Research Report

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Effects of Rhythmik Program on Isokinetic Muscle Function and Static Ability

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Background Music serves as an ergogenic aid for enhancing exercise performance, while Rhythmik is the study of organic bodily motion expression in response to music.

Purpose This study aimed to investigate the impact of the music-based movement program, Rhythmik exercise, on leg strength and static balance ability.

Study design A case-series study

Methods Nine healthy women aged 20–40 years participated in an eight-week music-based exercise program called Rhythmik exercise. This exercise program comprised three 60-min sessions per week. Leg strength and endurance were assessed using an isokinetic device, measuring parameters including speed, force power, for knee flexor and extensor muscles. Static balance was evaluated by performing one-legged standing with eyes closed and open.

Results Following the Rhythmik exercise program, significant improvements were observed in average speed, maximum speed, average power, maximum power of knee extensor muscle, and flexor muscle strength. Additionally, a significant enhancement in static balance ability was observed, both with open eyes and closed eyes.

Conclusions The music-based Rhythmik exercise program may enhance leg strength and static balance ability. This suggests that Rhythmik exercise could be considered a viable and engaging alternative exercise regimen for enhancing lower limb function and stability.

Key words Isokinetic; Music perception; Music therapy; Rhythmik; Static ability.

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INTRODUCTION

Physical activity coupled with music has been a subject of keen interest in various domains, including exercise physiology, psychology, and sports sciences. The role of music in enhancing exercise performance has been investigated since Ayres et al. pioneering research in 1911, which reported an 8.5% increase in cycling speed during a six-day cycle race when accompanied by military band music.[1] Subsequent studies have highlighted the potential of music to stimulate motivation,[2] reduce psychological and physical discomfort during exercise,[3,4] and enhance emotional responses during physical activity.[5] Moreover, listening to music pre-exercise and in-exercise improves physiological responses, such as physical performance and oxygen utilization efficiency,[6,7] as well as strength[8] and endurance enhancement.[9,10] Recognizing the ergogenic effects of music in physical activity, the American College of Sports Medicine recommends music-based exercise programs.[11]

However, some studies have reported conflicting results,[12,13] indicating that the impact of music on exercise performance may be negligible or inconclusive. This variability in research findings can be attributed to factors such as sex, individual preferences and familiarity with music, personal expertise in music, as well as personal factors related to the participants. The variability may also be influenced by training status, exercise intensity, exercise type, and musical elements such as tempo, rhythm, and synchronization between the music and exercise implemented.[14–16]

Rhythmik (German expression), a field that studies natural body movement expression through music,[17,18] differs from traditional dance programs that are typically based on pre-existing music. Rhythmik emphasizes immediate and spontaneous reactions to rhythm, tempo, and external auditory stimuli, activating muscles, the nervous system, and sensory organs. The ultimate goal of Rhythmik is to encourage individuals to express their movements naturally, developing emotional stability through intuitive rhythms and promoting creative thinking based on expressive movements. Music in Rhythmik facilitates these movements.[19]

Despite the interdisciplinary development of Rhythmik, research verifying its health benefits and its impact on physical fitness remains limited. Preliminary studies have suggested that exercise programs similar to Rhythmik, based on rhythm and musical elements, enhance exercise functions similar to general physical education.[20] Furthermore, such programs have proven effective in improving mobility and reducing fall risk in the elderly. This offers compelling evidence for considering the potential of Rhythmik exercise in improving physical fitness.[21] The movements in Rhythmik entail actions that align posture, express rhythm, involve walking, and necessitate changes in direction, all of which activate the leg muscles, enhancing leg function and balance. Nevertheless, research on the potential benefits of Rhythmik exercise in improving leg function and balance is lacking.

Accordingly, this study aimed to investigate the influence of Rhythmik exercise, a music-based movement program, on leg function and static balance in adults. The study sought to address the gap in the existing literature by examining the effects of Rhythmik exercise on these important aspects of physical fitness.

METHODS

Participants

We enrolled nine healthy females aged 20–40 years with no specific medical conditions and who did not regularly engage in exercise. Prior to their participation, all participants were thoroughly briefed on the study's purpose and content. They provided informed consent voluntarily. The experimental procedure was approved by the Ethics Committee of Inje University (INJE 2021-02-006-002). Table 1 presents the characteristics of the study participants.

