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ARTICLE

Efficacy of AI-Based Pilates on Motor Performance and Fear of Falling in Older Adults

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ABSTRACT: Over the past decade, research on artificial intelligence (AI) has expanded significantly, exploring its potential to enhance the quality of life for older adults. Therefore, the study aims to investigate the effect of a 4-week AI-generated Pilates training program on motor performance and fear of falling in older adults. This quasi-experimental study selected 30 female older adults aged 65 years and older, dividing them into two groups: one for experimental (N = 15) and another for control (N = 15). The experimental groups had four weeks of AI-based intervention with three sessions per week. During this period, the control group engaged in the routine activities. The Timed Up and Go and the Falls Efficacy Scale-International (FES-I) questionnaire were done as pre-posttest, respectively. The independent t-test was used for inferential statistics. Data analysis was conducted at a significance level of 95% with an alpha level less than or equal to 0.05. The findings showed that there was a significant difference between the two groups in the scores of the TUG test ($p<0.03$) and the FES-I questionnaire ($p<0.001$). By utilizing AI to develop personalized exercise programs, healthcare practitioners can improve motor performance and reduce the fear of falling in older adults. These findings highlight the potential of AI-driven rehabilitation strategies in geriatric care, emphasizing the need for further research to refine program parameters and extend their benefits to a broader aging population.

KEYWORDS: Artificial Intelligence, Elderly, Performance, Fall.

1 Introduction

In the 21st century, significant changes in global demographics have occurred, mainly due to an aging population attributed to longer life expectancies and lower birth rates [1]. By 2050, an estimated 16% of the population will be individuals aged 65 and older, with around 28–35% of this group experiencing falls each year [2]. The growing elderly population will lead to an increased risk of falls that significantly impact health, resulting in disability and higher mortality rates, while the economic burdens associated with falls

are considerable and continue to rise globally [3]. The World Health Organization defines a fall as an unexpected collapse to the ground that can lead to serious injuries, including fractures and brain injuries, with the risk increasing with age [4]. Fear of falling (FOF) is a persistent anxiety among older adults that diminishes confidence in balance [5], adversely affecting their mental health and quality of life [6]. This fear can lead to a reduction in social activities for 13% to 50% of those affected, resulting in impaired balance, greater isolation, and increased feelings of loneliness, anxiety, and sadness [4, 7]. FOF affects between 20.8% and 85% of older adults, significantly impairing motor performance by increasing functional dependency and decreasing walking speed [8]. A study by Sapmaz et al. (2021) found that dual-task performance was impaired in elderly individuals with FOF [8]. Moreover, FOF leads to activity avoidance, which reduces muscle and grip strength [9], limits mobility, heightens attentional demands for balance and ultimately compromises gait and overall motor performance [10].

Physical fitness is crucial in maintaining functional independence among older adults [11]. Engaging in physical activity is recognized as a key health determinant, offering significant benefits across all age groups, with a particularly strong impact on the well-being of the elderly [12]. The Pilates method, created by Joseph Hubertus Pilates in the early 20th century, is a structured exercise program to enhance overall flexibility, core strength, posture, and general well-being [13]. Additionally, it emphasizes efficient motion through proper alignment of the limbs, coordination of the shoulder joint and cervicothoracic spine, and balanced movement patterns throughout the body [14]. Research indicates that Pilates effectively reduces FOF and enhances motor performance in older adults by strengthening muscles, improving balance, and boosting coordination [15]. Another study demonstrated that Pilates minimizes the FOF and the risk of falls in older adults by improving functional mobility, gait, and postural stability [16].

Artificial intelligence (AI) transforms healthcare by utilizing big data to provide insights that enhance evidence-based clinical decision-making and promote value-based care [17]. Implementing AI in healthcare significantly enhances elderly care by improving disease prediction, risk assessment, diagnosis, and treatment [18]. This advancement has led to increased research and the adoption of technologies specifically designed for older adults, including robots, exoskeletons, smart homes, wearables, and mobile applications [19]. These technologies collectively perform essential functions like rehabilitation, social interaction, companionship, and monitoring, addressing the unmet healthcare needs of older adults and relieving pressure on the healthcare system [20].

Despite the well-documented benefits of Pilates in enhancing motor performance and reducing FOF, there is a significant gap in research regarding AI-generated Pilates training programs specifically for older adults. The urgency to incorporate artificial intelligence in this field arises from the potential for personalized, adaptive exercise prescriptions that can cater to the unique needs of this demographic. Current studies predominantly focus on traditional or therapist-guided interventions, leaving AI-driven solutions largely unexplored. Given the heightened concern among older adults about preventing falls, leveraging AI could revolutionize how Pilates is delivered, making it safer and more accessible. The effectiveness of AI-generated Pilates programs remains uncertain, and these interventions' safety, adaptability, and long-term impact have not been thoroughly investigated. This highlights the critical need for rigorous research to explore the feasibility and efficacy of AI-generated Pilates in improving motor performance and alleviating the FOF among older adults.

2 Methods

2.1 Participants

The present study was quasi-experimental and conducted in the field. Thirty female older adults aged 65 years and older were purposefully selected and assigned to either the experimental group (n = 15) or the control group (n = 15). Participants were included if they were 65 years or older, lived independently in the community, could walk without assistive devices, had no significant medical contraindications for physical activity, could communicate, had sufficient self-reported vision and hearing to follow the exercises, and provided written informed consent. Exclusion criteria were individuals unable to walk independently, those with a Mini-Mental State Examination (MMSE) score below 24 [21] or a Barthel Index (BI) score under 80 [22], severe visual or auditory impairments, unstable cardiovascular conditions, neurological disorders that could hinder participation, or a history of upper- or lower-limb fractures within the past year. Initially, demographic data of the participants were collected. Subsequently, the Timed Up and Go (TUG) test and the Falls Efficacy Scale-International (FES-I) were administered to assess motor performance and fear of falling, respectively. The results of these assessments were recorded as pre-test data for each participant. Then, the experimental group did the selected AI-based Pilates exercises for 4 weeks, but the control group continued their usual physical activities as part of their regular daily routine. After 4 weeks, all the tests were repeated, and the results were recorded as post-test data. Additionally, for ethical considerations based on the Declaration of Helsinki, all stages of the study were discussed with the subjects. Written informed consent was obtained from the participants themselves. Additionally, they were told that the examiner would take appropriate measures if there were any issues during the assessments. The subjects were instructed on how to perform each test. All steps were explained verbally to the participants. Before starting the tests, the procedure was presented to them verbally. The TUG test was performed three times, with the mean value of each variable recorded as study data, while the FES-I was administered only once.

2.2 Measurement and Tools

Assessment of Motor Performance

This study evaluated motor performance using the TUG test. Participants were instructed to stand up from an armless chair without hand support, walk 8 feet (2.44 meters), turn around, return to the chair, and sit down. They were encouraged to complete the task as quickly and efficiently as possible without running, and the total time taken was recorded as their score [23]. Good validity and reliability have been reported for this test [24].

Assessment of Fear of Falling

The Falls Efficacy Scale-International (FES-I) questionnaire assessed the fear of falling among older adults. This questionnaire comprises 16 items, each rated on a four-point Likert scale, where "1" indicates no fear, "2" represents mild fear, "3" corresponds to moderate fear, and "4" signifies severe fear. The total score ranges from 16 to 64, with higher scores reflecting greater fear of falling [25]. A study examined the validity and reliability of the Persian version of this questionnaire, yielding a satisfactory value of 0.70 [26]. Additionally, internal consistency was evaluated using Cronbach's alpha, which demonstrated an excellent reliability coefficient of 0.98, confirming the strong psychometric properties of this scale [26].

Implementation of the training programs

A day after the pre-testing, the implementation of the respective training programs for the experimental group commenced. The experimental group was administered the 4-week AI-generated Pilates training program, which was created using Scopus AI. The prompt includes the specifics of the training program using the principles of frequency, intensity, time, and type. Below is the exact prompt inputted in the Scopus AI. It should be noted that the training sessions were 30–40 minutes, including a warm-up (10 minutes),

Pilates exercise (20 minutes), and a cool-down (10 minutes). Moreover, we provided clear, concise verbal instructions for each movement and used tactile cues to guide body positioning.

Prompt : Write a 4-week Pilates exercise program for a 65-year-old older adult based on the FITT principle (Frequency, Intensity, Time, and Type) for optimal results. Please ensure the program includes specific exercises targeting the identified aging issues and adheres to the FITT principles. Additionally, it provides explanations for a better understanding of each exercise, emphasizing proper form and technique.

Table 1. Ai-generated Pilates training program

Week	Exercise	Description	Repetitions/Sets	FITT Principle
Week 1	Diaphragmatic Breathing	Deep inhalation through the nose, ribcage expansion, and slow exhalation through the mouth while engaging the core	5 minutes	F: 3x/week, I: Low, T: 20 min, T: Mat-based Pilates
	Pelvic Tilt (Supine)	Lying down, tilt the pelvis backward to flatten the lower back	10 reps	F: 3x/week, I: Low, T: 20 min, T: Mat-based Pilates
	Heel Raises	Standing on toes and lowering back down	10 Reps	F: 3x/week, I: Low, T: 20 min, T: Mat-based Pilates
Week 2	Bridging	Lifting hips off the ground while lying down	10 Reps	F: 3x/week, I: Low, T: 20 min, T: Mat-based Pilates
	Standing Side Leg Raises	Lifting one leg sideways while standing	10 reps per leg	F: 3x/week, I: Low, T: 20 min, T: Mat-based Pilates
	Seated Leg Extensions	Extending one leg at a time while seated	10 reps per leg	F: 3x/week, I: Low, T: 20 min, T: Mat-based Pilates
Week 3	Wall Roll-Downs	Rolling down the spine against a wall and back up	10 Reps	F: 3x/week, I: Moderate, T: 20 min, T: Balance & flexibility exercises
	Chair-Assisted Squats	Performing controlled squats using a chair	10 Reps	F: 3x/week, I: Moderate, T: 20 min, T: Balance & flexibility exercises
	Seated Hamstring Stretch	Stretching hamstrings while seated	Hold for 20 sec per leg	F: 3x/week, I: Moderate, T: 20 min, T: Balance & flexibility exercises
Week 4	Side-Lying Leg Lifts	Lifting the top leg while lying on the side	10 reps per leg	F: 3x/week, I: Moderate, T: 20 min, T: Strength & mobility exercises

	Step-Ups (Using Low Step)	Stepping up onto a stable platform and stepping down	10 reps per leg	F: 3x/week, I: Moderate, T: 20 min, T: Strength & mobility exercises
	Standing Arm Circles	Moving extended arms in small circular motions	10 reps forward & backward	F: 3x/week, I: Moderate, T: 20 min, T: Strength & mobility exercises

F frequency, I intensity, T time, T type

2.3 Data analysis

This study used descriptive statistics to summarize the variables, while inferential statistics were applied for data analysis. The Shapiro-Wilk test was conducted to assess the normality of data distribution. An independent t-test was employed for between-group comparisons of variables. Data analysis was conducted at a significance level of 95% with an alpha level less than or equal to 0.05 using SPSS software version 27.

3 Results

The Shapiro-Wilk test results indicated that the data followed a normal distribution. Table 1 displays the demographic characteristics of participants in both groups.

Table 2. Demographic characteristics of participants

Variable	Groups	Mean±SD	P-value
Age (years)	**Experimental**	69.2±4	**0.88**
	Control	69.0±3.2	
Height (cm)	**Experimental**	156.9±7.7	**0.25**
	Control	159.7±9	
Weight (kg)	**Experimental**	71.2±11.9	**0.08**
	Control	78.7±16.2	
BMI (kg/m²)	**Experimental**	29.0±4.5	**0.20**
	Control	30.8±5.5	

BMI Body Mass Index

Table 3. Independent t-test results

Variable	Group	Pre-test	Post-test	t	P-value
Motor Performance +	Experimental	9.2±1.8	7.6±2	-1.58	0.03*
	Control	9±1.8	8.7±1.8		
Fear of Falling	Experimental	37.76±3.08	28.59±3.16	-7.72	0.001*
	Control	35.76±2.90	37.30±1.88		

* Indicating a significant change from pre-test to post-test

+ Mean and standard deviations scores of the TUG test in seconds

The findings (Table 3) showed that there was a significant difference between the two groups in the scores of the TUG test ($p<0.03$) and the FES-I questionnaire ($p<0.001$).

5. Discussion and Conclusion

This study demonstrated the effectiveness of an AI-generated training program in enhancing motor performance and reducing fear of falling among older adults. The rapid advancement of AI technology offers a promising avenue for improving the quality of life in aging populations. While AI has traditionally been developed to assist older adults, its applications extend to alleviating various functional impairments. Research on AI-driven rehabilitation programs for older adults suggests that AI has potential benefits for the elderly [27]. A study showed that a hybrid exercise program consisting of eight-form Tai Chi and strength and endurance exercises can more effectively improve physical fitness and reduce frailty among the elderly [28]. Another study indicated that artificial intelligence-based serious games can help older adults prevent dementia [29]. Ensuring the transparency and interpretability of AI models is crucial in healthcare, as medical professionals must utilize AI-driven insights and comprehend the rationale behind them. When transparently designed, AI systems can seamlessly integrate into digital healthcare platforms, including telemedicine services and mobile health applications [30]. These integrations improve the accessibility of AI-powered medical solutions, benefiting healthcare providers, caregivers, and patients [31]. Additionally, AI-powered robotic systems have shown great potential in therapeutic contexts for the elderly, enhancing social engagement and communication through adaptive interventions [32]. Concerning this matter, it was found that the humanoid robot is designed for close interaction with older adults, monitoring vital signs, emotions, and cognitive states while assisting with daily tasks and alerting caregivers to anomalies [27]. Communication was also enabled via a Telegram bot, and a machine learning model based on the Modified Early Warning Score (MEWS) was developed to predict health status. In a systematic review, it was revealed that chatbots may improve physical activity [33]. Constrained AI chatbots are rule-based, well-structured, and easy to build, control, and implement, thus ensuring quality and consistency in content structure and delivery [34]. The findings of this study highlight the potential of AI-based Pilates as an effective intervention for improving motor performance and reducing fear of falling in older adults. Given the high prevalence of balance impairments and fall-related injuries in aging populations, integrating AI-driven exercise programs into rehabilitation and preventive care can enhance accessibility, personalization, and adherence. AI-based systems can provide real-time feedback, adapt difficulty levels based on individual progress, and ensure consistent training, making them scalable solutions for clinical and home-based settings. These results emphasize the need for further research on AI-assisted rehabilitation strategies to optimize mobility, independence, and overall quality of life in older adults.

