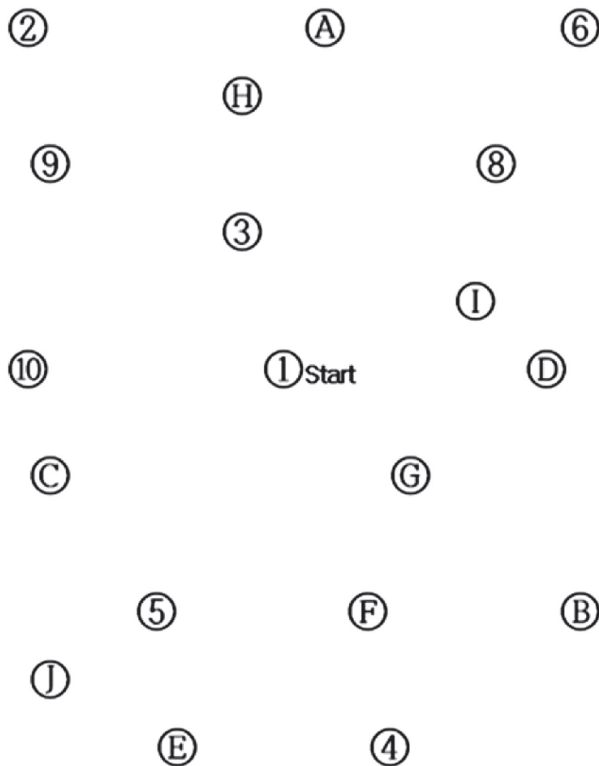
Test of Concentration (Trail Marking Test Part 2)

The test used to measure the concentration of players was the Trail Marking Test Part 2.¹³ Initially, this was used as a component of neuropsychiatric examinations; currently, the test is frequently used to measure concentration in neuropsychology.¹⁴ Briefly, the subject need to use a pen to draw a line between points at once, in the order 1-A-2-B-3-C; the time taken to complete the exercise is measured. Since 1958, scores have been defined as the time taken to complete the test, regardless of mistakes, which require subjects to start drawing the line again from the point of the error. This study used Trail B, based on the recent results of Shin et al.,¹² who reported that using Trail B was effective for evaluating the concentration of an individual. The specific content of the cognitive function test strips is shown in Figure 1.

Test of Mood State (Profile of Mood State; POMS)

Mood state was measured based on the questionnaire developed by McNair et al.,¹⁵ using the POMS reported in Morgan et al.¹⁶ This test consists of 65

FIG. 1 Trail Marking Test Part B.



questions, which are rated via adjectival five-point Likert scales (scores per item range from 0–4 points). It has 6 sub-factors: T–A (tension and anxiety), D (depression), A–H (anger and hostility), V (vigour), F (fatigue), and C (confusion). Internal consistency was 0.73~0.95 in previous studies.^{15,16}

Subjective Exercise Intensity (Rating of Perceived Exertion)