Rhythmik exercise program

The exercise program comprised Rhythmik exercises based on music, which were conducted three times a week over eight weeks. The exercise program was structured into 5 min of warm-up, 50 min of the main exercise, and 5 min of cool-down, totaling 60 min per session. These exercise sessions were conducted under the guidance of an instructor certified in Rhythmik exercises. The program included activities such as body alignment based on movement points and the center of gravity, free and improvisational movements accompanied by musical sounds and vocal music, walking to express rhythm, mobilization of muscles, the immediate and spontaneous response of the nervous system and sensory organs to external auditory stimuli, and movements that involved the expansion and contraction of the body in sync with the rhythm. Heart rate measurements during the exercise indicated an intensity of approximately 60% of the maximal heart rate. Table 2 presents detailed information regarding the exercise program conducted in this study.

Outcome measures

1) Anthropometric measurements

The body mass index was calculated as weight (kg) divided by height squared (m^2). Lean body mass and percentage body fat were estimated using bioimpedance analysis (BSM330, Inbody, Seoul, Korea). Waist circumference was also measured and recorded up to one decimal place.

Table 1. Participant characteristics (n=9)

Age (yr)	Height (cm)	Weight (kg)	BMI (kg/m^2)	WC (cm)	LBM (kg)	BF (%)
34±10	161.63±4.41	57.00 ±4.89	21.88 ± 1.53	76.32±4.51	38.24±3.04	27.09±2.15

Data are expressed as means±standard deviations.
BMI, body mass index; WC, waist circumference; LBM, lean body mass; BF, body fat.

Table 2. Rhythmik program

Category	Motion	Description	Time
Warm up	Self-control	Postural alignment and gait according to the center of motion and center of weight	5 min
Main exercise (Rhythm/music)	Improvisation	Spontaneous movements according to the elements of improvised instrumental music (rhythm, melody, magnitude, speed)	50 min
	Rhythm walking	Expression of rhythm during gait (rhythm, magnitude, and speed)	
	Breakbeat	Creation of rhythm within a set box	
Follow movement	Fingers fullness	Movements according to music with fingertips placed on a small gym ball, in a team of two individuals; one leader and one follower (with only the follower closing his or her eyes or with both individuals closing their eyes, and with body relaxing)	50 min
	Floor dance	Maximized mobility of the body with reduced use of the upper limbs	
Energy exercise	Extension reduction	Maximal expansion or reduction of the body and energy according to a set rhythm	50 min
	Staccato legato	Movements with a set of discontinuous motions and connected motions in an ensemble	
Cool down	Breath control	Postural alignment and gait Relaxation with even breathing	5 min

2) Muscle strength and endurance

Isokinetic muscle strength of the knee extensor and flexor was evaluated using a muscle function assessment device (Smart Module, Ronfic, Germany). Average and maximum speed, average and maximum force, and average and maximum power for leg extension and leg curl movements were measured. To set individualized test intensities, we directly measured each participant's one-repetition maximum (1RM) for both leg extension and leg curl exercises. The 1RM measurements were conducted following the guidelines of the National Conditioning & Strength Association and involved performing 1RM repetitions with incremental weight until the participant's maximum capacity was achieved.[22] The range of knee flexion for both leg extension and leg curl exercises were maintained at 180° and 90°, respectively. Muscle strength evaluations were assessed by performing three repetitions of leg extension and leg curl exercises at 1RM intensity, while muscular endurance was measured at 50% of the participant's 1RM, with each exercise being performed for 20 repetitions in two sets.

3) Static balance ability

Static balance ability was assessed through a one-leg standing test with both eyes open and closed. Participants were instructed to stand barefoot, raising one leg off the ground while keeping both feet positioned on a stable surface. They were required to maintain a 90° knee angle and to gaze straight ahead. Participants were instructed to maintain this position for as long as possible. Failure to maintain the position or for the supporting foot to deviate from its original position results in the measurement termination, and the time taken was recorded. Each test was conducted twice, with the longer of the two attempts being used for the subsequent analyses.

4) Statistical analysis

All measured data were presented as means and standard deviations. Due to the small sample size, the Wilcoxon signed-rank test was used to analyze the impact of the exercise program on pre- and post-exercise values. All statistical analyses were performed using SPSS-PC version 26.0 (SPSS Inc., Chicago, IL, USA), and statistical significance (α) was set at $p \leq 0.05$.