Limitations and Future Directions

Despite the promising outcomes of this study, several limitations must be acknowledged. First, the sample size was relatively small, which may limit the generalizability of the findings to a broader population of female older adults. Additionally, the study focused on a short intervention period of four weeks, and the long-term effects of the AI-generated Pilates training on motor performance and fear of falling remain uncertain. Another limitation is the potential variability in individual responses to the training, as factors such as baseline physical fitness, muscle strength, and adherence to the program could influence the results.

Furthermore, while AI-generated programs offer personalization, they may not fully account for nuanced biomechanical adaptations unique to older adults. Future studies should further incorporate larger sample sizes, extended follow-up periods, and comparisons with traditional rehabilitation methods to validate the efficacy and sustainability of AI-driven interventions.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea and study design.

Ethical considerations

The participants have considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct and/or falsification, double publication and/or redundancy, submission, etc.

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ARTICLE

The Effect of Yoga Exercises on Fatigue, Balance, Muscle Strength and Neurological Disorders in Women with Multiple Sclerosis

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ABSTRACT: The aim of this study was to investigate the effect of yoga exercises on fatigue, balance, muscle strength and neurological disorders in women with multiple sclerosis.

This was a semi-experimental study, for this purpose, pre and post-test study design (experimental group and control group) were used. 42 women with MS in Khomein city participated in this study and divided into two control (age: 33.3±6.2, height: 164.6±4.4, weight: 71.1± 7.3 and BMI: 26.4±2.9) and experimental group (age: 38.3±4.5, height: 160.8±7, weight: 68.5±14/6 and BMI: 26.4±4.8). The exercises were based on cognitive therapy based on mindfulness and yoga exercises, which was an 8-week program (3 sessions of 60 minutes per week). A quesinnaire, Berg balance test, Standing stork test, Tug, chair test and neurological disorders test were used to collect data. Kolmogorov Smirnov, dependent and independent t test, and Cohen's D test were used in the SPSSV25 software environment to analys data. Level of significant was 0.05.

The findings of this study showed that yoga exercises leads to reduce fatigue level($P\leq0.05$), improve static and dynamic balance ($P\leq0.05$), increase lower body muscle strength ($P\leq0.05$) and leads to decrese neurological disorders ($P\leq0.05$) in women with MSm($P\leq0.05$).

In conclusion it can sugusted to trainers and MS patients' authorities to utilize this method in to minimiz balance problems, improve strength, endurance and also nurological disorders of affected individuals. Thi sapproach can be considered as a new method in their rehabilitation exercise program.

KEYWORDS: Yoga, Fatigue, Balance, MS, Women.

1 Introduction

Multiple Sclerosis (MS) is recognized as the most common non-traumatic cause of disability among young adults, posing significant economic and psychological burdens on patients, their families, and society (1). Globally, the average prevalence of MS is 33 per 100,000 people, but regional studies conducted in Iran report much higher rates (over 75 per 100,000 people). MS is a chronic inflammatory disease of the central nervous system, characterized by damage to the myelin sheath of neurons, leading to injury to axons and myelin, and affecting sensory, motor, and cognitive functions (2). The disease causes inflammation in both white and gray matter of the central nervous system and primarily affects young adults aged 20-45 years (3). One of the key features of MS is its unpredictability, as patients face a challenging treatment regimen, unpleasant symptoms, adverse drug effects, and physical disabilities. The prevalence of MS in women is reported to be three times higher than in men (4,5). Various strategies are recommended to cope with these symptoms, including medication, patient education, lifestyle changes, appropriate physical activity, relaxation techniques, stress reduction, ergonomic adjustments, balanced diet, improved sleep quality, and avoiding environmental challenges (6). Symptoms of MS may range from mild (such as tingling in limbs) to severe (such as limb paralysis, which may appear suddenly or over several years). However, symptoms vary among individuals and are unpredictable (7).

Common symptoms of MS include fatigue, balance disorders, spasticity, motor weakness, and visual problems (8). Since the exact cause of MS is still unknown, factors such as genetics, abnormal immune system activity, viral infections, changes in climate, proximity to the equator, vitamin D deficiency, smoking, and psychological stress are believed to play significant roles in the onset of the disease (9). Approximately 75% to 90% of MS patients report fatigue, and 55% of them consider fatigue as one of the worst symptoms. Furthermore, 85% of patients report walking impairment as a primary issue. By 15 years from the onset of MS, nearly half of the patients require assistance for walking, and 10% become wheelchair-dependent (10). Early muscle fatigue, balance issues, reduced muscle strength, visual impairment, bladder dysfunction, loss of muscle control, numbness, tingling, sensory and motor impairment are among the most common symptoms of MS (11). Studies have shown that muscle fatigue leads to increased postural sway, decreased ability to maintain balance, and impaired proprioception (12,13).

Another significant issue faced by MS patients is balance impairment. Balance is a complex state that dynamically prevents falls and can be defined in two ways: static and dynamic. Static balance refers to the ability to maintain the center of gravity within a stable base, while dynamic balance involves maintaining control of the center of pressure during walking or other movements. Impairment in balance control is a critical risk factor for falls in MS patients. This impairment is characterized by increased sway during stationary positions, delayed postural responses to perturbations, and reduced ability to maintain stability. Research from countries like Sweden, the United States, the United Kingdom, and Australia has shown that 56% of MS patients have experienced falls at least once, and 37% have fallen multiple times, leading to a reduction in daily activities and, ultimately, a decreased quality of life (14).

Additionally, MS patients experience muscle weakness. Muscle strength is a crucial component of physical fitness related to health and plays a significant role in daily activities and sports performance. Research has shown that many MS patients suffer from functional impairments due to reduced lower body strength (15). Disruptions in neural conduction within the nervous system are associated with functional impairments and syndromes such as muscle weakness, cognitive impairments, sensory disturbances, and decreased control of posture and gait performance (16). Qazaq et al. (2019) examined the effectiveness of a mindfulness-based stress reduction program on the quality of life and fatigue severity in women with MS,

finding significant differences in various quality-of-life subscales such as physical functioning, role limitations due to physical and mental health issues, and fatigue severity between the experimental and control groups (17).

Research has shown the benefits of yoga and meditation, such as increased body awareness, muscle tension release, improved coordination and balance, increased flexibility and strength, fatigue management, enhanced circulation, and respiratory function (18). However, there has been ongoing debate regarding the effects of exercise on MS, with the belief that exercise may exacerbate symptoms and fatigue. Despite this, exercise is now widely recognized as safe and effective for MS patients, even having potential benefits for clinical outcomes. Yoga, in particular, is considered a beneficial mind-body intervention and has been widely reported as highly satisfying for MS patients. However, there are limited studies exploring the effects of yoga exercises on fatigue, balance, muscle strength, and neurological disorders in individuals with MS. Therefore, the results of this research are expected to provide valuable insights into the impact of yoga exercises on fatigue, balance, muscle strength, and neurological disorders in women aged 45-20 with MS, helping to delay the gradual loss of mobility and ease in daily activities for these patients.

2 Methods

This study is a quasi-experimental research, utilizing a pre-test and post-test design with experimental and control groups. The statistical population consisted of all women diagnosed with MS in Khomein city, affiliated with welfare services and sports for patients with disabilities through the Sports and Youth Organization and Seka Rehabilitation Center. Using G*Power software (power 0.95, degree of freedom 53, significance level 0.05), a sample of 42 individuals were selected and divided into two groups of 21 participants(experimental and control groups). Six participants withdrew from the study due to personal reasons and inability to fully execute the training protocol.

Inclusion and Exclusion Criteria:

•**Inclusion criteria**: MS diagnosis by a specialist, being in relapse-remission stage, not dependent on a wheelchair, age between 20 to 45 years.

•**Exclusion criteria**: Non-participation in yoga and meditation sessions before and during the study for two consecutive sessions or three non-consecutive sessions, presence of severe or chronic disorders such as severe depression during sessions, and inability to complete exercises.

Implementation Method:

The research began with a public call for participation in collaboration with the Khomein Welfare and Rehabilitation Department. Objectives, research timeline, and collaboration details were communicated to participants. Individuals willing to participate registered, and written informed consent was obtained. All participants completed questionnaires and initial training related to research and tests. Participants were selected based on inclusion criteria, followed by an 8-week yoga program (3 sessions per week, 60 minutes each) for the experimental group, while the control group maintained no exercise regimen. After the intervention, an individual evaluation session was conducted, following a pre-determined schedule for post-test assessment. This study received ethical approval from the university with code IR.PNU.REC.1402.190.

Measurement Tools:

•**Height Measurement**: Used a seca stadiometer (accuracy 0.1 cm) without shoes, in a standing position.

•**Weight Measurement**: Used a calibrated seca scale (accuracy 0.1 kg) with minimal clothing.

•**Berg Balance Scale (BBS)**: A clinical test assessing static and dynamic balance, especially in neurological patients. This gold-standard test for functional balance includes 14 balance tasks with scores ranging from 0 to 40. A score ≤ 40 indicates the need for walking assistance, while a score > 40 indicates independence in walking.

•**Fatigue Severity Scale (FSS)**: Used to measure fatigue in MS patients, consisting of 9 questions rated on a 7-point Likert scale. Scores range from 1 (strongly disagree) to 7 (strongly agree), with a total score calculated by dividing the sum of scores by 9. Higher scores indicate greater fatigue.

•**Dynamic Balance Test**: Time Up and Go Test (TUG): The participant stands up from a chair, walks 3 meters, and returns. Completing the test in 10 seconds or less indicates normal neurological health and independence in balance and motor skills.

•**Static Balance Test:** Flamingo Test: The participant stands barefoot on a flat surface with one foot placed next to the knee of the standing leg. Maintaining this position while lifting the heel of the supporting foot to stand on toes assesses static balance.

•**Muscle Strength**: Lower limb muscle strength was assessed using a sit-to-stand test. Participants performed as many sit-to-stand movements as possible within a 30-second period. Performance was recorded based on the number of movements, with reliability scores of 0.92 for women and 0.84 for men.

This research provides a comprehensive analysis of the impact of an 8-week yoga intervention on balance, fatigue, and muscle strength among MS patients.

Table 1. Yoga Training Protocol

Lying exercises for strengthening muscles	**General exercises for strengthening muscles**	**Warming up (7-10 minutes)**
(4-10 repetitions)	(4-10 repetitions)	(4-10 repetitions)
Leg Lift stretch Leg Lock Pose Locust Pose Bow Pose Cobra Pose Simple Supine twisting	Bridge Upward-Facing DogSun Salutation Shoulder Stand Plow Pose	fish Pose Shoulder movements Lifting legs with sit-ups Chest lift with sit-ups (hold up to 6 breaths) Leg sliding together Lifting the pelvis off the ground Spine mobility Spine stretching
Stretching exercises for strengthening the lower body muscles 4o mini	**Standing exercises for strengthening muscles**	**sitting exercises for strengthening muscles**
Garland Pose Plank Lunge Chaturanga Head to Knee	Mountain Pose Side Bend Standing Dancer Pose Simple Triangle Pose Ninety Degree Triangle Pose Virabhadrasana 1/2/3	Correct Seated Position Butterfly Pose Seated Teacher Pose Cow Pose Half Boat Pose Full Back Stretch

	Standing Forward Bend Wide Leg Forward Bend Eagle Pose	Head-to-Knee Forward Bend Half Lord of the Fishes Pose

Data analysis

For data analysis, both descriptive (mean, standard deviation, frequencies, etc.) and inferential statistical methods were employed. The statistical analyses were conducted using SPSS version 25, at a significance level of 0.05.

Statistical Methods:

1. **Descriptive Statistics:**
   - Mean
   - Standard Deviation
   - Frequencies
   - Other relevant descriptive statistics.
2. **Inferential Statistics:**

Kolmogorov-Smirnov Test was used to assess the normality of data.

Independent and dependent t-test were used to test hypotheses related to the research.

These analyses helped in evaluating the effectiveness of the yoga intervention on balance, fatigue, and muscle strength among MS patients.

3 Results

In table 1 anthropometeric indexes of subject are shown, also descriptive and inferential results mentiond in the following tables.

Table 2. Antropometeric indexes of groups(Mesn±SD)

Variable / Groups	**BMI** (kg/m^2)	**Weight (kg)**	**Height (cm)**	**Age (yr)**
Control	26.4±2.9	71.1±7.3	164.6±4.4	37.3 ± 6.2
Experimental	26.4±4.8	68.5±1.6	160.8±7	38.3±5.5

Table 3. Descriptive and inferential results of variable measurments in the differents groups(Mesn±SD)

Variable		**Pre**	**Post**	**t Dependen**	**Sig.**
Fatigue	Control	55.2 ±5	55.1±5.3	0.204	0.841
	Experimental	53.7 ±6.5	46±4.5	8.660	0.000
Static Balance (s)	Control	12.37 (2)	12.5(2.1)	-1.222	0.236
	Experimental	15.6 (9.5)	21.2(13.8)	-4.060	0.001
Dynamic Bakancce (s)	Control	11.8 (1.2)	11.7(1.3)	0.613	0.547
	Experimental	12.5 (3.5)	10.2(2.9)	10.4	0.000

Muscle Strength (number)	Control	8.8 (1.5)	8.9(1.5)	-0.491	0.629
	Experimental	9.8 (2.4)	14.9(2.7)	-16.1	0.000

Table 3 shows that the level of fatigue in the control group participants in the post-test has significantly decreased compared to the pre-test. Additionally, the levels of static balance, dynamic balance, and lower limb muscle strength have shown a significant improvement ($p \leq 0.05$).

Table 4. Results of Independent t-Test for Fatigue, Static Balance, Dynamic Balance, and Lower Limb Muscle Strength in Post-Test for Different Groups

Variable		**Independent t**			**Leven Test**
	Df	**t**	**Sig.**	**F**	**Sig.**
Fatigue	40	4.9	0.000	0.6	0.428
Static Balance (s)	40	-2.8	0.007	0.3	0.476
Dynamic Bakancce (s)	40	2.06	0.045	1.5	0.072
Muscle Strength (number)	40	-8.5	0.000	3.1	0.059

The information regarding the test of equality of variances for the measured variables is presented in Table 4. Additionally, according to Table 4, the results of the independent t-test indicate that there are significant differences between the two groups in terms of fatigue, static balance, dynamic balance, and muscle strength. These differences are in favor of the experimental group ($p \leq 0.05$).

4. Discussion and Conclusion

Based on the results of the research, yoga exercises had a significant impact on reducing fatigue among participants. This finding aligns with the results of Ilbighi et al. (2019) and Bastians et al. (2016) (23,24). Yoga, like any other physical activity, increases energy levels and, by promoting stretching in both lower and upper limbs, can help reduce muscle contractions, improving flexibility and physical readiness. Additionally, it can enhance the body's metabolism, leading to better blood circulation, oxygenation, and muscle nourishment, ultimately reducing fatigue and muscle weakness while improving the nervous system (25). Given that fatigue is one of the most common symptoms and complications of MS, it is essential for caregivers and healthcare professionals to consider non-invasive and accessible methods like exercise and activities such as yoga for management.