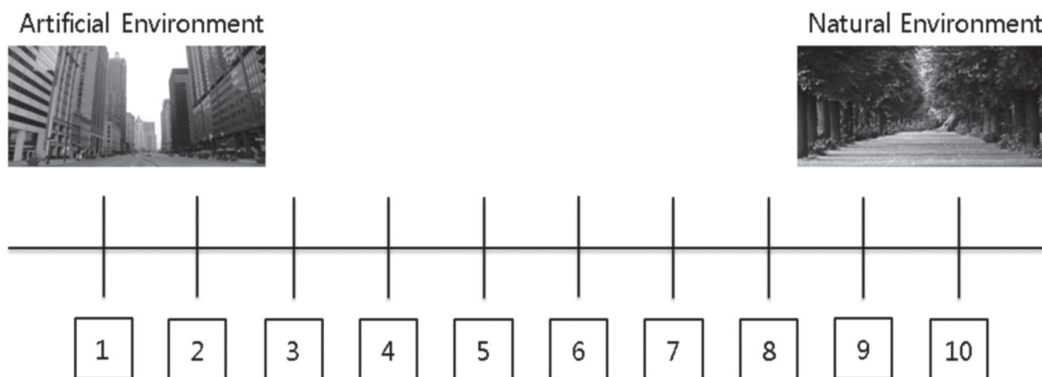
To assess the exercise intensity of taekwondo skill training conducted in the natural environment and indoors, subjective exercise intensity ratings were collected, via Borg and Nobel’s Rating of Perceived Exertion (RPE) scale.¹⁷ The RPE charts the degree of fatigue based on heart rate. It is composed of 15 stages from 6 to 20, where 6 represents intensity at rest, and 19~20 represents intensity at maximum performance (“all-out”). This instrument is self-administered at the end of exercise, and is used as a way of measuring awareness of the intensity of exercise. According to a previous report, the reliability of the Borg Scale is relatively good (Cronbach’s alpha=0.64~0.78).¹⁸

EVALUATION OF EXERCISE ENVIRONMENT

To ensure the desired exercise conditions were met, a 10-point scale used in a previous study was employed,^{5,19} in which 1 point denotes a very artificial or city environment, and 10 points denote a very natural environment, such as a forest. In this study, to increase the understanding of the participants, a city illustration was provided at the 1-point checkbox, and a forest illustration at the 10-point checkbox. The scale is shown in Figure 2.

The average score for the outdoor taekwondo group (mean=9.22, standard deviation=1.09) and indoor taekwondo group (mean=1.33, standard deviation=0.70) differed significantly ($t=18.181, p<0.001$). Thus, the desired training conditions were achieved.

FIG. 2 Evaluation of exercise environment.



Experimental Procedure

Prior to beginning the study, we contacted taekwondo team leaders of five universities to explain the purpose of this study. G University in Gyeonggi Province agreed to collaborate with us in this study. Subsequently, at a given date and time, researchers, assistant researchers, and training assistants visited our facility. A meeting with the study subjects occurred in an indoor gymnasium, at which time we explained the research purpose and procured written consent for study participation from the taekwondo players.

Before beginning the study, preliminary tests consisted of the pre-trail marking test, main-trail marking test, and completion of the mood state questionnaire. Based on the results of the concentration test, participants were sorted into the natural environment training group (hereafter called outdoor taekwondo training) and the indoor taekwondo training group (each group was assigned 9 people). The outdoor taekwondo training group drove to the nearby Y mountain (a 3-minute car drive), and the indoor taekwondo training group completed their training in the same gymnasium where the study was explained to the participants.

Both groups underwent the same training procedure, namely reverse turning kicks were carried out repeatedly in response to a whistle (sequence: two-second interval of whistle and one bout for 1 minute → five-second intervals of whistle and one bout for 2 minutes → two-second interval of whistle and one bout for 1 minute → five-second interval of whistle and one bout for two minutes), which was configured on a computer in advance. The exercise required 40 minutes, with a break of 5 minutes after exercising for 10 minutes.

The post-test was carried out immediately after the test was completed, starting with the concentration test, then the POMS, subjective exercise intensity rating, and exercise environment evaluation.

Statistical Analyses

Independent *t*-tests and 2 × 2 repeated-measures ANOVA were performed via SPSS Version 21.0 (SPSS Inc., Chicago, IL, USA). If a significant interaction effect was present in the ANOVA, post-hoc tests (with Bonferroni correction) were used to assess pairwise

differences in scores between groups. The level of significance was set at 0.05.

RESULTS

In the analysis of the concentration test, the interaction effect was statistically significant ($F=4.736$, $p=0.045$). Post-hoc comparisons (Bonferroni correction) revealed that scores of the outdoor taekwondo group were significantly lower at post-test than pre-test (mean difference=26.424, $p=0.003$).

