Original Article

JER

https://doi.org/10.12965/jer.2550048.024

Journal of Exercise Rehabilitation 2025;21(1):32-37

The effect of Gyrokinesis exercise on fatigue and sleep quality in female office workers

Kyoung-Bin Min[1], Myung-Sung Kang[1], Yong-Gon Seo[1], Si-Hyeon Park[1], Mal-Soon Shin[1], Myung-Ki Kim[1], Seung-Ik Cho[2], Sang-Hoon Kim[3], Sang-Seo Park[4,*]

[1]College of Culture and Sports, Division of Global Sport Studies, Korea University, Sejong, Korea
[2]Sports Medical Center, Kon Kuk University, Seoul, Korea
[3]Department of Neurosurgery, Rutgers Robert Wood Johnson Medical School, The Stat University of New Jersey, Piscataway, NJ, USA
[4]Department of Physiology, College of Medicine, Kyung Hee University, Seoul, Korea

Fatigue is a state of difficulty maintaining voluntary activity. Cortisol, which is essential for stress regulation, can cause tissue damage when elevated for long periods of time, which is a common problem for office workers in stressful environments. Sleep quality is important for health and cognitive function, while sleep deprivation increases the risk of physical and mental health disorders. Gyrokinesis combines circular, spiral, and wave movements influenced by yoga, tai chi, and ballet to provide a calming effect on the sympathetic nervous system. This study investigated the effects of Gyrokinesis exercise on lower extremity edema, muscle strength, fatigue, and sleep quality in sedentary office workers. Twenty-seven adult women aged 20–40 years were randomly assigned to a Gyrokinesis exercise group (n = 14) or a control group (n = 13). The exercise group participated in 60-min Gyrokinesis sessions twice a week for 8 weeks, while the control group used elastic compression stockings during their working hours. Results showed a significant decrease in fatigue and an improvement in sleep quality in the exercise group. Cortisol and serotonin levels showed a significant between-group interaction effect, with within-group changes observed only in the exercise group. Sleep quality indices improved significantly over time. In conclusion, Gyrokinesis exercise has the potential to improve physical and psychological well-being in sedentary office workers by positively influencing fatigue, sleep quality, and related hormone levels.

Keywords: Gyrokinesis exercise, Fatigue, Sleep quality, Cortisol, Serotonin

INTRODUCTION

Fatigue is broadly defined as a condition characterized by difficulty in initiating or maintaining voluntary activity (Evans and Lambert, 2007). Employees who work in environments with high job demands, limited autonomy, and limited coworker support are more likely to experience increased levels of fatigue due to stress. In particular, office workers have higher levels of stress than manual workers, due to greater job-related strain and reduced energy activation (Rose et al., 2017).

Cortisol, a hormone secreted from the pituitary gland as a physiological response to mental stress, increases significantly during physical stress responses (Knezevic et al., 2023). Normal cortisol levels are essential for maintaining homeostasis under stress, but prolonged elevated cortisol levels can cause tissue damage (Bhake et al., 2019). In the case of office workers, long-term exposure to stressful work environments often leads to persistently elevated cortisol levels. The physical and psychological benefits of exercise have been highlighted as an effective strategy for stress management (Stults-Kolehmainen and Sinha, 2014).

Sleep quality is an important factor in determining overall health and physiological function. Adequate and restorative sleep supports physical and mental recovery, improves cognitive functions such as memory and concentration, and strengthens the immune system while maintaining homeostasis (Desai et al., 2024). Conversely, poor sleep quality has been shown to increase the risk of

*Corresponding author: Sang-Seo Park https://orcid.org/0000-0001-7033-9630
Department of Physiology, College of Medicine, Kyung Hee University,
24 Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Korea
Email: sps07@naver.com
Received: December 10, 2024 / Revised: January 15, 2025 / Accepted: January 25, 2025

various physical conditions, including obesity, diabetes, hypertension, and cardiovascular disease, as well as mental health disorders such as depression, anxiety, and suicidal ideation (Uchida et al., 2012).