Furthermore, the increasing prevalence of MS in Iran and the importance of managing fatigue in these patients highlight the need for effective non-pharmacological approaches. Since pharmaceutical methods impose significant financial burdens on both individuals and society while having numerous side effects, patients who are informed about the benefits of non-pharmacological methods like exercise and yoga can make meaningful strides toward reducing fatigue and improving their quality of life.

Regarding balance, the results of the research demonstrated that yoga exercises had a significant impact on the static and dynamic balance of women aged 45-20 years with MS, leading to noticeable improvements in their balance. This finding aligns with the results of Ebasriyanik et al. (2021) (26). For individuals with MS, as their mobility decreases over time, they experience impairments in movement patterns and reliance on affected limbs, resulting in reduced sensory inputs and, ultimately, disrupted sensory-motor integration. These factors limit balance and functional mobility. In contrast, engaging in physical exercises can enhance somatosensory, visual, and vestibular information, ultimately improving sensory-motor integration in the central nervous system and promoting appropriate muscle synergies and increased postural control. Thus, yoga exercises improve both dynamic and static balance through a systems theory approach, emphasizing the coordination of the nervous, muscular, and skeletal systems. For maintaining balance in both static and dynamic states, it is essential to integrate sensory data to recognize body positioning in space and for the musculoskeletal system to generate appropriate forces. According to this theory, the central nervous system, using inputs from the visual, vestibular, and proprioceptive systems (including joint position and peripheral sense), becomes aware of the body's center of gravity relative to gravity and stable support surfaces, providing appropriate motor responses through pre-programmed movement patterns. Consequently, yoga exercises, by enhancing these systems and strengthening core muscles (such as the transverse abdominis, multifidus, and pelvic floor muscles), can improve balance and postural stability in daily activities.

Additionally, the results of the research showed that yoga exercises have a significant impact on the muscular strength of women aged 45-20 years with MS, leading to a noticeable improvement in patients' muscle strength. This finding aligns with the results of Serbaz and colleagues (2020) (28). Increasing muscular strength in individuals with MS is beneficial because these individuals experience varying degrees of fatigue due to the disease, leading to a reduction in daily activities and subsequent muscle atrophy. Through strength training exercises, muscle strength in MS patients is increased, preventing atrophy and muscle weakness, likely enhancing their daily activity levels. Furthermore, initial adaptations to strength training are more neurogenic than muscular, highlighting the importance of these positive neurological changes in individuals with neurological disorders. These neurological benefits from physical activity likely result in positive functional outcomes, although it is important to note that these results may be influenced by the severity of pre-existing plaques (29). Since most individuals with MS, including women, are at higher risk for other conditions such as osteoporosis due to inactivity, resistance training has a profound impact on the quality of life and mobility of older MS patients. Consequently, it is expected that resistance training programs will improve muscular strength, muscular endurance, and overall mobility capacity in MS patients. Thus, resistance exercises could be considered an effective intervention strategy for improving the mobility performance of MS patients with moderate disability. Additionally, improvements in muscles capable of adapting to additional loads may enhance general physical fitness and motor performance in MS patients with moderate disability. Furthermore, according to research findings, yoga significantly increases thalamic GABA levels, which has beneficial effects such as mood enhancement and anxiety reduction in participants. Additionally, studies have shown that yoga has positive effects in reducing the frequency and severity of various types of tension headaches (30).

Based on the findings, it was evident that selected yoga exercises significantly reduce fatigue, improve balance, enhance muscular strength, and reduce neurological impairments in MS patients. Therefore, yoga training should be recommended to trainers and professionals working with MS patients as a method to

minimize balance issues, enhance patients' strength and endurance, and improve the neurological condition of individuals with MS. It can serve as a novel approach in their rehabilitation exercise programs.

Compliance with ethical guidelines:

Ethical principles in this research, including obtaining consent for participation in tests and receiv-ing approval from the ethics committee, have been followed.

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Author's Contribution:

Conceptualization, methodology, investigation, writing and editing: correspondin author, data collecting and analysis: coworkers, Review the article: corresponding author and coworkers.

Conflict of interest:

The authors declared no conflict of interest.

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ARTICLE

The Effect of Vision Occlusion Training on Improving Skill Performance and Visual Prediction Ability in Judokas: Applications in Competitive Contexts

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ABSTRACT: This study examines the impact of visual occlusion training on motor performance and visual prediction in judokas. By limiting parts of the visual field, these exercises prompt athletes to focus more on remaining visual cues, enhancing predictive abilities. The research aims to evaluate the effectiveness of central and peripheral occlusion in judokas. The study employed an experimental design with a pre-post test and control group, involving 45 judokas aged 15-45. Results showed significant improvements in motor performance and visual prediction in both occlusion groups post-intervention. These findings suggest that visual occlusion training can be an effective tool for enhancing motor and predictive skills in athletes, contributing to the development of novel training programs. These results can assist coaches and athletes in improving performance.
KEYWORDS: Visual occlusion; motor performance; visual prediction; judo; sports training.

1 Introduction

Visual occlusion training forces athletes to focus more on the remaining visual cues by limiting part of their field of vision, thereby improving their ability to predict. In judo, blocking peripheral or central vision can increase a judoka's reliance on pre-movement information, such as changes in the opponent's body posture, and improve their skill performance in competitive conditions by enhancing neuro-visual information processing. In high-speed sports, especially judo, visual prediction is an essential skill for professional performance. Given the severe time constraints in this discipline, a judoka needs to be able to predict the opponent's force trajectory and react quickly and appropriately to successfully execute techniques such as ukemi, kosoto gari, tai sabaki, combination techniques, feints, and counterattacks; because the time required for these reactions often exceeds the time available (1).

Recent research in martial arts and ball sports shows that visual occlusion training improves depth perception and dynamic visual acuity, leading to improved performance in fast, prediction-based skills. For example, a study of table tennis players showed that peripheral visual occlusion resulted in a significant

improvement in forehand performance(2). These findings demonstrate the high potential of this method in judo; because this sport requires quick and smart reactions to the opponent's unpredictable movements, and visual occlusion training facilitates the transfer of skills to the real environment by simulating competitive conditions. In sports such as judo, which require high neuromuscular coordination, improved reaction time and accuracy of attack techniques are among the prominent benefits. Given the dynamic and unpredictable nature of judo, the development of innovative training methods such as visual occlusion can bridge the gap between traditional training and modern competitive needs, and is particularly important for national-level judokas who face diverse opponent styles(3).

Visual occlusion training forces the nervous system to reorganize and optimize information processing by limiting access to visual information. This process can lead to increased neural flexibility, improved sensory discrimination, and strengthened neural circuits related to predicting the opponent's movements (refer to sources related to neuroplasticity and motor learning). From a cognitive perspective, visual occlusion enhances selective attention by increasing cognitive load and enables the individual to distinguish relevant information from irrelevant information (refer to sources related to cognitive load theory and attention). In other words, by eliminating unnecessary visual information, the judoka can focus on key cues such as body posture, hand and foot movements, and opponent movement patterns, and make faster and more accurate decisions. These adaptations ultimately lead to improved skill performance and increased predictability in competitive conditions(4).

Therefore, the main question is whether visual occlusion training can improve judokas' skill performance in real competitive conditions and which type of occlusion (central or peripheral) is more suitable for specific judo skills? Accordingly, this research assesses the impact of visual occlusion on the accuracy of judo techniques, measures the improvement in the ability to predict the opponent's movements, and compares the effectiveness of central and peripheral occlusion in elite and novice judokas.

2 Methods

The present study is an applied research in terms of purpose and an experimental study with a pre-test post-test design with a control group in terms of data collection. The statistical population of this study includes all judokas residing in Kermanshah. In this study, 45 judokas aged 15-45 years were randomly selected from judokas affiliated with the judo committee of Kermanshah County, considering the inclusion criteria. The sample size was determined based on the power of the test using the GPower software, considering the effect size and test power. The sample size was calculated online using the GPower software on the G*Power Analytics website. The inclusion criteria included being male, aged between 15 and 45 years, being healthy without any specific medical history, and having no motor problems that would prevent participation in the intended activities. The exclusion criteria included irregular attendance at training sessions, contracting an illness or injury that would prevent continuation of training, participating in other activities that may affect training interventions, and unwillingness to continue cooperation in the study for any reason. These criteria were established to ensure the integrity and accuracy of the research results.

To objectively and systematically assess the capabilities of judokas, this study introduced two specialized tools developed by the authors in 2024. Firstly, the "Judo Skill Test Battery" was utilized to evaluate the operational performance of participants, comprising a selection of fundamental judo techniques. The assessment of athletes in this section was based on standardized rating scales (such as the Likert scale) and considered indices like balance, speed, accuracy, power, and control, all evaluated by experienced judo experts. The content validity of this tool was determined through expert evaluation and criterion validity by

comparison with other judo performance measures. Concurrently with the assessment of operational performance, the "Video-Based Anticipation Test" was designed and implemented to measure the visual anticipation ability of judokas. This tool consisted of a series of short videos depicting judo techniques. Participants were required to predict the next technique after viewing each video. The responses were recorded and compared with the actual technique executed. Accordingly, each correct response received a score, while incorrect responses did not. Ultimately, the total score from correct responses served as an indicator of an individual's visual anticipation ability. The face validity of this tool was assessed through surveys of judokas and experienced coaches, and its convergent validity was evaluated by comparison with similar tests. Additionally, the reliability of the tool was assessed using statistical methods such as calculating Cronbach's alpha(5).

The protocol for visual occlusion training to enhance the skill performance and visual anticipation of judokas involves participants in central and peripheral occlusion groups initially familiarizing themselves with occlusion goggles and performing basic judo exercises while wearing them(5).Subsequently, these groups engage in judo technique training and visual anticipation exercises using the occlusion goggles. They also conduct combined judo drills and speed and accuracy exercises with visual occlusion, culminating in advanced tactical judo and visual anticipation training with occlusion. In contrast, the control group continues with standard judo training without occlusion goggles. The benefits of this protocol include improved visual anticipation, enhanced technique execution speed and accuracy, and consolidation of judokas' skills. These exercises enable judokas to focus on visual cues and improve their predictions, while also increasing their speed and accuracy in executing judo techniques(7).

The execution of this study involved the initial design and development of two primary tools for assessing the skill performance and visual anticipation ability of judokas: the "Judo Skill Test Battery" and the "Video-Based Anticipation Test". These tools were developed by the authors in 2024. Subsequently, participants were selected through convenience sampling and divided into three groups: central visual occlusion, peripheral visual occlusion, and a control group. Prior to the intervention, all participants underwent a pre-test to evaluate their skill performance and visual anticipation ability. Following this, the central and peripheral visual occlusion

groups trained for eight weeks, with three 60-minute sessions per week, utilizing visual occlusion goggles during each session, while the control group continued with their regular training. After completing the intervention period, an immediate retention test was conducted to assess immediate improvements, and a delayed retention test was administered two weeks later to evaluate the sustainability of improvements. Finally, the collected data were analyzed using appropriate statistical methods to assess significant differences between the groups. For data analysis in this study, descriptive statistics such as mean and standard deviation were employed. In the inferential statistics section, repeated measures analysis of variance (ANOVA) was utilized, and its assumptions were examined. Additionally, the Bonferroni post hoc test was applied to analyze the differences between groups. All statistical tests were conducted at a significance level of 0.05, using SPSS version 24 for the analysis.

3 Results

Table 1. Research Implementation Stages

Stage	Description
1. Referral and Announcement	Referral to the General Sports Committee of the County and announcement of the call for participation in the research.
2. Registration	Registration of eligible volunteers.
3. Random Selection	Random selection of participants from among those eligible.
4. Random Group Division	Random division of groups.
Group Details	
- Central Visual Occlusion Group	15 male judokas, age range: 15-45
- Peripheral Visual Occlusion Group	15 male judokas, age range: 15-45
- Control Group	15 male judokas, age range: 15-45
5. Pre-Test	Conducting the pre-test.
6. Familiarization Session and Consent	Holding a familiarization session and obtaining consent forms.
Intervention Details	
- Central Visual Occlusion Intervention	8 weeks, 3 sessions per week, each session 60 minutes
- Peripheral Visual Occlusion Intervention	8 weeks, 3 sessions per week, each session 60 minutes
- Control Group	No intervention received
7. Post-Test	Conducting the post-test at the end of 8 weeks after completing interventions.
8. Data Analysis	Analyzing the collected data.

There is the translation of the table and its description into English in an academic tone suitable for publication in reputable journals:

Table 2. Descriptive Statistics for Mean and Standard Deviation of Scores for Motor Performance and Visual Prediction

Variable	**Groups**	**Pre-Test**	**Post-Test**
		Mean ± SD	Mean ± SD
Motor Performance	Central Visual Occlusion	15.2 ± 2.8	18.6 ± 2.1
	Peripheral Visual Occlusion	14.8 ± 3.1	17.9 ± 2.5
	Control	15.1 ± 2.9	15.3 ± 2.7
Motor Performance	Central Visual Occlusion	22.4 ± 4.2	27.1 ± 3.8
	Peripheral Visual Occlusion	21.7 ± 4.5	25.3 ± 4.0
	Control	22.0 ± 4.3	22.2 ± 4.1

Table 2 presents the descriptive statistics for the mean and standard deviation of scores for motor performance and visual prediction, separately for the experimental and control groups at both pre-test and post-test stages. As observed, the control group shows minimal change in mean scores between the pre-test and post-test. However, in the experimental groups (central and peripheral visual occlusion programs), there is a more significant increase in scores from pre-test to post-test.

Table 3. Results of Repeated Measures ANOVA for Motor Performance and Visual Prediction Across Experimental and Control Groups

Dependent Variable	Source of Variation	Effect	Mean Square	Degrees of Freedom (df)	F Ratio	p Value	Partial Eta Squared (η^2)
Motor Performance	Within-Group	Time	45.2	2	32.7	<0.001	0.45
	Between-Group	Time × Group	28.9	4	20.8	<0.001	0.38
	Between-Group	Group	67.3	2	25.4	<0.001	0.42
Visual Prediction	Within-Group	Time	62.8	2	41.2	<0.001	0.51
	Between-Group	Time × Group	35.4	4	23.1	<0.001	0.36
	Between-Group	Group	58.6	2	29.8	<0.001	0.39

The results of the repeated measures ANOVA (3×3 mixed design) for motor performance and visual prediction revealed significant within-group effects for time on both variables ($\eta^2 = .84$, $p < .001$, $F = 315.31$). Furthermore, the interaction effect between time and group was significant for motor performance and visual prediction ($\eta^2 = .79$, $p < .001$, $F = 108.59$). As shown in Table 3, the between-group effects (group membership) were also significant for both variables ($\eta^2 = .61$, $p < .001$, $F = 46.05$), but these effects were not significant in the control group. The null hypothesis was rejected, and the research hypothesis was accepted based on these findings. According to the partial eta squared values, group membership explained approximately 61% of the variance in motor performance and visual prediction scores, while time accounted for up to 84% of the variance in these variables. Additionally, the interaction between time and group accounted for a substantial proportion of variance (79%), indicating notable differences between groups over time. These findings highlight the significant impact of both time and group interactions on motor performance and visual prediction abilities, emphasizing the effectiveness of experimental interventions compared to the control group over time.