RESULTS

Changes in muscle strength and endurance

The changes in isokinetic knee extensor muscle strength and endurance following eight weeks of Rhythmik exercise were presented in Table 3. In strength assessment, average (p=0.05) and maximum speed (p=0.02) significantly increased after training. The average (p=0.04) and maximum power (p=0.05) also increased significantly. The muscle endurance assessment revealed similar trends. The average

Table 3. Changes in isokinetic knee extension muscle strength and endurance

Variables	Strength				Endurance			
	Pre	Post	z	*p*	Pre	Post	z	*p*
Average speed (cm/s)	11.82±2.18	17.01±6.31*	–1.96	0.05	41.18±11.15	52.31±13.72*	–2.19	0.03
Max speed (cm/s)	36.99±9.20	55.23±14.64*	–2.31	0.02	79.19±19.69	92.69±24.74*	–2.07	0.04
Average force (kgf)	45.36±10.17	45.04±11.30	–0.46	0.69	28.07±6.61	27.78±6.88	–1.13	0.26
Max force (kgf)	61.91±14.40	61.38±13.47	–0.65	0.52	31.71±7.00	33.18±6.92*	–2.19	0.03
Average power (watt)	546.48±189.94	728.92±225.40*	–2.03	0.04	1,144.17±415.43	1,421.65±456.72	–1.72	0.09
Max power (watt)	2,342.91±926.24	3,304.66±909.84*	–1.956	0.05	2,509.65±869.62	3,019.54±910.28*	–2.19	0.03

Data are expressed as means±standard deviations. Tested using Wilcoxon singed-rank test.
* $p<0.05$.

($p=0.03$) and maximum speed ($p=0.04$) both increased. Only the maximum power increased significantly, while the average showed a statistically significant difference.

The changes in isokinetic knee flexor muscle strength and endurance following eight weeks of Rhythmik exercise were presented in Table 4. In strength assessment, average ($p=0.05$) and maximum speed ($p=0.01$) significantly increased after training. The average power ($p=0.03$) and maximum power ($p=0.05$) also increased significantly. In muscle endurance assessment, maximum speed ($p=0.04$) and maximum force increased significantly ($p=0.01$), while the other variables showed a tendency to increase after training, although they did not reach statistical significance.

Changes in static balance ability

The changes in static balance ability after eight weeks of Rhythmik exercise were presented in Table 5. Both one-leg standing with open and closed eyes demonstrated significant improvements. The duration of one-leg standing with eyes open increased significantly ($p=0.01$). Similarly, one-

Table 4. Changes in isokinetic knee flexion muscle strength and endurance

Variables	Strength				Endurance			
	Pre	Post	z	*p*	Pre	Post	z	*p*
Average speed (cm/s)	18.12±6.05	21.22±5.71*	–1.96	0.05	52.94±9.20	59.34±7.22	–1.36	0.17
Max speed (cm/s)	45.13±14.23	55.82±14.24*	–2.55	0.01	90.27±11.27	100.01±10.70	–1.01	0.31
Average force (kgf)	29.60±5.50	29.36±6.08	–0.06	0.95	16.35±3.31	16.57±3.65	1.01	0.31
Max force (kgf)	43.07±15.72	42.83±8.41	–1.24	0.21	20.85±3.90	23.73±5.13**	–2.67	0.01
Average power (watt)	518.14±135.25	606.04±132.91*	–2.19	0.03	876.26±269.12	984.51±241.20	–1.36	0.17
Max power (watt)	1,992.82±1,192.09	2,351.21±647.81*	–1.96	0.05	1,901.65±502.91	2,388.59±631.43	–1.24	0.21

Data are expressed as means ± standard deviations. Tested using Wilcoxon singed-rank test.
*$p<0.05$.

Table 5. Changes in static balance ability

Variables	Pre	Post	z	*p*
Open eyes (s)	315.20±59.07	485.40±192.65*	–3.23	0.01
Closed eyes (s)	96.40±63.10	148.40±67.57*	–9.22	<0.001

Data are expressed as means±standard deviations. Tested using Wilcoxon singed-rank test.
*$p<0.05$.

leg standing with eyes closed improved substantially, with the duration increasing ($p<0.001$).

DISCUSSION

The primary objective of this study was to investigate the impact of an eight-week Rhythmik exercise program on leg strength and static balance ability. The results demonstrated notable improvements in speed and force for both knee extensor and flexor muscles. Moreover, there was a significant enhancement in static balance. These outcomes are in line with previous research,[8–15] which have indicated that music-integrated exercise programs could enhance physical fitness.