Serotonin is a precursor of melatonin that regulates the activity-rest cycle, and plays an essential role in the pathophysiology of mental health conditions such as depression. Serotonin, a neurotransmitter in the central nervous system, regulates key behaviors, including sleep, appetite, and emotional stability (Daut and Fonken, 2019; Mavanji et al., 2022). It is particularly involved in sleep regulation, mediated through interactions with the midbrain nuclei and cortex, particularly during nonrapid eye movement (NREM) sleep (Knoop et al., 2021). Consequently, serum serotonin levels serve as an important biomarker for diagnosing sleep disorders and assessing whether sleep quality has improved (Wieckiewicz et al., 2023). Regular physical activity has been shown to positively affect serotonin levels, suggesting that exercise may potentially help improve sleep quality and overall mental health (Melancon et al., 2014).

Developed by Juliu Hovarth in the late 1970s, Gyrokinesis draws inspiration from a variety of disciplines, including yoga, tai chi, swimming, gymnastics, and ballet. Gyrokinesis and similar exercises, such as tai chi and Pilates, have shown significant benefits in improving self-efficacy, mood, stress levels, and sleep quality in college students (Campbell and Miles, 2006). Campbell and Miles (2006) reported that the basic principles of Gyrokinesis exercise consist of movements characterized by circular, spiral, and undulating patterns.

However, empirical research on the effectiveness of Gyrokinesis is still limited both domestically and internationally. This study aims to investigate the benefits of Gyrokinesis exercise in reducing fatigue and improving sleep quality in adult female office workers who mainly lead sedentary lives.

MATERIALS AND METHODS

Participants

This study was conducted on 30 working women in their 20s and 40s who voluntarily expressed their willingness to participate. Ethical approval for this study was obtained from the Institutional Ethics Committee of Korea University (approval No. SM-202105-051-2). Participants were selected from office workers who sat for more than 8 hours a day. The 30 participants were randomly assigned to the exercise group (EG) that participated in the Gyrokinesis exercise program and the control group (CG) that did not participate in the program according to the order of study registration. The physical characteristics of the subjects are shown in Table 1.

Table 1. Physical characteristics of the subjects

Group	Age (yr)	Height (cm)	Weight (kg)	BMI (kg/m^2)
GG (n=14)	32.21±5.07	161.33±5.01	54.93±5.42	21.12±1.97
CG (n=13)	33.46±6.33	163.70±5.75	58.65±7.09	21.84±2.13

Values are presented as mean±standard deviation.
GG, Gyrokinesis exercise group; CG, control group; BMI, body mass index.

Experimental method

The EG performed Gyrokinesis exercise for 60 min twice a week for 8 weeks, and the non-EG wore elastic compression stockings during work hours for 8 weeks. Blood samples were taken from the forearm vein before and after the experiment to assess fatigue and stress levels, and blood samples were taken from the finger before and after the experiment to assess peripheral fatigue. In addition, questionnaires on fatigue and sleep quality were administered before and after the experiment.

Blood panel test

Blood samples were collected before and after the experiment to assess changes in serotonin and cortisol levels, as described previously (Payne et al., 2008). Venous blood samples (6 mL) were obtained from the antecubital vein using a disposable syringe between 8:00 a.m. and 10:00 a.m. after a fasting period of at least 8 hr. Capillary blood samples were also obtained via the fingertip method, with a minimum volume of 0.3 µL collected for analysis using a portable lactate analyzer.

Proinflammatory cytokines

The Fatigue Severity Scale (FSS) developed by Krupp et al. (1989) was used as a subjective fatigue measurement tool. The FSS consists of nine items rated on a 7-point Likert scale that assesses fatigue severity over the past week. A total score of less than 36 indicates low fatigue, while a score of 36 or more indicates high fatigue and requires further investigation. The FSS showed high reliability with a Cronbach α of 0.93. Subjective sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) developed by Buysse et al. (1989). The PSQI consists of 19 items classified into seven components, each rated on a 4-point scale. A total score of 5 or more indicates poor sleep quality, while a score of 5 or less indicates good sleep quality. The reliability of the PSQI was confirmed with a Cronbach α of 0.84.