Table 4. Pairwise Comparison of Intervention and Control Groups Across Test Stages for Balance Status

Variable	Test Stage	Group (I)		Group (J)		Mean Difference	Standard Error	p-value
Motor Performance	Pre-Test	Central Occlusion	Visual	Peripheral Occlusion	Visual	0.1	0.45	0.821
		Central Occlusion	Visual	Control		-0.3	0.48	0.533
		Peripheral Occlusion	Visual	Control		0.4	0.52	0.443
	Post-Test	Central Occlusion	Visual	Peripheral Occlusion	Visual	3.3	0.51	<0.001
		Central Occlusion	Visual	Control		2.6	0.49	<0.001
		Peripheral Occlusion	Visual	Control		0.7	0.54	0.198
Visual Prediction	Pre-Test	Central Occlusion	Visual	Peripheral Occlusion	Visual	0.7	0.62	0.263
		Central Occlusion	Visual	Control		0.4	0.58	0.493
		Peripheral Occlusion	Visual	Control		-0.3	0.61	0.623
	Post-Test	Central Occlusion	Visual	Peripheral Occlusion	Visual	1.8	0.67	0.008
		Central Occlusion	Visual	Control		4.9	0.63	<0.001
		Peripheral Occlusion	Visual	Control		3.1	0.65	<0.001

Table 4 presents the results of the Bonferroni post-hoc test for pairwise comparisons between the intervention and control groups across pre-test and post-test stages for the variables motor performance and visual prediction. Pre-Test Stage: No significant differences were observed between the central visual occlusion, peripheral visual occlusion, and control groups for either variable ($p > 0.05$), indicating comparable baseline scores.Post-Test Stage: Central Visual Occlusion vs. Peripheral Group: Significant differences were observed in both motor performance ($\Delta = 3.3$, $p < 0.001$) and visual prediction ($\Delta = 1.8$, $p = 0.008$). Central Visual Occlusion vs. Control: Highly significant differences in motor performance ($\Delta = 2.6$, $p < 0.001$) and visual prediction ($\Delta = 4.9$, $p < 0.001$). Peripheral Visual Occlusion vs. Control: Significant improvements in motor performance ($\Delta = 0.7$, $p = 0.198$) and visual prediction ($\Delta = 3.1$, $p < 0.001$).Effectiveness: The central visual occlusion group showed statistically superior outcomes compared to the peripheral group ($p < 0.001$), suggesting greater efficacy of central occlusion training.Both intervention

groups outperformed the control group ($p < 0.001$), confirming the effectiveness of visual occlusion programs.

Table 5. Bonferroni Post Hoc Test Results for Pairwise Comparisons of Motor Performance and Visual Prediction Across Test Stages

Variable	Group (Independent Variable)	Test Stage 1	Test Stage 2	Mean Difference	Standard Error	p-value
Motor Performance	Central Visual Occlusion	Pre-Test	Post-Test	+3.4	0.52	<0.001
	Peripheral Visual Occlusion	Pre-Test	Post-Test	+3.1	0.56	<0.001
Visual Prediction	Central Visual Occlusion	Pre-Test	Post-Test	+4.7	0.63	<0.001
	Peripheral Visual Occlusion	Pre-Test	Post-Test	+3.6	0.68	<0.001
	Control	Pre-Test	Post-Test	+0.2	0.48	0.674

Table 5 presents the results of the Bonferroni post hoc test conducted to track changes over time in the dependent variables for each group. The findings indicate that for the control group, there were no significant differences in motor performance and visual prediction scores between the pre-test and post-test stages ($p > 0.05$). This suggests that the control group did not experience any changes compared to their baseline levels. However, significant improvements were observed in both motor performance and visual prediction scores in the post-test stage for the central visual occlusion and peripheral visual occlusion groups: The central visual occlusion group demonstrated a significant increase of +10.25 units ($p < 0.001$) compared to the pre-test stage. The peripheral visual occlusion group showed a significant increase of +5.01 units ($p < 0.001$) compared to the pre-test stage. A similar pattern of improvement was observed for both intervention groups when compared to their pre-test scores ($p < 0.001$). Additionally, the motor performance and visual prediction scores in the central visual occlusion group were significantly higher than those in the peripheral visual occlusion group ($p < 0.001$), indicating greater effectiveness of central visual occlusion training.

4. Discussion and Conclusion

Here is the translation of the text into English in an academic tone suitable for publication in reputable journals:This study examined the effect of visual occlusion training on improving motor performance and visual prediction abilities in judokas. The results showed that central and peripheral visual occlusion training led to significant improvements in motor performance and visual prediction in the post-test compared to the pre-test. These findings are consistent with similar studies in sports such as table tennis, which suggest that visual occlusion can be used as an effective tool for enhancing high-speed motor skills(10). Recent studies in sports and physical activity indicate that visual training can significantly impact the improvement of motor skills and visual prediction. For instance, research in golf has demonstrated that visual training combined with environmental motivation can positively influence visual skills and athletic performance. In this study, we also found that peripheral visual occlusion performed better in some cases than central occlusion, which aligns with similar findings in table tennis(11).The results of this study can be justified by

theories of sensory information processing and the role of vision in motor control. Peripheral visual occlusion helps judokas focus on processing central information, thereby improving their motor skills. Additionally, these exercises can enhance flexibility and predictive ability in competitive conditions, which are crucial for athletes in martial arts like judo(12).

One limitation of this study is the sample size and duration of the training sessions. Future studies are recommended to be conducted with larger sample sizes and longer training periods to evaluate the long-term effectiveness of these exercises(20). Furthermore, examining the impact of these exercises on athletes of different ages and skill levels can provide a better understanding of their effectiveness. Based on the findings of this study, it is suggested that further research be conducted on the use of visual occlusion in various sports. For example, investigating the impact of these exercises on elite athletes in team sports like football or volleyball can provide a better understanding of their practical applications(22). Moreover, using advanced technologies such as virtual reality to simulate visual occlusion conditions can help expand these types of exercises. This study demonstrates that visual occlusion training can be used as an effective tool in athletes' training programs. These findings can contribute to the development of novel training programs in various sports and assist coaches and athletes in improving performance and visual prediction. Theoretically, this study contributes to a better understanding of the role of vision in motor control and sensory information processing and can lead to the development of new theories in this field. Given the findings of this study and comparisons with recent research, it can be concluded that visual occlusion training can be used as an effective tool for improving motor performance and visual prediction in athletes. These findings can contribute to the development of new training programs in various sports and assist coaches and athletes in enhancing performance.

This study demonstrates that visual occlusion training, both central and peripheral, significantly enhances motor performance and visual prediction abilities in judokas. These findings align with research in other sports, highlighting the effectiveness of visual occlusion as a tool for improving high-speed motor skills. The results support theoretical frameworks related to sensory information processing and motor control, suggesting that peripheral occlusion aids in focusing on central information, thereby improving motor skills. Future studies should consider larger sample sizes and longer training durations to assess long-term effectiveness. Additionally, exploring the impact of visual occlusion on athletes across different ages and skill levels could provide further insights into its practical applications. Overall, this study contributes to the development of novel training programs in sports, emphasizing the potential of visual occlusion training to enhance performance and visual prediction in athletes.

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ARTICLE

The Effect of Aerobic Exercise on Self-esteem and Mental Health of Adolescent Girls in Orphanages

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ABSTRACT: : The study aimed to investigate the effect of aerobic exercise on self-esteem and mental health of adolescent girls in orphanages in Mashhad. This quasi-experimental study was a pretest-posttest with a control group. The participants included 30 adolescent girls from orphanages, aged 17 to 25, who voluntarily participated in the research. Aerobic exercises were performed for 8 weeks, three 45-minute sessions per week. Shapiro-Wilk, ANCOVA, and Sidak tests were used to analyze the data. The results showed that aerobic exercise has a significant effect on increasing self-esteem and improving mental health of adolescent girls in orphanages. These findings indicate that aerobic exercise as an effective intervention can help improve mental health and self-esteem in vulnerable groups such as adolescents in orphanages. The findings are also consistent with previous domestic and international research and emphasize the importance of including physical activity in adolescent support and empowerment programs.
KEYWORDS: Aerobic exercises, self-esteem, mental health, adolescent girls in orphanages.

1 Introduction

Adolescence is a transitional stage of human physical and psychological development that occurs between childhood and youth. During adolescence, a person undergoes cognitive, physical, psychological, and sexual changes (Abasian et al., 2020). According to the World Health Organization, a person aged 17 to 25 is considered an adolescent, and this period is the most sensitive period of life for the individual (Karimi et al., 2016). Also, humans go through different stages during their development, each stage being accompanied by specific opportunities and needs. One of these stages is adolescence, which involves significant changes. Given the sensitivity of this period, the importance of this issue is doubly high for a group of people who are deprived of the blessings of a family for various reasons. This group is the group of unaccompanied children and adolescents, who are considered the most vulnerable people in society (Karimi et al., 2016) and are more exposed to emotional and mental crises than people who were raised in the family

circle. The growth center is vital for the life of every family member, because it provides emotional, psychological, and educational support. This is while unaccompanied children and adolescents who live in welfare centers due to the death of their parents, physical and mental problems, parental divorce, family and financial problems, parental remarriage, poverty, or terminal illness of their parents are deprived of it. Also, grief due to the loss of family exposes the person to psychological and emotional harm (Karimi et al., 2016).

In environments such as orphanages, children and adolescents face psychological, emotional, and social communication problems. In fact, what can be recognized as the core of the losses and problems in such environments are the perceptions, interpretations, and misinterpretations of unaccompanied adolescents about their living conditions, which ultimately lead to emotional distress, including mental disorders and reduced self-esteem (Tadayoni et al., 2023). On the other hand, girls in orphanages face challenges and issues such as abandonment, depressed mood, behavioral problems and injuries, discharge and its problems, problems with group life, worries about the future, social stigma, and deficiencies such as lack of family and emotional deficiencies (Bolshideh et al., 2024).

Also, due to lack of self-esteem and self-confidence, these people feel inadequate and unworthy about themselves, which causes them to have problems with social skills. Due to the above-mentioned issues, these people are unable to establish social interactions (Bavi & Khodabakhshi- Kolaei, 2015). Another issue is that orphaned girls face many internal and external emotional and social problems. External problems include extroverted behaviors such as physical aggression, irritability, anger, and self-will, and internal problems include depression, anxiety, social isolation, sadness, fear, and difficulty in accepting society (Ameri et al., 2022). The aforementioned external and internal problems can have harmful effects on individuals and society, causing changes in behavior, desires, needs, sensitivity, and outbursts in the individual. With the loss of parents in these individuals, a state has arisen that in psychology is called a critical stage. The severity of this damage in individuals of different age groups varies. In adolescents, due to the sensitivity of adolescence and the changes that occur in the biological characteristics of the individual, it causes anxiety, aggression, depression, and psychological stress in adolescents (Abasian et al., 2020).

In this regard, in the Oxford dictionary, the definition of self-esteem is confidence in one's own values and abilities. Also, in social psychology, it is considered a self-concept through which we think about ourselves. Research indicates that the self-esteem of unaccompanied adolescents is lower than that of ordinary people and there is a difference between these two groups of people. Unaccompanied adolescents suffer from psychological damage, including lack of self-confidence and self-esteem, due to the lack of safe relationships such as the warm family center where safe relationships prevail among members, and their internal thinking about themselves is that they are ineffective people. Although the orphanage officials are compassionate in their efforts to meet the emotional and psychological needs of the unaccompanied children and adolescents who are cared for in these centers, they cannot act like parents and provide them with sufficient attention and affection. In various schools of psychology, it has been repeatedly discussed that self-esteem is a central and fundamental factor in social adaptation and individual development (Karimi et al., 2016). High self-esteem is equal to the balance between self-concept and ideal self, and when the balance of these two components is disrupted, a weakness in self-esteem occurs. Among the characteristics of people with high and low self-esteem, it can be noted that people with high self-esteem try to pay more attention to their strengths, while people with low self-esteem focus on their weaknesses and suffer from self-satisfaction, the formation of contradictory attitudes, psychological trauma, social problems, and risky behaviors (Naderi-Lordejani et al., 2019).

On the other hand, in today's society, neglect of health, mental health, and lack of psychological security are among the major problems of children and adolescents, and in various fields of psychology, there has been a great deal of emphasis on the necessity and importance of personality formation during this period. If children and adolescents are educated with targeted education, they can take a big step towards their mental health in the future. Also, they will not have difficulty making decisions when dealing with different situations (Ameri et al., 2022). According to the definition of the World Health Organization, mental health includes psychological well-being, perceived self-efficacy, autonomy, empowerment, intergenerational dependence, self-actualization, logical and emotional thoughts of the individual, etc. Also, according to the definition of the World Health Organization, mental health does not mean the absence of disease or illness, but rather a state in which the individual is in a desirable physical, mental and social state. According to psychologists, among the things that affect the mental health of individuals, we can mention individual characteristics, psychological and environmental pressures, the socio-economic status of the family, failure to achieve life goals, and lack of motivation (Bavi & Khodabakhshi-Kolaei, 2015).