In the analysis of mood state, an interaction effect was present for anger and hostility ($F=19.782$, $p<0.001$), vigour ($F=36.971$, $p<0.001$), and fatigue ($F=39.878$, $p<0.001$), whereas anxiety, depression, and confusion did not show significant interactions or main effects. Anger scores of the indoor taekwondo group were greater at post-test than pre-test (mean difference=10.444, $p<0.001$). For vitality, while scores of the outdoor taekwondo group increased at post-test versus pre-test (mean difference=5.111, $p<0.001$), scores of the indoor taekwondo group were lower at post-test than pre-test (mean difference=4.778, $p=0.001$). Finally, for fatigue, while the scores of the outdoor taekwondo group were lower at post-test than pre-test (mean difference=5.000, $p<0.001$), the indoor taekwondo exercise group had higher scores at post-test than pre-test (mean difference=4.222, $p=0.001$).

Regarding the subjective exercise intensity, despite the same training being conducted, the scores of the outdoor (mean=9.22, standard deviation=2.63) and indoor taekwondo exercise groups (mean=15.11, standard deviation=2.08) differed significantly ($t=5.254$, $p<0.001$).

Additionally, in analysis of sex difference in 4 factors (tension and anxiety, anger and hostility, vigour, and fatigue) that showed significant interaction, male participants showed more positive scores than female in all 4 factors (tension and anxiety, men: 42.80±17.90 points, women: 66.00±31.18 points; anger and hostility, men: 15.28±9.72 points, women: 23.50±15.71 points; vigour, men: 16.07±7.65 points, women: 10.00±8.67 points; fatigue, men: 12.07±6.14 points, women: 16.50±10.11 points).

DISCUSSION

The data showed the presence of group-related differences in attention and subjective exercise intensity, and there were interactions in subcomponents of mood state. Concentration-assessment scores of the outdoor taekwondo exercise group were lower at post-test than pre-test. Thus, the study supports the finding that as the presence of the natural environment increases, and as we visually experience the natural environment, there are improvements in brain function, such as in cognition and memory.²⁰ Another study reported that phytoncide, which is known as a major component of forest therapy (forest bathing), was reported to be effective in improving attention and memory.²¹

In addition, the positive changes seen in the outdoor taekwondo group as compared with the indoor taekwondo group can be explained by attention-restoration theory.¹ This theory posits that attention is recovered due to exposure to the natural environment, which begins when observing small natural components, such as grasses. It further suggests that taekwondo training in the natural environment can likely help improve the quality of the exercise effect.

Second, the mood state of the group that got trained outdoors significantly changed in the positive direction with respect to anger-hostility, vigour-energy, and fatigue-lethargy. These results are supported by other studies; one such study reported that the mood state of a forest-walking group changed positively at post-test,¹² and another study reported that stress and anxiety dropped after performing exercise in the natural environment.^{2,5}

Taekwondo training while being exposed to the natural environment clearly has positive benefits, and being exposed to the natural environment itself helps maintain a positive mood state. Of relevance here is a study that showed increase in alpha waves in the temporal lobe in response to olfactory stimulation by essential oil components, which represented extracts of odours that we experience in the natural environment. Olfaction has a close relationship with emotion, and odours can reduce stress, and effectively change mood state in a positive manner.²¹ Additionally, psychophysiological stress recovery theory suggests that positive thinking replaces negative thinking while watching

the natural environment.^{22,23} Therefore, the current study results suggest that exercise can positively affect mood state, and the training environment is also a very important factor in the psychological state of exercising individuals.