Table 2. Gyrokinesis exercise program

Classification	Exercise program
Warm up (10 min)	
Chair (sitting on a chair)	Awakening of the senses
	Spinal motions/figure 8 twist exercise
Main exercise (45 min)	
Chair (sitting on a chair)	Arch and curl
	Spiraling twists
	Sideways arches
	Circle/Massaging the organs
	Wave series
	Leg/hip series
	Wave series
Chair (standing series)	Small knee circles
	Ankle circles
	Kneading of the legs
Mat (floor sequence)	Cat back series
	Curl back into spiraling twists
	Alternating leg series
	Scooping wave series
	Pulsation series
	Hip knee joint mobilization series
	Arches/back strengthening
	Sphinx series
	Abdominal series
Cool down (5 min)	
Standing	Shiva steps
	Slow turns

Gyrokinesis exercise program

The Gyrokinesis exercise program is a 60-min program that focuses on seven basic movements. Details of the specific exercise program are listed in Table 2.

Compression stockings

As described in a previous method (Guedes et al., 2020), participants wore therapeutic compression stockings. These stockings are commonly used to prevent lower extremity circulation problems in individuals with early signs of edema or in those whose jobs require prolonged sitting or standing. These stockings have a silicone-treated band at the top to minimize slippage and skin irritation, extend below the knee, and have a compression range of 20–30 mmHg.

Data analysis

The data collected in this study were analyzed using IBM SPSS Statistics ver. 26.0 (IBM Co., Armonk, NY, USA). Two-way repeated measures analysis of variance was performed to evaluate the differences in dependent variables between the groups before and after the treatment. Paired samples *t*-test was used to analyze the differences within the groups before and after the intervention, and independent samples *t*-test was used to compare the differences between the groups. The significance level for all statistical analyses was set at α = 0.05.

Table 3. Changes of lactate

Variable	Group	Pretest	Posttest		*F*	*P*-value
Lactate (mmol/L)	GG	5.69 ± 4.54	5.29 ± 3.82	G	0.527	0.475
	CG	4.91 ± 3.11	4.56 ± 2.48	T	1.913	0.685
				G × T	0.001	0.974

Values are presented as mean ± standard deviation.
GG, Gyrokinesis exercise group; CG, control group.

Table 4. Changes of cortisol

Variable	Group	Pretest	Posttest		*F*	*P*-value
Cortisol (μg/dL)	GG	12.92 ± 4.95	11.53 ± 4.35	G	9.862	0.004**
	CG	8.00 ± 4.00	7.54 ± 3.47	T	1.298	0.265
				G × T	6.135	0.572

Values are presented as mean ± standard deviation.
GG, Gyrokinesis exercise group; CG, control group.
$^{**}P < 0.005$, significant main effect or interaction.

RESULTS

Lactate levels

The changes in resting lactate levels before and after exercise intervention for the EG and CG are presented in Table 3. After 8 weeks of Gyrokinesis exercise intervention, there was no statistically significant interaction effect between groups and the measurement times on resting lactate levels ($F = 0.001$, $P = 0.974$). In addition, there was no significant difference between groups ($F = 0.527$, $P = 0.475$) or between measurement times ($F = 1.913$, $P = 0.685$).

Cortisol levels

The changes in cortisol levels before and after exercise intervention for the EG and the CG are presented in Table 4. After 8 weeks of Gyrokinesis exercise intervention, there was no statistically significant interaction effect between the groups and the measurement time in the cortisol levels ($F = 6.135$, $P = 0.572$), and there was no significant difference according to the measurement time ($F = 1.298$, $P = 0.265$). However, there was a significant difference between the groups ($F = 9.862$, $P < 0.005$).

 https://doi.org/10.12965/jer.2550048.024

Table 5. Changes of FSS

Variable	Group	Pretest	Posttest		F	P-value
FSS	GG	4.29±1.32	2.86±0.97†††	G	0.016	0.900
	CG	3.84±1.16	3.42±1.09	T	34.393	0.000***
				G×T	10.304	0.004**

Values are presented as mean±standard deviation.
FSS, Fatigue Severity Scale; GG, Gyrokinesis exercise group; CG, control group.
**P<0.005, ***P<0.001, significant main effect or interaction. †††P<0.001, significant difference between pre- and posttest.