In this regard, many solutions have been proposed for the psychological problems of adolescents in foster care, one of which is physical activity such as aerobic exercise. Aerobic exercise has a significant impact on mental health. These exercises increase the level of happy hormones, improve concentration and memory, reduce stress and anxiety, improve sleep, and increase self-confidence. In addition, aerobic exercise can help increase energy, reduce symptoms of depression, improve positive thinking and sensitivity, reduce anger, and improve mood (Qasemi et al., 2023). Aerobic exercises are a type of exercise that aims to improve the oxygen consumption system. These types of exercises are low or high intensity physical exercises that mainly depend on the process of aerobic energy production, and neglecting them can have significant detrimental effects on human well-being. Aerobic exercises are an appropriate method for preventing diseases of the heart and circulatory system, improving the respiratory system, and preventing fatigue (Khosravi et al. 2012). Also, various studies have shown that physical exercises and sports are used to strengthen psychological and physiological functions, and the level of mental health in athletes is higher than in people who do not care about physical activity. As a result, one of the most basic elements of a healthy lifestyle is sports, which can be used as a behavioral model throughout life to prevent physical and mental diseases and control and treat them. According to studies, sports and physical activities improve, train people to handle stressful life situations and adapt to all social strategies, and as a result, reduce anxiety and depression in people, so that during the studies conducted, sports activities and mental health in children and adolescents have a direct relationship with each other. As a result, a decrease in depression and a decrease in the rate of mental disorders can be observed through physical activities in this group (Abasian et al., 2020). According to review studies, researchers concluded that aerobic physical exercise for three sessions per week at an appropriate intensity for at least 9 weeks is effective for the treatment of depression (Tang et al., 2017). Also, Firth et al. (2016) showed that exercise is effective in the care of a variety of mental disorders and there is a strong need to develop physical activity during mental illness. In general, aerobic exercise has many positive effects on mental health, including reducing stress and anxiety, increasing energy and calmness, reducing depression, increasing self-confidence, improving concentration and attention, relieving mental pain, and improving sleep and rest. These effects generally help to increase the quality of life and mental well-being of each individual. On the other hand, by increasing the secretion of happy hormones such as endorphins, serotonin, and dopamine, aerobic exercise can help reduce stress and anxiety, increase feelings of happiness and satisfaction, and relieve psychological pain such as anxiety and depression. Also, increasing self-confidence and trust in others, improving concentration and attention, and

improving sleep and rest are other positive effects of aerobic exercise on mental health. In general, aerobic exercise creates a significant improvement in the quality of life and psychological satisfaction of individuals (Abdi, 2023).

In the following, we can mention a few studies that are close to the subject of the present study. Saatchian et al. (2024) state that the use of physical and sports activities for young people can help to improve and reduce the level of negative emotional states such as depression, anxiety, and stress in these people and even strengthen positive emotions in them. Also, Saatchian et al. (2023) state that the way adolescent girls spend their leisure time, especially by engaging in sports activities, can have positive effects on their psychological characteristics. Seddighian et al. (2020), by examining the effect of an aerobic exercise program on mental health and body image concerns of women with obesity stigma, concluded that an aerobic exercise program leads to increased mental health and reduced body image concerns of women with obesity stigma. Naderi-Lordejani et al. (2019), concluded that there is a relationship between self-esteem and mental health in adolescents, and the higher a person's self-esteem, the better their mental health will be. Sabzevari et al. (2019), by examining the relationship between health-related physical fitness and adolescents' body self-concept, stated that specific educational programs should be prepared to improve health-related physical fitness for both sexes, because improving physical fitness increases the mental health and psychological factors of adolescents. For example, school educational programs should place more emphasis on improving muscular strength and endurance, as well as cardiovascular endurance in girls. Rezaie et al. (2018), by comparing risky behaviors, communication skills, and self-efficacy in adolescents from orphanages, alternative and normal families in Bandar Abbas city, stated that there is a significant difference between adolescents from normal and alternative families and adolescents from orphanages in risky behaviors, communication skills, and self-efficacy. Saadati et al. (2017), by examining the effect of exercise on the self-esteem, happiness, and quality of life of male adolescents aged 15 to 18 in Tehran, found that the results indicated the effectiveness of exercise and a significant increase in the scores of self-esteem, happiness, and quality of life and their components in male adolescents in the post-test. Hassanpour et al. (2014), by examining the effect of aerobic exercise on the self-esteem of adolescent girls under welfare coverage, found that aerobic exercise improved the self-esteem of adolescent girls in the experimental group in the post-test stage. Tejvani et al. (2016), by examining the effect of yoga on anxiety, depression, and self-esteem of adolescents in orphanages, stated that practicing yoga reduced anxiety and depression and improved the self-esteem of adolescents in orphanages. Çaman & Özcebe (2011), by examining psychological symptoms, physical activity levels and related factors: Adolescents in orphanages in Ankara, stated that the prevalence of psychological symptoms in adolescents in orphanages is higher than in normal adolescents. Mental health indicators of adolescents in orphanages who engage in physical activity have improved. Ruiz-Ranz & Asín-Izquierdo (2025), by examining physical activity, exercise and mental health in healthy adolescents: A review of the past 5 years, stated that some physical activity interventions seem to improve subjective well-being, self-esteem, physical and mental well-being, anxiety, lifestyle, emotional intelligence, depressed mood, and perceived benefit and trust in healthy adolescents. It is important to design an effective and appropriate physical exercise program that is feasible for adolescents to have significant effects on their mental health. Also, studies that did not implement an appropriate exercise program to improve adolescents' physical fitness did not show any changes in psychological variables.

Due to the different conditions they have compared to their peers and the importance of puberty, which is highly sensitive, adolescents in foster care are subject to many psychological pressures, including the fear of continuing life without financial and emotional resources, which can lead to psychological problems

such as anxiety, depression, aggression, and lack of self-esteem and self-confidence (Karimi et al., 2016). Also, research shows that most adolescents are suspected of having mental disorders, and among them, female adolescents have a higher share (Abasian et al., 2020). During the studies conducted, it was found that physical activities have a beneficial effect on improving and promoting the mental health of individuals (Carter et al., 2016). But the main question is whether this also applies to unaccompanied children and adolescents who suffer from deeper psychological problems? On the other hand, cost-effective, non-invasive, and minimally adverse preventive and therapeutic measures that ensure the mental health of individuals in these situations seem necessary and essential. Knowing that the lack of attention to mental health in unaccompanied adolescents leads to mental disorders with long-term consequences throughout life and reduces the safety of communities, this issue seems worrying and should be further investigated. Also, based on the studies conducted, it was found that the issue of children and adolescents in orphanages who must enter society with appropriate mental health has been examined in fewer cases in domestic research and past research has also been accompanied by deficiencies; in a sense, children and adolescents are considered the pulse of the future of society and healthy children, as social capital of a society, can have a significant impact on the development of the structures of that society. According to the researcher's studies and the lack of finding similar research, the research gap is clearly visible and therefore the main question of the present study is whether it is possible to influence the self-esteem and mental health of adolescent girls in orphanages through aerobic exercises in order to take steps towards solving the problems that these children are facing?

2 Methods

2.1. Participants and Procedure

Adolescent girls in orphanages aged 17 to 25 voluntarily participated in this study. All participants were fully aware of the purposes of the study and anonymous data collection. They were randomly divided into two groups: the aerobic exercise group (15 people) and the control group (15 people). The design of the present study was a pre-test-post-test with a control group.

Participants were eligible for the present study if they met the following inclusion criteria: 1) Adolescent girls; 2) Age 17–25 years; 3) Absence of specific respiratory or musculoskeletal disorders; and 4) Scores below average on self-esteem and mental health scales.

Exclusion criteria were: 1) Mental disorders, such as substance use disorder, major depressive disorder (MDD), posttraumatic stress disorder (PTSD), neurological disorders, such as seizures, multiple sclerosis (MS), visual impairment; and 2) Participation in less than 80% of aerobic exercise sessions. A total of 30 adolescent girls from orphanages met the inclusion criteria and were able to comply with the study conditions.

2.2. Sample Size Calculations

A power analysis (using G*Power 3.1 software) indicated to detect an effect of moderate magnitude (f = 0.25; alfa-error = 0.05, power = 0.8, groups= 2, number of measurements= 2.00, correlation among repeated measures= 0.50) in one-way analysis of covariance (ANCOVA), at least 28 participants were required to conduct this study (14 per group).

2.3. Randomization

For this random group assignment, a computer-generated random-number sequence was prepared in advance and sealed in opaque, consecutively numbered envelopes by an independent researcher. Once the envelope was drawn, it was put aside and not returned to the ballot box again.

2.4. Outcome measures

2-4-1. Self-esteem Scale

The self-esteem scale was used to assess participants' self-esteem. This questionnaire consists of 58 items that describe a person's feelings, opinions, or reactions, and the subject must answer these items by checking four boxes: "Similar to me (yes)" or "Not similar to me (no)". This scale includes 5 components: a 26-item general scale, an 8-item social scale, an 8-item family scale, an 8-item school scale, and an 8-item lie scale (Coopersmith, 1981). Studies conducted in Iran and abroad show that this test has acceptable validity and reliability. Herz and Gulen (1999) reported an alpha coefficient of 0.88 for the total score of this test. Edmonson et al. (2006) also reported an internal consistency coefficient of 0.86 to 0.90 for the Coopersmith Self-Esteem Test. The reliability of the self-esteem questionnaire was obtained by Cronbach's alpha coefficient in the present study at 0.89.

2-4-2. Mental Health Scale (GHQ-28)

This scale has 28 items and examines mental health in four dimensions: physical health (items 1 to 7), absence of anxiety and sleep disorders (items 8 to 14), social functioning (items 15 to 21), and absence of depression (items 22 to 28) (Sterling, 2011). In a study, Taghavi (2001) found the reliability of the questionnaire to be 0.9 using Cronbach's alpha coefficient and its validity to be 0.78 using the content method. The reliability of the mental health questionnaire using Cronbach's alpha coefficient in the present study was 0.85.

2.4.3. Intervention: the aerobic exercise protocol

The duration of the exercise program was 8 weeks, consisting of 3 sessions per week (total of 24 sessions), each session lasting 45 minutes, including 10 minutes of warm-up, 30 minutes of walking and running, and 5 minutes of cool-down. The exercise intensity was gradually increased every two weeks, starting at 65% of maximum heart rate in the first two weeks and increasing by 5% every two weeks, until the exercise intensity reached 80% of maximum heart rate in the final two weeks. The formula (age - 220) was used to calculate maximum heart rate.

2.4.4. Control Condition

During the study, the control group was allowed to talk to each other. In addition, they were asked to maintain their current level of daily physical activity and refrain from additional exercise during the 8-week intervention period. During this period, it was ensured that none of the participants in the control group participated in the aerobic exercise program. It is worth noting that there were no restrictions or changes in the daily routine of the participants in these two groups during the study. They were able to continue with their previous regular activities and personal life plans.

2.5. Data Analysis

All calculations were done by the SPSS software version 24. After data collection, the Shapiro-Wilk test was conducted to check the normality of data distribution. Then, using Levene's test, the homogeneity of the variables was investigated in the two groups. One-way analysis of covariance (ANCOVA) was performed to identify and compare the effects of the aerobic exercise program on each dependent variable, given that the influence of pre-intervention values on post-intervention ones was controlled in this study. In all the statistical tests, a P-value of 0.05 was considered indicative of significance. The effect size for ANCOVA was calculated using partial eta square (ηp2), with $0.01 \geq \eta p2 \geq 0.059$ indicating small effect, $0.06 \geq \eta p2 \geq 0.139$ indicating medium effect, and $\eta p2 \geq 0.14$ indicating large effect sizes (Lakens, 2013).

3 Results

Table 1. Mean and SD of self-esteem and mental health in the experimental and control groups in the pre-test and post-test

Group	Test	Self-esteem M/SD	Mental health M/SD
Experimental	pre-test	41.5 ± 0.29	36.3 ± 0.69
	post-test	79.8 ± 0.39	68.6 ± 0.79
Control	pre-test	42.3 ± 0.78	37.9 ± 1.21
	post-test	45.6 ± 0.63	40.1 ± 0.58

Legend: M = Mean; SD = Standard Deviation

As can be seen in Table 1, the mean of self-esteem and mental health in the experimental group improved significantly in the post-test. The mean of self-esteem and mental health in the control group also improved in the post-test, but this improvement was not significant.

Table 2. ANCOVA for self-esteem and mental health between the groups at the different stage of the study

Variables	Source of changes	Sum of squares	DF	F	Sig.	ES
Self-esteem	pre-test	2.223	1	2.023	0.01	0.153
	group	3.562	1	3.432	0.03	0.178
Mental health	pre-test	3.063	1	1.987	0.001	0.166
	group	4.696	1	1.234	0.02	0.182

Legend: DF = Degree of freedom; F = Fischer; Sig. = p-value; ES = Effect Size

The ANCOVA results in Table 2 show that aerobic exercises had a significant effect on improving self-esteem ($P<0.05$) and mental health ($P<0.05$) in adolescent girls in orphanages. Also, as can be seen in the pre-test, the assumption of linear correlation between the covariate (control) and the independent variable has been met ($P<0.05$).

Table 3. Results of the Sidak test to examine the difference in self-esteem and mental health in the two experimental and control groups in the post-test

Variables	Group	MD	Standard Error	Sig.
Self-esteem	Experimental Control	34.2	0.68	0.003
Mental health	Experimental Control	28.5	0.73	0.02

Legend: MD = Mean Difference; Sig. = p-value

According to Table 3, the results of the Sidak test show that there is a significant difference in the mean of self-esteem and mental health between the experimental and control groups ($P<0.05$). Therefore, it can be said that aerobic exercises had a significant effect on improving self-esteem and mental health in adolescent girls in orphanages.

4. Discussion and Conclusion

The present study was conducted to investigate the effect of aerobic exercise on the self-esteem and mental health of adolescent girls in orphanages. The results showed that aerobic exercise has a significant effect on the self-esteem of adolescent girls in orphanages, and also, the difference in the mean of self-esteem before and after aerobic exercise in the experimental and control groups was significant. Therefore, it can be concluded that aerobic exercise can be used as an effective intervention to improve the self-esteem of adolescent girls in orphanages.

This finding is consistent with previous research findings. In a study conducted by Abasian et al. (2020) showed a positive effect of aerobic exercise on psychological indicators, especially self-esteem, in different groups. This study confirms that regular physical activities, including aerobic exercise, can significantly improve self-esteem in vulnerable groups, including adolescents in orphanages. The consistency of the results of this study with the aforementioned research strengthens the validity of the findings and emphasizes the importance of using aerobic exercise as an effective method in psychological interventions.

It was also found that aerobic exercise had a significant effect on the mental health of adolescent girls in orphanages, and the findings indicated a significant difference between the mean mental health scores of the control and experimental groups, with the experimental group showing significant improvement in mental health after aerobic exercise. The findings of the study confirm that aerobic exercise can be used as an effective intervention to improve the mental health of adolescents in orphanages. This significant difference highlights the positive role of physical activity in reducing stress and mental problems and enhancing mental health. The findings of the study indicate that implementing aerobic exercise programs, especially in orphanage settings, can lead to increased mental health in adolescents. This clearly demonstrates the importance of including physical activity in support and empowerment programs for adolescents in orphanages and highlights the need to design and implement such programs.

This finding is consistent with previous research. Based on the findings of various studies, aerobic exercise has been recognized as an effective intervention in improving mental health and reducing mental problems in different population groups. This has also been emphasized in the research of Bonanno (2004), Castro & Graham (2022), Coffey & Warren (2020), Dey & Beena Daliya (2019), Fredrickson et al. (2003), and Hidayah et al. (2023) that physical activities can reduce stress, improve mood, and enhance mental health. These results are also consistent with domestic research. For example, the study of Sabzevari et al. (2019) showed that sports activities can affect the mental health of adolescents. Soufi & Behzadpoor (2020) also state that environmental support and physical exercise can improve mental health. Also, the findings of Sinaei et al. (2019) emphasize the positive effect of aerobic exercise on improving mental health. Therefore, the results of this study clearly support the positive effect of aerobic exercise on improving the mental health of adolescents in orphanages and are consistent with the findings of other studies.