This is particularly noteworthy as it highlights the importance of these aspects in maintaining posture, balance, and lower limb stability. The specific muscles investigated in this study—the rectus femoris and hamstrings—maintain lower limb stability. These muscles are integral to tasks such as postural control, walking, and upright-posture maintenance.[23]

The Rhythmik exercise program employed in this research, known as “Rhythmik,” was designed to promote natural body movements through rhythm auditory stimulation, involving spontaneous movements, walking, and expressive bodily actions synchronized with music’s rhythm, melody, volume, and tempo changes.[19] Rhythmik exercises, facilitated by auditory stimulation, activated specific muscle groups, fostering neuromuscular adaptations that contributed to improved lower limb function and balance.[12]

From a kinematics perspective, the Rhythimk exercises program involved activities such as the repetitive flexion and extension movements of the quadriceps and hamstring muscles in the thigh region, which occur during low- to moderate-intensity aerobic exercise with speed adjustments based on rhythm, directional changes involving forward, backward, lateral, or geometric pattern walking, movements involving descending with a lunge-like posture in response to variations in music intensity, and ascending stair climbing, activate the quadriceps and hamstring muscles. These movements may have contributed to the improvement in lower limb muscle function. While improving lower limb function requires resistance exercises of at least moderate intensity using resistance equipment,[24] which differed from the exercise format in this study, Korean traditional dancers who engage in weight-bearing exercises involving movements such as walking, squatting, and jumping have shown higher hip joint strength compared to that observed in non-dancers.[25] Despite the differences in age groups between this study’s participants and Korean traditional dancers, a meta-analysis examining the effects of Korean traditional dance on the physical fitness and exercise performance of elderly women identified significant effects in lower limb strength, muscular endurance, and static balance.[26]

An interesting observation is that even with exercise intensity being approximately 60% of the maximum heart rate, significant improvements in lower limb function and static balance were achieved within a relatively short eight-week period. This suggests that Rhythmik exercise may engage participants in an effective neuromuscular workout and that music’s ergogenic potential may play a role in facilitating these outcomes. As research analyzing the effects of Rhythmik exercise on strength improvement is lacking, the underlying mechanisms challenging to precisely elucidate. However, the ergogenic potential of music can be considered. The stimulation applied in Rhythmik exercise is distinctive as it utilizes music as a medium for inducing neural stimulation via auditory cues rather than artificial loads applied by machinery. Auditory stimulation is conveyed directly to the spinal cord without the involvement of higher cognitive and analytical processes. Throughout this process, it synchronizes with the central nervous system’s motor pattern generation system.[27] The Rhythmik elements in music activate motor neurons and enhance muscle readiness for movement control. Rhythm, beat, and phase in music provide cues for the initiation and termination of walking and trajectory information, thus facilitating efficient and effective movement execution. Through such mechanisms, rhythm activates and aids in controlling and regulating the neuromuscular system.[28,29] Furthermore, Rhythmik exercise improved lower limb function through self-initiated body movements performed within the individual’s safe range of motion rather than employing artificially prescribed exercise intensities. Considering the safety and stability of this exercise modality, Rhythmik exercise may serve as an innovative alternative movement program for enhancing lower limb function.

This study had some limitations. First, the lack of a control group hindered us from determining whether the observed effects were specific to Rhythmik exercise. Future research should incorporate control groups to validate the effectiveness of this exercise modality. Second, the relatively small sample size and participant attrition posed limitations. Subsequent studies should address these issues by recruiting larger sample sizes and implementing strategies to minimize attrition. Finally, the muscle activity during exercise was not objectively quantified. Future investigations should analyze movement patterns and caloric expenditure during Rhythmik exercise to further elucidate its efficacy.

CONCLUSIONS

We investigated the impact of Rhythmik exercise, a music-based exercise program, on lower extremity function and static balance in women aged 20–40 years without specific medical conditions or regular exercise routines, identifying a significant enhancement in lower extremity function and static balance within a brief eight-week duration. Our positive results emphasize the potential health-promoting effects of Rhythmik exercise. The improvements in lower extremity function and static balance provide a promising foundation for future research efforts. Further research is warranted on the effects of Rhythmik exercise on various aspects of physical fitness and its utility in different populations.

Key Points

Question Does Rhythmik exercise impact isokinetic knee extensor and flexor muscles function and static balance ability?

Findings In 8 weeks, Rhythmik exercise significantly improved isokinetic knee extensor and flexor muscles strength and endurance. Additionally, static balance ability was significantly improved.

Meaning This study confirmed the potential of Rhythmik exercise to improve physical fitness, calling for further research to confirm its health benefits and investigate underlying mechanisms.

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Author contributions

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