FSS levels

The changes in FSS before and after exercise intervention for the EG and the CG are presented in Table 5. After 8 weeks of Gyrokinesis exercise intervention, a statistically significant interaction effect was observed between the group and the measurement time in the fatigue index (F=10.304, P<0.005). A *post hoc* test based on the interaction effect revealed that there was no significant difference in the change in the fatigue index between the EG and the CG after 8 weeks of Gyrokinesis exercise intervention (t=1.413, P=0.170). Compared to before exercise intervention, no significant difference was observed in the CG (t=1.730, P=0.109), but a significant difference was observed in the EG (t=6.991, P<0.001). In the main effect comparison, there was no statistically significant difference between the groups (F=0.016, P=0.900), but a significant difference was observed according to the measurement time (F=34.393, P<0.001).

Serotonin levels

The changes in serotonin levels before and after exercise intervention for the EG and the CG are shown in Table 6. After 8 weeks of Gyrokinesis exercise intervention, a statistically significant interaction effect was observed between the group and the measurement time in the serotonin levels (F=6.135, P<0.05). In a *post hoc* test based on the interaction effect, there was no significant difference in the serotonin changes between the CG and the EG after 8 weeks of Gyrokinesis exercise intervention (t=0.123, P=0.903). Compared to before exercise intervention, no significant difference was observed in the CG (t=-0.137, P=0.893), but a significant difference was observed in the EG (t=-3.342, P<0.05). In the main effect comparison, there was no statistically significant difference between the groups (F=1.532, P=0.227), but a significant difference was observed according to the measurement time (F=7.016, P<0.05).

PSQI levels

The changes in PSQI before and after exercise intervention for the EG and the CG are shown in Table 7. After 8 weeks of Gyrokinesis exercise intervention, there was no statistically significant interaction effect between the group and the measurement time in the Sleep Quality Index (F=2.756, P=0.109). However, there was a significant difference between the groups (F=0.730, P=0.401) and the measurement time (F=8.680, P<0.05).

Table 6. Changes of serotonin

Variable	Group	Pretest	Posttest		F	P-value
Serotonin (ng/mL)	GG	131.62±41.88	168.69±51.34†	G	1.532	0.227
	CG	169.88±40.34	171.13±51.77	T	7.016	0.014*
				G×T	6.135	0.020*

Values are presented as mean±standard deviation.
GG, Gyrokinesis exercise group; CG, control group.
*P<0.05, significant main effect or interaction. †P<0.05, significant difference between pre- and post test.

Table 7. Changes of PSQI

Variable	Group	Pretest	Posttest		F	P-value
PSQI	GG	7.00±1.84	5.07±1.54	G	0.730	0.401
	CG	5.77±2.59	5.23±1.74	T	8.680	0.007*
				G×T	2.756	0.109

Values are presented as mean±standard deviation.
PSQI, Pittsburgh Sleep Quality Index; GG, Gyrokinesis exercise group; CG, control group.
*P<0.05, significant main effect or interaction.

DISCUSSION

Fatigue can be caused by a variety of factors and is generally defined as difficulty in initiating or sustaining voluntary activity (Evans and Lambert, 2007). Among the numerous contributing factors, stress is recognized as an important determinant. Fatigue has been consistently identified as a prominent symptom of stress-related mental disorders in several studies (Kocalevent et al., 2011).

This study investigated changes in peripheral fatigue (measured by lactate), stress (measured by cortisol), and fatigue indices after an 8-week Gyrokinesis exercise program combined with elastic compression stockings. Peripheral fatigue, characterized by lactate accumulation, is attributed to decreased muscle efficiency and depletion of energy reserves (Finsterer, 2012). Resting lactate levels showed no significant interaction effects or variability across groups or measurement periods. In contrast to previous studies that primarily investigated lactate dynamics during or immediately after exercise (Mota et al., 2020), our results may have been influenced by the participants' lack of previous exercise experience and high resting lactate levels (4.0–5.0 mmol/L).