The results of this study not only highlight the importance of aerobic exercise in improving the mental health and self-esteem of adolescents in foster care, but also clearly demonstrate the need to include these

activities in empowerment and psychological support programs for these vulnerable groups. The use of aerobic exercise as an effective intervention in foster care settings can significantly contribute to improving the mental health of these individuals and can be considered as an efficient tool in treatment and prevention programs to reduce mental problems in these adolescents.

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ORIGINAL ARTICLE

Psychometric Evaluation of the Mental Talent Identification Questionnaire in Athletes with Physical and Motor Disabilities

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ABSTRACT

purpose: This study aimed to assess the validity and reliability of the "Mental Talent Identification Questionnaire for Athletes with Disabilities.This descriptive, cross-sectional survey encompassed 367 athletes (194 women and 173 men) participating in the December 2024 Talent Identification Festival organized by the Sport Federation for the Disabled Persons. Exploratory factor analysis utilizing the principal components approach with varimax rotation was conducted to evaluate validity, and Cronbach's alpha coefficient was applied to ascertain reliability. The KMO index was 0.872, and Bartlett's test yielded a significant result demonstrating the appropriateness of the data for factor analysis. Preliminary exploratory factor analysis identified six components with eigenvalues exceeding one, together accounting for 55% of the total variance. Five principal variables (self-confidence, resilience, Goal Setting, competitive motivation, and commitment) were kept based on factor loadings and statistical criteria. The Cronbach's alpha coefficient for the complete questionnaire was 0.807, indicating satisfactory reliability of the instrument. The findings demonstrate that the Mental Talent Identification Questionnaire for Athletes with Disabilities exhibits suitable psychometric features and can function as a valid and reliable tool for evaluating mental factors pertinent to talent identification in this demographic.

Keywords: Self-confidence, Resilience, Goal Setting, Competitive motivation, Commitment

Introduction

Intense competitions to achieve podium finishes and win medals in global, Olympic, and Paralympic events, along with the exploitation of the cultural, social, economic, and political achievements of these successes, have led governments and sports institutions to invest in identifying and nurturing sports champions. Concurrently, with the increasing importance of competitive sports, sports sciences have facilitated the improvement of athletes' performance and assisted them in competitions. One of the important and influential areas of sports sciences that has played a significant role in enhancing performance levels and setting new records in recent years is sports psychology [1]. With the expansion of sports psychology knowledge, the importance of mental skills in the successful execution of sports skills has received more attention. It is clear that to achieve success in the realm of sports competitions, just as optimal physical readiness is essential, psychological readiness also holds a special place. Although in the past the main focus was on the physical preparation of athletes, today sports psychologists, coaches, and athletes emphasize the necessity of developing mental and psychological readiness as one of the key pillars of sports success [2]. In recent years, studies related to the sports of individuals with disabilities have seen significant growth. Much of this progress has been influenced by changing attitudes and new narratives about the concept of disability. In the past, the dominant view of disability was medical and individualistic; meaning that disability was defined as a problem or deficiency in an individual's body [3]. This approach considered individuals with disabilities as needing specialized intervention and treatment, thereby focusing on individual problems rather than examining social barriers. Since the 1980s, this individualistic perspective has been seriously criticized. Activists such as Oliver, Sapey, and Thomas [4], Oliver and Barnes [5], and Oliver [6] emphasized that the focus should shift from individual deficiencies to social structures and institutions; as it is these social structures that limit the full participation of individuals with disabilities by creating physical, cultural, and social barriers. The broader acceptance of the social model of disability has led to increased attention to the issue of access to sports opportunities for individuals with disabilities. Due to physical limitations and social barriers, individuals with disabilities are often deprived of a decent quality of life and the confidence to actively participate in society. However, these individuals can serve as positive role models, inspiring future generations and demonstrating the will, perseverance, and ability to achieve sporting goals. According to the World Health Organization report [7], about 15% of the world's population lives with some form of disability. Disability is defined as any limitation in fulfilling social roles, in accordance with the cultural and social conditions of each society [8]. Additionally, one of the common consequences of disability is a decreased willingness to participate socially and withdrawal from social activities [9]. Another very important and effective factor in the remarkable and stunning growth of athletes with physical-motor limitations is the timely and scientific identification of their sports talents. The effective and efficient talent identification methods play a significant role in modern sports activities, and countries that use these methods achieve more success in sports arenas than others [10]. Achieving success and superiority is a common goal in professional sports. For this, the personal effort of athletes is very important, but it is not enough. Experienced coaches, high-level teammates and competitors, and access to good sports facilities are other important factors in this path [11]. However, these resources are not available to everyone, and only top-tier and elite teams have access to such facilities. Therefore, the talent identification and selection process becomes important to decide which athletes have the chance to join these elite teams. The definition of "talent" is a highly debated topic in the world of sports. Some believe that talent is the current ability of an individual that places them in the top 10 percent of their age group [12]. Others view talent as the potential ability for future success. However, everyone agrees that talent is

something rare [11]. Discovering future sports stars has always been one of the main goals and motivations for researchers entering the field of sports talent identification. Nevertheless, research in this area faces numerous challenges and complexities [13]. Undoubtedly, overlooking some of the effective components in identifying talented individuals, although it does not completely prevent achieving success, does pose limitations and challenges to the talent identification process [14]. These components, which are considered the fundamental prerequisites of the talent identification process, are defined based on various dimensions such as anthropometric, skill, physiological, and psychological indicators [15]. In recent years, attention to the athletic abilities of individuals with disabilities, especially in identifying talents and providing opportunities for their participation in Paralympic competitions, has become one of the important priorities of international disability sports federations [16]. Given the increasing prevalence of sports among these individuals, there is a strong need to utilize credible and targeted research resources in the field of talent identification for individuals with disabilities [17]. Although various factors play a role in the process of sports talent identification, specialists and researchers in the field of youth and adolescent sports believe that the indicators of sports talent identification in this age group can be classified into four general categories: specialized characteristics related to the execution of sports skills, physiological characteristics, perceptual-cognitive abilities, and finally, the psychological characteristics of athletes. Among these, and specifically in the fourth group, the goal orientation of athletes can be utilized [18]. Identifying individuals' psychological capacities is a key factor in determining talent and predicting the success of elite athletes. Psychological variables are recognized as the main and influential components in the process of identifying and predicting sports talents in most sports talent identification models [19]. Sports psychologists categorize mental skills into three main groups: basic skills, psychomotor skills, and cognitive skills [17, 18]. Basic skills include goal setting, self-confidence, and commitment; these skills are the foundation of other mental skills, and until they are formed in an athlete in a stable and established manner, other skills cannot reach their desired level. The second group includes psychomotor skills, which encompass stress response, fear control, relaxation, and energization, and are primarily related to the athlete's physiological reactions and characteristics. The third group, known as cognitive skills, includes imagery, mental rehearsal, concentration, and similar skills; these skills are categorized in this group due to their direct connection with cognitive processes such as learning, perception, recall, and thinking [20]. For this purpose, considering standardized mental talent identification tests can play an effective role in identifying and nurturing sports talents [21]. Some mental traits play a decisive role in sports success, and athletes utilize these skills to achieve an optimal mental state. These traits include self-confidence, focus and attention, high commitment, goal orientation, resilience, having an optimistic attitude, optimism, constructive perfectionism, and competitive motivation [22]. One of the significant gaps in this area is the lack of localized indicators of mental skills for identifying sports talents in individuals with physical-motor disabilities; an issue that underscores the necessity of conducting specialized and targeted studies in this field. The establishment of effective talent identification systems not only increases competitiveness in attracting professional athletes but also strengthens their commitment to clubs and sports teams by reducing the rate of player turnover. Therefore, adopting management approaches that align with the needs of athletes and planning to enhance their psychological skills with the expertise of sports psychologists in clubs seems essential. Despite the significant importance of mental skills in the talent identification process, studies show that this issue has received less attention. Furthermore, no comprehensive research has been conducted on the introduction of psychological indicators effective in identifying

mental skills and their evaluation, especially in athletes with physical-motor disabilities across various sports disciplines. Accordingly, the question arises: what indicators and criteria should coaches and talent identification officials consider in the field of mental skills to identify talented athletes? Thus, the aim of this research was to examine and present the most important components of mental skills effective in the sports talent identification of athletes with physical-motor disabilities.

Methods

The present study was descriptive-cross-sectional and conducted with the aim of examining the factors related to mental talent identification in athletes with physical-motor disabilities.

Participants

Participants in the present study were all athletes who took part in the talent scouting festival of the Federation of the Disabled and Handicapped in December 2023 in Tehran, totaling 367 individuals, including 194 women and 173 men. Considering that the required sample size for factor analysis studies is suggested to be 10 to 15 respondents per questionnaire item (Klein, 2005, p.7), it can be said that the criterion has been well met. The average age of the participants in the present study was 17.87 years, with an age range of 15 to 26 years and an average sports experience of 2.5 years. The participants were engaged in 8 sports disciplines, with the majority in athletics (48.8%), sitting volleyball (17.2%), powerlifting (13.6%), basketball (8.2%), and other disciplines (shooting, archery, swimming, and arm wrestling) (20.4%).

Research tool

The data collection tool in this research was a researcher-developed questionnaire for identifying mental skills in athletes with physical disabilities. This questionnaire consisted of 22 items based on a five-point Likert scale (from strongly disagree = 0 to strongly agree = 4). To design the tool, a systematic review of the theoretical foundations, previous research, and specialized texts in sports psychology was conducted. Additionally, semi-structured interviews were held with several experts in the field of sports psychology, prominent coaches, and university faculty members. Participants in this stage were purposefully selected from among specialists with practical experience in sports talent identification, particularly for athletes with disabilities. Based on the collected information, an initial list of the most important psychological components affecting talent identification in athletes with disabilities was prepared. Subsequently, using qualitative content analysis techniques, the initial items were extracted and compiled. Items that had conceptual overlap or ambiguity were reviewed and refined through several stages, and ultimately, 22 final items were selected for the questionnaire. To assess face and content validity, the questionnaire was provided to six faculty members and sports psychology experts. The expert judgment method was used to revise the items. The specialized judges offered suggestions regarding clarity, conceptual appropriateness, and comprehensiveness of the items, which were reviewed and incorporated into the final version of the questionnaire. To measure reliability, a pilot study was conducted on a sample of 20 athletes with physical-motor disabilities. The initial analysis results showed that the Cronbach's alpha coefficient for the entire questionnaire was 0.807, indicating acceptable reliability and good internal consistency of the tool. According to international standards [19], a Cronbach's alpha coefficient above 0.7 is considered appropriate. The final questionnaire was designed in two sections: the first section included demographic

information such as age, gender, sports history, sports discipline, and activity level, and the second section included the main items related to the identification of mental skills.

Data collection method

For this purpose, the researchers were present at the location of the athletes participating in the talent identification festival at the Federation of Disabled and Handicapped. The mental skills talent identification questionnaires were randomly distributed among athletes with physical and motor limitations. The questionnaire was distributed among the research samples in two sections: personal details and the main section of the questionnaire (mental skills talent identification).

Data analysis method

In this research, exploratory factor analysis was used to analyze the data and examine the conceptual structure of the mental skills talent identification questionnaire. This method was employed to identify the underlying components and correlation patterns between the items. Factor analysis was conducted using the principal component method, and to simplify the interpretation of the factors, the Varimax orthogonal rotation was applied. Before conducting the factor analysis, the adequacy of the data and the suitability of the correlation matrix between the variables were evaluated to ensure the validity of the analysis method. To measure the internal consistency of the questionnaire, Cronbach's alpha coefficient was used, which is a common indicator for assessing the internal consistency of psychometric tools. Additionally, normality tests were conducted to examine the data distribution and determine the type of statistical tests needed in the subsequent stages. All statistical analyses were performed using SPSS software version 26.

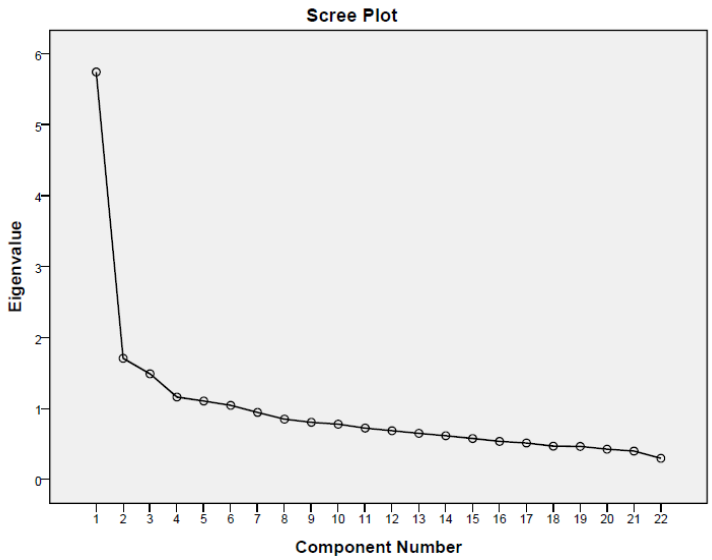

Figure 1 - Theoretical model of the questionnaire structure based on the Scree criterion along with the corresponding factor loadings and structural relationships with subscales

The KMO value and Bartlett's test were also significant at the 0.001 error level ($P < 0.001$). Items that loaded on a factor with a factor loading of 0.30 or higher were included. Table 1 shows the factor loadings of each item after Varimax rotation. In total, six factors had eigenvalues greater than one, explaining 55 percent of the total variance. Upon examining the factors, it was determined that questions 11 and 16 related to the sixth factor should be removed from the analysis due to having a factor loading of less than 0.30. With the removal of these questions, the number of items in the sixth factor dropped below 3, and therefore the sixth factor was also identified as a weak factor and removed, with its two questions being categorized into the second and fifth factors.

Table 1. Items related to each factor in the questionnaire for identifying the mental skills of athletes with physical disabilities

factor loading	Questions (Item)	factors
0.607	2	Factor1: self-confidence
0.480	7	
0.647	10	
0.754	17	
0.734	18	
0.573	22	
0.407	6	Factor2: resilience
0.702	14	
0.373	16	
0.506	19	
0.624	20	
0.696	21	
0.757	1	Factor3: Goal Setting
0.702	3	
0.644	4	
0.726	5	Factor4: competitive motivation
0.566	9	
0.358	12	
0.701	13	
0.748	8	Factor5: commitment
0.373	11	
0.741	15	

Self-confidence factor: This includes items (2, 7, 10, 17, 18, 22) and had the highest factor loading for these questions, with an eigenvalue of 5.745, explaining 26.1% of the total variance of the test.