Third, despite the same taekwondo training being conducted in each group, the group that got trained in the natural environment considered the exercise less intense than the indoor taekwondo group. These results can be partially explained with reference to electromyographic findings of reduced muscular tension in subjects after placing plants in their vicinity.²⁴ Another study reported that pulse rate and blood pressure were lowered and the autonomic nervous system stabilized while looking at the natural environment.^{25,26} Further, exercising in unpolluted outdoor settings has a positive effect on physical activity.^{27,28}

The above result can be explained as follows: oxygen uptake is increased as physical activity increases, and oxygen intake through respiration is essential for efficient energy production;²⁹ another result reported that indoor air is 100 times more contaminated than outdoor air,^{30,31} and prolonged exposure to such pollution can cause dizziness and severe cases of respiratory illness.³²

Finally, male participants showed more positive score in 4 factors that showed significant interaction compared with female participants. This result would mean that participating in exercise has a more positive effect for male than female participants. Thus, in the future, well-designed studies with various points of view must be conducted to analyze the sex differences in exercise.

As described above, not only does outdoor taekwondo training improve concentration more than indoor taekwondo training, but it also changes mood state positively, and makes the same exercise seem easier. This result is derived from complex interactions among various physical components that can be experienced in a natural environment, such as visually refreshing sensations that can be gained from plants, along with light, sound, and air. This suggests that the natural environment can be used to improve the psychological state of taekwondo players.

This study provides basic information for qualitatively improving exercise effects during taekwondo

TABLE 1 Comparison of Results Before and After Training.

Variables	Taekwondo	Pre	Post	Group	Repetition	Group × Repetition	Interaction Post-hoc
Concentration	A	62.81 (17.52)	36.39 (9.80)	2.795	7.205*	4.736*	A: pre > post**
	B	62.29 (15.92)	59.52 (26.41)				
Tension and anxiety (points)	A	11.22 (4.35)	9.44 (3.20)	3.745	3.464	0.037	-
	B	14.88 (5.62)	13.44 (4.82)				
Depression (points)	A	15.22 (10.05)	11.55 (6.59)	3.228	0.532	1.630	-
	B	21.44 (12.44)	22.44 (13.17)				
Anger and hostility (points)	A	13.55 (7.03)	9.44 (5.05)	6.407*	3.745	19.782***	A: pre<post***
	B	14.33 (6.38)	24.77 (10.70)				
Vigor (points)	A	15.55 (4.06)	20.66 (2.91)	9.250**	0.042	36.971***	B: pre<post*** A: pre > post**
	B	13.55 (5.57)	8.77 (7.04)				
Fatigue (points)	A	12.66 (5.63)	7.66 (3.53)	7.948*	0.284	39.878***	B: pre > post*** A: pre<post**
	B	14.22 (4.68)	18.44 (5.43)				
Confusion (points)	A	9.88 (5.23)	8.33 (2.91)	2.289	0.077	2.766	-
	B	11.11 (2.52)	12.22 (4.54)				
Subjective exercise intensity (points)	A	9.22 (2.63)			t=5.245***		-
	B	15.11 (2.08)					

Data are presented as mean (standard deviation).

A = indoor taekwondo; B = outdoor taekwondo.

Tested by independent t-test and 2 × 2 repeated-measures analysis of variance.

*p<0.05, **p<0.01, ***p<0.001

training, namely by exposing players to the natural environment. However, limitations exist, such as being a short-term study that targeted a relatively uncommon participant group, so as to effectively control the experiment. Further, only attention and mood state were evaluated from among the various psychological factors. Additionally, taekwondo does not typically occur in the natural environment. Therefore, in subsequent studies, it is necessary to conduct and assess taekwondo training in the natural environment. Such studies would help provide scientific and objective information to improve the performance of players.

Moreover, interdisciplinary cooperation among various disciplines must be promoted, including physiological factors in addition to the psychological factors that were analyzed in this study. Finally, future studies would benefit from recruiting subjects of various ages and larger cohorts, and utilizing subdivided assessment periods.

CONCLUSION

The various physical components of the natural environment can provide sensory refreshment, such as can be gained from plants, light, sound, and air;

these work affirmatively on concentration and mood state of taekwondo players. Accordingly, we suggest that training in a natural environment can be helpful to such players.

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