Fatigue index showed a significant interaction effect, and a significant decrease was observed only in the EG. Pilates program, similar to Gyrokinesis, improves sleep quality and reduces fatigue (Amzajerdi et al., 2023). Our results are consistent with these studies, suggesting that 8 weeks of Gyrokinesis exercise contributes to fatigue reduction by increasing blood volume, increasing hemoglobin levels, and improving waste removal (McDonnell et al., 2013).

Sitting for long periods of time increases muscle tension, impedes blood circulation, and accumulates fatigue, which causes stress. The stress hormone cortisol is secreted in response to mental stress (Knezevic et al., 2023). In this study, we measured cortisol changes after an 8-week Gyrokinesis exercise program and the use of elastic compression stockings. Significant differences in cortisol levels were found between the groups, but no interaction effects or time-dependent changes were observed. A previous study showed that sitting and wearing compression stockings for 4 hr reduced cortisol (Liu et al., 2012). In our study, both interventions tended to lower cortisol, but no significant changes occurred. These results suggest that hormonal responses to exercise may be more pronounced in individuals with prior exercise experience (Govindaraj et al., 2016). This may explain the differences in previous results due to the participants' limited exercise experience.

Serotonin is specifically associated with NREM sleep through the midbrain nuclei and cortex (Monti, 2011). Plasma serotonin levels are an important biomarker for diagnosing and managing sleep disorders (Mavanji et al., 2022; Monti, 2011). In this study, serotonin levels significantly increased only in the EG, which is consistent with evidence that regular physical activity improves serotonin levels (Melancon et al., 2014). Results vary, but most studies emphasize the importance of exercise type and intensity in modulating serotonin levels (Rethorst et al., 2009). This study supports the idea that Gyrokinesis exercise can improve serotonin and improve sleep quality.

Sleep quality includes factors such as sleep onset, interruption, depth, arousal, and daily impact (Krystal and Edinger, 2008). This study investigated the effects of an 8-week Gyrokinesis exercise program and elastic compression stockings on sleep quality using the Sleep Quality Index. No significant group or interaction effects were observed, but significant improvements were observed between pre- and post-exercise comparisons. Elastic compression stockings have been shown to help reduce discomfort during flights and improve sleep (Hagan and Lambert, 2008) and help alleviate sleep apnea symptoms (Liao et al., 2021).

Exercise, including Pilates, Taekwondo, and Gyrokinesis, has been associated with improved sleep quality in college students. The 8-week period of this study was relatively short, but it did show improvements in sleep quality, and further research is needed to determine the effects of exercise duration.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGMENTS

The authors received no financial support for this article.

REFERENCES

Amzajerdi A, Keshavarz M, Ezati M, Sarvi F. The effect of Pilates exercises on sleep quality and fatigue among female students dormitory residents. BMC Sports Sci Med Rehabil 2023;15:67.

Bhake RC, Kluckner V, Stassen H, Russell GM, Leendertz J, Stevens K, Linthorst ACE, Lightman SL. Continuous free cortisol profiles-circadian rhythms in healthy men. J Clin Endocrinol Metab 2019;104:5935-5947.

Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193-213.

Campbell J, Miles W. Analyzing the Gyrotonic® arch and curl. J Bodyw Mov Ther 2006;10:147-153.

Daut RA, Fonken LK. Circadian regulation of depression: a role for serotonin. Front Neuroendocrinol 2019;54:100746.

Desai D, Momin A, Hirpara P, Jha H, Thaker R, Patel J. Exploring the role of circadian rhythms in sleep and recovery: a review article. Cureus 2024;16:e61568.

Evans WJ, Lambert CP. Physiological basis of fatigue. Am J Phys Med Rehabil 2007;86(1 Suppl):S29-S46.

Finsterer J. Biomarkers of peripheral muscle fatigue during exercise. BMC Musculoskelet Disord 2012;13:218.

Govindaraj R, Karmani S, Varambally S, Gangadhar BN. Yoga and physical exercise - a review and comparison. Int Rev Psychiatry 2016;28:242-253.