Resilience factor: This factor includes items (6, 14, 16, 19, 20, 21) and had an eigenvalue of 1.708, explaining 7.7 percent of the total variance.

Goal-oriented factor: This factor includes items (1, 3, 4) and has an eigenvalue of 1.489, which explained 6.7% of the total variance.
Competitive motivation factor: This factor includes items (5, 9, 12, 13) and has an eigenvalue of 1.162, explaining 5.2 percent of the total variance.
Commitment factor: This factor includes items (8, 11, 15) and had an eigenvalue of 1.106, explaining 5.0 percent of the total variance.

Table 2. Percentage of the most important components of mental talent identification in athletes with physical-motor disabilities by sport and gender

Weighted Overall Average	Boys	Girls	Swimming	Arm Wrestling	Athletics	Archery	Basketball	Para Powerlifting	Shooting	Sitting Volleyball	Group
30.21	30.13	30.34	30.64	31.01	30.28	30.17	30.09	30.65	29.26	29.79	self-confidence
25.98	26.71	25.40	26.40	23.81	25.88	25.81	26.25	26.06	25.32	26.67	resilience
14.57	14.61	14.55	14.07	15.33	14.34	13.47	14.33	15.08	14.63	14.91	Goal Setting
18.34	18.25	18.45	18.69	19.16	18.77	19.17	17.90	17.59	17.44	17.88	competitive motivation
10.90	10.30	11.26	10.21	10.69	10.73	11.39	11.43	10.62	13.34	10.75	commitment

Discussion and Conclusion

The aim of the present study was to examine and present the most important components of mental skills effective in sports talent identification, specifically for athletes with physical-motor disabilities. For this purpose, the researchers sought to identify the psychological components related to sports talent identification in adolescents and young adults with physical limitations through factor analysis. The results of the study, based on exploratory factor analysis, showed that the psychological components were categorized into five main factors (self-confidence, resilience, goal orientation, competitive motivation, commitment), which explain the most important psychological indicators in sports talent identification. Overall, in the present study, these skills are considered as strategies to facilitate the process of mental talent identification and the effective recognition of athletes with physical-motor disabilities. According to the research background, mental skills play a role beyond physical readiness, technical abilities, or tactical understanding in sports success; because what distinguishes elite athletes from others are their psychological capabilities and competencies, which define the boundary between good performance and excellent performance. Certainly, currently, prominent and expert coaches in the field of talent identification, in addition to physical readiness, pay special attention to the mental and psychological readiness of players. The findings of the study by Prieto-Ayuso et al [13] also support the notion

that greater emphasis on psychological skills is necessary in talent identification models. Furthermore, these researchers believe that the process of sports talent identification should begin in school and thus welcome the replacement of modern talent identification models during childhood and adolescence. Considering the modern methods of athlete preparation and the decreasing chronological age of national and international champions in Paralympic competitions, various factors are effective in the psychological talent identification process. These factors include the living environment [15], sports background, athletes' gender, type and nature of the sport [17], and the level of physical ability. These variables, along with psychological characteristics, must be simultaneously considered to ensure a comprehensive and effective talent identification process for individuals with physical limitations. Based on the research findings, it can be concluded that all the indicators mentioned in the psychological talent identification process are important, and other factors along with their interactive effects can also play a significant role in this area. The role of psychological factors in athletes' performance is no less than physical-motor abilities. Therefore, sports psychology is considered not only for enhancing performance and success in competitions but also as a tool for mental talent identification in sports. Accordingly, the results of the present study on the importance of the key components related to talent identification and the improvement of performance and success levels of athletes in eight sports (sitting volleyball, shooting, para-weightlifting, basketball, archery, athletics, arm wrestling, and swimming) showed that the first component, self-confidence, is more prevalent among arm wrestlers and in girls than in boys. Thus, it can be concluded that self-confidence holds a significant place in this sport, and girls possess more self-confidence in arm wrestling compared to boys. The second component, resilience in sitting volleyball among boys, has been identified as an important factor, and it can be inferred that among the eight sports examined, sitting volleyball boys have shown greater resilience; thus, resilience can be a crucial factor for success in this sport. The third component identified was goal orientation, where boys in arm wrestling exhibited higher levels of goal orientation in this study. It can be concluded that for mental talent identification in arm wrestling, goal orientation should be prioritized among the athletes' mental characteristics. The competitive motivation component also received high scores from shooting athletes, similar to goal orientation, indicating the importance of competitive motivation among talented athletes, especially girls, who scored higher than boys. The final component, commitment, received the highest score from the group of female shooters. Therefore, it can be concluded that commitment is one of the important factors in identifying talented individuals in this sport for success. In the overall conclusion of the present study, it can be stated that, based on the weighted average, self-confidence, resilience, competitive motivation, goal orientation, and commitment are respectively the most important factors in identifying talented athletes with physical-motor limitations. In girls, self-confidence and competitive motivation, and in boys, resilience, goal orientation, and commitment are identified as important factors in the mental talent identification of these athletes. Therefore, coaches and talent scouts can identify individuals with the aforementioned indicators in the talent identification process, and this criterion will serve as a suitable guide and instruction for improving the talent identification process. Additionally, the overall results align with the exploratory factor analysis and the identification of five effective factors in mental talent identification, consistent with the findings of the studies [17, 20, 22]. Therefore, it can be concluded that the efforts made in examining the most important components affecting the mental talent identification of athletes with physical-motor disabilities have been fruitful. This questionnaire, considering its implementation method and ease of scoring—which are the most important practical aspects of the test—serves as a useful and valid tool. It can assess the mental talents of athletes with limitations within the socio-cultural context of Iran, making it a reliable and credible instrument for

various sports disciplines. Finally, given that the data obtained from this research were examined in the age group of 15 to 26 years with an average sports experience of 2.5 years, generalizing this research to other age groups and levels requires careful consideration. Therefore, it is suggested that to generalize the findings of this research, athletes at different age and skill levels should be studied separately, as the talent identification process according to the dynamic model changes over time and requires continuous evaluation.

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ORIGINAL ARTICLE

Comparison of Two Exercise Protocols on Gait Speed in Older Adults with Locomotive Syndrome

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Abstract: Locomotive Syndrome (LS) is a prevalent condition among older adults, characterized by reduced mobility and associated with musculoskeletal disorders such as osteoporosis and osteoarthritis. It significantly impacts the quality of life and increases the risk of falls, fractures, and functional decline. This study aimed to compare the effectiveness of two exercise programs, Vivifrail and Locotra, on improving walking speed in elderly individuals with LS. Thirty elderly women aged 65 and older from the Ranginkamanesepid Day Care Center in Isfahan, Iran, participated in this randomized controlled trial, divided into two groups for an eight-week intervention, conducted three times a week. The primary outcome was the 6-meter walking time test, measured before and after the intervention. Both exercise programs demonstrated improvements in walking speed post-intervention; however, no statistically significant difference was found between the two groups. The Vivifrail group had a mean walking time post-test, while the Locotra group also showed improvement. The effect sizes indicated that both programs were effective but did not significantly outperform each other. Both Vivifrail and Locotra exercise programs are beneficial for enhancing walking speed in elderly individuals with LS, and given the lack of significant differences between the two interventions, healthcare providers may consider either program as a viable option for improving mobility in this population. Further research is needed to explore long-term outcomes and the impact of these programs on overall quality of life.

Keywords: Locomotive Syndrome, Elderly, Walking Speed, Vivifrail, Locotra.

Introduction

Inability to perform motor activities such as walking or maintaining balance can be the first sign of a common disorder in older adults, which is associated with decreased muscle function and mobility abilities(Cruz-Jentoft et al., 2018; Koivunen et al., 2020).Locomotive Syndrome(LS) is a condition primarily affecting older adults, characterized by reduced mobility and commonly associated with issues like osteoporosis, low back pain, knee osteoarthritis, and lumbar spinal canal stenosis, aimed at facilitating early intervention for at-risk individuals(Akahane et al., 2019).This syndrome arises from damage to parts of the locomotor system, such as bones, joints, or muscles, and can lead to disturbances in the motor activities of older adults(Akahane et al., 2019).The occurrence of musculoskeletal disorders can lead to weakness in walking ability, an increased risk of falls, bone fractures, persistent pain, and a decrease in physical activity levels among the elderly(Park & Lee, 2020).Approximately 30% of older adults are affected by this syndrome, resulting in limitations in daily activities and a reduced quality of life(Nakamura & Ogata, 2016).Decreased muscle mass and increased body fat are significant factors contributing to the development of LS in older adults(Ahangari et al., 2024).In epidemiological studies, walking speed is used as a key indicator for assessing individual performance and is recognized as a valid predictor of mortality and functional decline(Brach et al., 2002; Elbaz et al., 2013; Studenski et al., 2011).Previous reports have shown that walking speed, as a simple and reliable indicator, can predict the survival of older adults(Studenski et al., 2011). This research indicates that higher walking speeds are significantly associated with increased longevity, suggesting that measuring walking speed can be an effective method for assessing health status and making care decisions for the elderly(Studenski et al., 2011).A decrease in physical activity levels, accompanied by increased sedentary behaviors such as prolonged television watching and continuous sitting, exacerbates the risks associated with reduced mobility in the middle-aged and elderly population(DiPietro et al., 2018).A sedentary lifestyle is associated with decreased physical performance, including reduced walking speed and diminished performance in complex daily activities (Gilchrist et al., 2022).It has been shown that moderate-intensity physical activity (equivalent to ≥3.0 METs) is significantly associated with a reduced risk of developing LS in community-dwelling older women(Ishihara et al., 2022).The Locotra exercise program is designed to enhance and maintain standing and walking abilities in older adults and includes safe exercises that can be performed at home, such as squats and single-leg standing with eyes open(Nakamura & Ogata, 2016).Research has indicated that this program helps reduce the symptoms of LS by improving balance, coordination, and increasing muscle strength(Kikuchi et al., 2020).On the other hand, the Vivifrail program offers exercises aimed at enhancing physical capacity and overall health in frail older adults, which includes strength, balance, flexibility, and endurance exercises(Sánchez-Sánchez et al., 2022).Reports indicate that this program, as an effective and safe method, improves the physical capabilities of older adults suffering from frailty or pre-frailty(Casas-Herrero et al., 2022).Despite the reported positive effects of various exercise programs on improving the motor capacities of older adults, there is conflicting evidence regarding the direct comparison of the effectiveness of these programs in individuals with LS.Previous studies have primarily focused on evaluating a single type of intervention or a general elderly population, while the impact of multiple interventions in at-risk populations, especially older adults with LS, has been less explored. Furthermore,

the differences in the nature of the exercises in the Vivifrail and Locotra programs underscore the importance of comparing these two approaches to determine a more effective intervention for improving walking speed and enhancing functional independence in this group, thereby increasing the significance of the comparison. Therefore, the present study is designed and conducted to compare the effects of eight weeks of Vivifral vs Locotra exercises on the walking speed of older adults with LS. This research can help identify optimal exercise methods for older adults facing mobility issues and lead to improvements in their quality of life. By thoroughly examining these two programs, we can gain a better understanding of the needs and challenges faced by these individuals and provide effective support strategies.

Methods and Materials

This study was conducted on 50 elderly individuals from the Ranginkamanesepid Day Care Center in Isfahan, Iran. Among these individuals, 30 participants aged 65 years and older who met the required criteria were purposefully selected. After attending an introductory session and receiving complete information about the study, they expressed their willingness to participate by signing an informed consent form. The necessary sample size was determined using G Power software version 3.1.0, based on an analysis of variance with a significance level of 5% ($\alpha = 0.05$), a power of 80% ($\beta = 0.2$), and a large effect size ($d = 0.6$). Participants were randomly divided into two groups: the Vivifrail group (15 individuals) and the Locoyra group (15 individuals). The inclusion criteria for the study consisted of elderly women aged 65 years or older, without significant physical or cognitive limitations that would hinder their ability to perform exercise, and who scored one or more on the Loco-chek questionnaire. Additionally, participation in the study required the completion and signing of an informed consent form. Conversely, the exclusion criteria included voluntary withdrawal from the exercise program, inability to continue exercises, absence from three consecutive sessions or a total of eight training sessions, and lack of cooperation in pre-test and post-test assessments. The research commenced with obtaining the necessary permissions and an introductory letter from the General Directorate of Welfare of Isfahan Province. Coordination meetings were held with the management of the Ranginkamanesepid Day Care Center to ensure the safety of the elderly and to review the required training. Eligible individuals were identified, and a comprehensive orientation session was conducted to explain the exercise programs, benefits, risks, and proper execution of the exercises. Participants were asked to refrain from engaging in other exercise programs during the intervention to avoid any conflicting effects. They were also assured that their personal information would remain confidential and would only be reported in aggregate form. Participants could withdraw from the study at any time. After approval from the management, the Loco-chek questionnaire was administered as a criterion for entering the exercise protocols. A demographic questionnaire was provided to all participants, and for those with low literacy, the questionnaires were completed through interviews. Following this, the 6-meter walking time test was conducted(Sadeghi Mahali et al., 2019). The exercise phase lasted for eight weeks, with three sessions per week held in the gym of the Ranginkamanesepid Day Care Center. The post-test for the 6-meter walking time test was conducted after the exercise phase, and interviews were also conducted for participants with low literacy. The multidimensional exercise protocol of Vivifrail was designed to improve physical performance and reduce the risk of falls in the elderly. Participants were

divided into four groups based on their scores from functional tests (SPPB, TUG, and 6MWTT) and cognitive assessments: weak (scores 0 to 3), pre-weak (4 to 6), at risk (7 to 9), and healthy (10 to 12). Individuals with cognitive impairments and at risk of falling received specialized training. Training sessions for each group were supervised by a coach and conducted three times a week for 45 to 60 minutes over eight weeks. Participants received a translated manual, and coaches utilized the Vivifrail training app for greater accuracy. The exercises included strength training, cardiovascular activities, balance exercises, and flexibility training, with the training load adjusted based on individual capacity. Additionally, the Locotra protocol, proposed by the Japanese Orthopedic Association, was designed to improve and manage symptoms of movement syndrome. This program included two main exercises: standing on one leg and squats, along with two supplementary exercises: calf raises and forward lunges, as well as exercises to strengthen the quadriceps and hamstrings. These exercises were conducted three times a week for eight weeks under the supervision of a coach. Each session included 15 minutes of warm-up, 20 minutes of main exercises, and 10 minutes of cool-down, totaling 60 minutes. The collected data were analyzed at both descriptive and inferential levels. Descriptive statistics included means and standard deviations. At the inferential level, analysis of variance was used to compare the effects of the Vivifrail exercise program and Locotra exercises, controlling for the initial scores of these variables (pre-test). The underlying assumptions of the model, including the normality of error distribution, homogeneity of variance, and homogeneity of regression slopes, were examined and confirmed. Independent t-tests were conducted to compare the individual characteristics of the elderly in both groups, considering the normality of data distribution. All tests were performed at a 5% error level using version 27 of SPSS software.