Guedes PM, Saldanha NA, Matos PM, Carvalho FS, Veiga G, Norton P. Occupational leg edema-use of compression stockings. Porto Biomed J 2020;5:e093.

Hagan MJ, Lambert SM. A randomised crossover study of low-ankle-pressure graduated-compression tights in reducing flight-induced an-

 https://doi.org/10.12965/jer.2550048.024

kle oedema. Med J Aust 2008;188:81-84.
Knezevic E, Nenic K, Milanovic V, Knezevic NN. The role of cortisol in chronic stress, neurodegenerative diseases, and psychological disorders. Cells 2023;12:2726.
Knoop MS, de Groot ER, Dudink J. Current ideas about the roles of rapid eye movement and non-rapid eye movement sleep in brain development. Acta Paediatr 2021;110:36-44.
Kocalevent RD, Hinz A, Brähler E, Klapp BF. Determinants of fatigue and stress. BMC Res Notes 2011;4:238.
Krupp LB, LaRocca NG, Muir-Nash J, Steinberg AD. The fatigue severity scale. Application to patients with multiple sclerosis and systemic lupus erythematosus. Arch Neurol 1989;46:1121-1123.
Krystal AD, Edinger JD. Measuring sleep quality. Sleep Med 2008;9 Suppl 1:S10-S17.
Liao WC, Hsin LJ, Li HY, Tsai MS, Tsai YT, Yu CC, Lee YC. Effect of compression stockings on overnight rostral fluid shift and obstructive sleep apnea: a meta-analysis. Auris Nasus Larynx 2021;48:934-941.
Liu R, Kwok YL, Lao TT. Effects of skin pressure from compression legwear on resting salivary cortisol and urinary catecholamines excretion in women. Dermatol Surg 2012;38:83-90.
Mavanji V, Pomonis B, Kotz CM. Orexin, serotonin, and energy balance. WIREs Mech Dis 2022;14:e1536.
McDonnell BJ, Maki-Petaja KM, Munnery M, Yasmin, Wilkinson IB, Cockcroft JR, McEniery CM. Habitual exercise and blood pressure: age dependency and underlying mechanisms. Am J Hypertens 2013;26:334-341.
Melancon MO, Lorrain D, Dionne IJ. Exercise and sleep in aging: emphasis on serotonin. Pathol Biol (Paris) 2014;62:276-283.
Monti JM. Serotonin control of sleep-wake behavior. Sleep Med Rev 2011;15:269-281.
Mota GR, Simim MAM, Dos Santos IA, Sasaki JE, Marocolo M. Effects of wearing compression stockings on exercise performance and associated indicators: a systematic review. Open Access J Sports Med 2020;11:29-42.
Payne JK, Held J, Thorpe J, Shaw H. Effect of exercise on biomarkers, fatigue, sleep disturbances, and depressive symptoms in older women with breast cancer receiving hormonal therapy. Oncol Nurs Forum 2008;35:635-642.
Rethorst CD, Wipfli BM, Landers DM. The antidepressive effects of exercise: a meta-analysis of randomized trials. Sports Med 2009;39:491-511.
Rose DM, Seidler A, Nübling M, Latza U, Brähler E, Klein EM, Wiltink J, Michal M, Nickels S, Wild PS, König J, Claus M, Letzel S, Beutel ME. Associations of fatigue to work-related stress, mental and physical health in an employed community sample. BMC Psychiatry 2017;17:167.
Stults-Kolehmainen MA, Sinha R. The effects of stress on physical activity and exercise. Sports Med 2014;44:81-121.
Uchida S, Shioda K, Morita Y, Kubota C, Ganeko M, Takeda N. Exercise effects on sleep physiology. Front Neurol 2012;3:48.
Wieckiewicz M, Martynowicz H, Lavigne G, Lobbezoo F, Kato T, Winocur E, Wezgowiec J, Danel D, Wojakowska A, Mazur G, Smardz J. An exploratory study on the association between serotonin and sleep breathing disorders. Sci Rep 2023;13:11800.