Results

In this study, a total of 26 elderly individuals with LS (14 in the Vivifrail group and 12 in the Locotra group) were examined, with a mean age of 71.86 years (ranging from 65 to 85 years). The mean and standard deviation of age, height, weight, and body mass index (BMI) of the elderly participants in both groups are presented in Table 1. To assess the normality of the distribution of anthropometric data, the Shapiro-Wilk test was used. If normality was confirmed ($p > 0.05$), an independent t-test was employed to compare quantitative variables between the two groups. A significance level of less than 0.05 was considered for all analyses. The results of the independent t-test indicated that there were no significant differences between the two groups in terms of age ($p = 0.191$), height ($p = 0.114$), weight ($p = 0.975$), and body mass index ($p = 0.422$). These results suggest that the initial anthropometric characteristics of the participants in both exercise groups were homogeneous and comparable.

Table 1: Comparison of Individual Characteristics of Participants in Two Groups

Variable	Group	Number	Mean	Standard Deviation	Test Criterion	p-value
Age (years)	Vivifaril	14	73.14	6.50	t=1.344 [a]	.191
	Locotra	12	70.00	5.20		
Height (centimeters)	Vivifaril	14	151.57	5.98	t=-1.641 [a]	.114
	Locotra	12	155.50	6.20		
Weight (kilograms)	Vivifaril	14	66.36	12.92	t=-.031 [a]	.975
	Locotra	12	66.50	9.71		
BMI (kilograms per square meter)	Vivifaril	14	29.03	6.48	t=0.817 [a]	.422
	Locotra	12	27.38	2.84		

Calculated Based on the Independent t-Test

With analysis of covariance and after controlling for the effects of pre-test scores, no significant difference in 6-meter walking time test was observed between the two exercise groups ($p=0.719$, $\eta^2=0.006$). The mean time taken to cover the specified distance (6 meters) improved in both groups after the intervention period; however, the difference between the Vivifrail exercise group and the Locotra exercise group was not statistically significant. This finding indicates that both training programs were somewhat effective in improving walking speed, but neither had a significant advantage over the other.

Table 2: Mean and Standard Deviation of 6-Meter Walking Time Test for Elderly Individuals in Two Groups: Vivifrail Exercises and Locotra Exercises

Index	Test Stage	Vivifrail		Locotra		Analysis of Covariance	
		Mean	Standard Deviation	Mean	Standard Deviation	Pre-Test Effect	Group Effect
6-meter walking time test	Pre-Test	14.06	4.40	10.25	3.41	$p<0.001$ $\eta^2=$ 0.745	$p=0.719$ $\eta^2 =$ 0/006
	Post-Test	11.25	3.28	8.21	3.42		
	Adjusted Post-Test	9.97	1.82	9.70	1.84		

By controlling for the effect of the pre-test.

Discussion

The findings of this study provide valuable insights into the effectiveness of exercise interventions for improving walking speed in older adults with LS. Both the Vivifrail and Locotra programs demonstrated improvements in walking speed; however, no significant difference was observed between the two

interventions. This aligns with previous research indicating that structured exercise can enhance mobility and functional independence in older populations(Brandão et al., 2018; Haripriya et al., 2018) .

Physical activity is crucial for maintaining and improving muscle function, balance, and overall mobility in older adults(Billot et al., 2020; Paterson et al., 2007). Regular exercise has been shown to mitigate the decline in physical performance associated with aging, thereby reducing the risk of falls and enhancing quality of life(Dipietro et al., 2019; Ikegami et al., 2019). The current study reinforces these findings by demonstrating that both intervention programs effectively improved walking speed, a key indicator of functional ability and overall health status in older adults(Chou et al., 2012; Purser et al., 2005).

The lack of significant differences between the Vivifrail and Locotra programs suggests that both approaches can be beneficial for elderly individuals with LS(Casas-Herrero et al., 2022; Kikuchi et al., 2020; Nakamura & Ogata, 2016). Previous studies have highlighted the effectiveness of multi-faceted exercise programs that incorporate strength, balance, and flexibility training(Gangwar; Lauersen & Andersen, 2017). The Vivifrail program, which emphasizes a multidimensional approach, may offer comprehensive benefits that address various aspects of physical decline(Casas-Herrero et al., 2019; Izquierdo, 2019). Conversely, the focuses on specific exercises aimed at improving core mobility and strength, which are also critical for enhancing walking speed(Ikemoto & Arai, 2018).

Despite the positive outcomes observed in both groups, the absence of a statistically significant difference raises questions about the comparative effectiveness of these programs(Izquierdo et al., 2025). Future research should explore larger sample sizes and longer intervention durations to better assess the long-term impacts of these exercise regimens on mobility and overall health(Yang et al., 2022). Moreover, investigating the specific components of each program that contribute to improvements in walking speed could provide deeper insights into optimizing exercise interventions for older adults with(Xu et al., 2023).

The study also highlights the detrimental effects of a sedentary lifestyle on mobility in older adults(Martins et al., 2021). Increased sedentary behavior, such as prolonged sitting and reduced physical activity, has been linked to declines in muscle strength and walking speed (Felipe et al., 2023). Addressing sedentary behavior through structured exercise programs may be essential for enhancing mobility and preventing the onset of LS in at-risk populations(Fanning et al., 2022; Jiang et al., 2022).

Conclusion

This study highlights the effectiveness of both the Vivifrail and Locotra exercise programs in improving walking speed among elderly individuals with Locomotive Syndrome (LS). While no significant differences were found between the two interventions, both programs effectively enhanced mobility and functional independence.

The results underscore the importance of regular physical activity in mitigating age-related decline and improving the quality of life for older adults. Future research should focus on long-term effects and broader health outcomes to further support tailored exercise interventions for this population.

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COMMENTARY ARTICLE

Informed Team Managers, Effective and Efficient Decision-Making: The Role of Psychology in the Management of Para-Sport Teams

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ABSTRACT: Athletes with disabilities navigate a landscape of unique challenges: limited infrastructure, scarce resources, financial uncertainty, and pervasive social barriers, all alongside the physical and mental demands of elite sport. These pressures can heighten vulnerability to burnout, anxiety, depression, and other psychological risks. Yet, narratives reveal remarkable resilience, determination, and adaptive coping strategies that emerge through lived experience. This paper highlights the critical role of managers, coaches, and technical staff in shaping environments that sustain mental health and performance. By leveraging emotional intelligence, participatory decision-making, ethical reasoning, and cognitive management during crises, leaders can foster cohesion, motivation, and psychological safety. We advocate embedding structured psychological-care protocols within managerial practices, supported by interdisciplinary collaboration with sport psychologists. Synthesizing empirical findings and first-hand accounts, this study presents actionable strategies for optimizing both competitive success and quality of life, emphasizing that holistic, informed management is pivotal to empowering elite athletes with disabilities while safeguarding their well-being.

Keywords: Informed-Managers, Decision-Making, Psychology, Sports Teams, Athlete, Disabilities

EDITOR'S NOTE

Asian sports teams are currently preparing for the forthcoming Asian Youth Games in Bahrain and the Islamic Solidarity Games in Riadh. For adolescent and youth athletes, sustaining physical fitness, maintaining psychological resilience, and high-level performing in competitions represent considerable challenges. So, it is imperative that team managers and coaches adhere to guidelines that not only safeguard athletes' mental health but also foster the enhancement of their athletic performance. In line with this perspective, the present article has been developed by two psychologists with extensive professional experience in working with young athletes.

Introduction

Over recent decades, sport for individuals with disabilities has attracted growing attention not only as a specialized domain within the sport sciences but also as a vital arena for personal transformation, improved quality of life, social identity, and self-efficacy. Above all, it inspires the broader public. Socially, athletes with disabilities are often confronted with pitying attitudes or negative stereotypes that can undermine their self-image and self-esteem; however, participation in national and international competitions provides opportunities to challenge such views by showcasing competence and offering positive role models to society.

The lived experiences of professional athletes with disabilities in Iran and across the world show that the path to elite performance is interwoven with intensified effort and with physical, psychological, and social challenges alongside the need to overcome barriers in personal life. Crucially, elite disability sport is not only a field of competition; it is also a platform for redefining ability and building an identity independent of physical limitations.

Narratives and interviews indicate that infrastructural constraints, a shortage of specialized equipment, limited access to standard facilities, and insufficient, sustained financial support are among the principal challenges in disability sport. Nevertheless, the accounts of athletes with disabilities do not merely list problems: they spotlight determination, resilience, mental toughness, and motivation forged through personal and social experience. These psychological attributes are not easily acquired and are not invariably stable; under the pressure and strain of competitive sport, they may fluctuate.

Researchers and professionals in mental health and sport psychology contend that high-level competitive sport may reduce mental well-being and increase symptoms of depression, anxiety, and burnout particularly among athletes with disabilities. As sport psychologists and mental skills coaches with years of experience providing counseling services to professional athletes as well as athletes with disabilities at high competitive levels, we have observed that these athletes, in addition to enduring physical pain (including pain associated with limb loss or impairment, mobility restrictions, sport-related injuries during training and competition, reduced physical capacity due to overtraining, and so forth), may also be exposed to various environmental stressors. Such stressors may include being cut or excluded from the team, non-renewal of contracts, lack of formal insurance and stable income, occupational and livelihood difficulties, experiencing defeat, consequences of unhealthy weight gain or loss, unfair officiating, repercussions of match-fixing or related misconduct in sport, discrimination within the team, unfulfilled promises by managers, family problems, emotional relationship breakdowns, incidents of violence or abuse in sport (including exploitation, verbal aggression, or online harassment), media pressure, and lack of support from certain managers and coaches during times of challenge, among others.

Experiencing these issues can precipitate mental-health outcomes and psychology-related challenges, including cognitive fatigue and burnout; mood disturbance; state or trait anxiety; depression; aggression; rumination; sleep disorders; psychological effects related to the use of medication; mental-health concerns around athletic retirement; and eating disorders and feeding-related conditions (avoidant/restrictive food intake disorder; anorexia nervosa; binge-eating disorder; bulimia nervosa). Potential acute or chronic psychopathology may also emerge, such as disruptive mood dysregulation disorder (DDMD); major

depressive disorder (MDD) and persistent depressive disorder (PDD); anxiety disorders (including specific phobias for example, fear of flying generalized anxiety disorder (GAD), and agoraphobia); obsessive compulsive disorder (OCD); trauma- and stressor-related disorders (reactive attachment disorder (RAD), post-traumatic stress disorder (PTSD), acute stress disorder (ASD), adjustment disorders); neurocognitive disorders (NCDs); and somatic symptom and related disorders (illness anxiety disorder, factitious disorder, and others).

Reports indicate that countries which have succeeded in effective policy-making and the creation of multilayered support networks including managers, technical staff, sport psychologists, and athletes trained in disability sport have both protected the mental health of athletes and achieved greater competitive success. Studying the particular conditions of athletes with disabilities alongside empirical findings can yield strategies that not only elevate performance but also improve quality of life, mental health, and the social status of these champions.

In addition to the individual efforts of athletes, the roles of technical staff, team managers, federation officials, and Chefs de Mission are vital in enhancing the mental health and psychological welfare of athletes with disabilities. Research demonstrates that supportive conduct, effective communication, and tension management in training and competition settings directly influence performance and motivation. Informed managers and trained coaches can build safe, motivating, and discrimination-free environments in which athletes feel valued, secure, and a strong sense of belonging.

Accordingly, embedding psychological-care protocols within the codes of conduct for managers, Chefs de Mission, federations, and technical staff as an inseparable component of athlete preparation is essential. From an interdisciplinary sport-psychology perspective, this paper offers a comprehensive picture of the lived realities of athletes with disabilities and proposes practical strategies for more effective support.

Key Considerations for Supervisors and Managers of Disability Sports Teams in Competitive Events

Professional mindset

A team manager by detecting cues, interpreting meaning, linking variables, and forecasting trajectories and likely outcomes can, with the support of sport psychologists, prepare themselves and others for decision-making under pressure through (pre-competition) psychoeducational sessions, crisis simulations, and rehearsals of likely scenarios. In crises, the mind defaults to familiar templates; prior simulation of comparable situations increases the speed and effectiveness of the response. Illustrative scenarios include: “injury to the star player or team captain,” “player conflicts”, “schedule changes”, “transportation delays and missed connections,” or “inadequate nutrition at the host venue.”

From Control to Coordination- “The Manager as a Cognitive Regulator within the Team”

The role of a manager during competition extends beyond controlling and commanding. Their core value lies in cognitive coordination: sensing the psychological state of the delegation and teams, intervening at tense moments, sustaining collective focus on the primary goal, and fostering team cohesion.

Cognitive Management under Crisis Conditions

Decision-making under pressure is influenced by psychological factors such as anxiety, cognitive bias, mental fatigue, and social pressure. Human judgment relies on two systems: (1) a fast, heuristic system efficient under urgency yet error-prone; and (2) a slow, analytic system deliberative but time and attention-intensive. Seasoned managers train to recognize when to deploy "prepared mental models" and "decision-making checklists" so as to minimize human error in critical moments.

Emotional intelligence (EQ) of managers in sport

EQ is foundational to self-management and, in turn, to guiding a team by cultivating empathy and interaction in a safe, low-conflict environment. Leveraging and developing EQ helps managers adapt under adversity and decide with greater confidence to obtain better outcomes.

***Self-awareness:** The most important element of EQ is self-awareness. Managers with emotional self-awareness by recognizing their emotions and their strengths and limitations across contexts are less likely to escalate tension (e.g., raising one's voice or displaying inappropriate conduct) and are better able to cope with crises. Self-awareness functions as self-regulation; it calms operational staff and, especially before competition, steadies coaches and athletes so they can think and perform optimally.

Crisis and ethical decision-making

In international arenas, many decisions are not merely technical or operational; some are fundamentally ethical. For instance: Should an injured athlete be allowed to return to play? Here, values-based management matters. Consistent with ethical frameworks in psychology, the process involves recognizing the moral issue, moral judgment, moral motivation, and moral action. Informed managers make decisions that protect athletes' physical and psychological health and long-term futures while preserving national dignity.

Engaging a sport-psychology consultant

Because the mind influences all performance, professional managers worldwide consult domain specialists; psychology is one such domain. As a professional manager, maintain ongoing collaboration with competent, experienced sport psychologists (They are introduced through relevant legal authorities and are licensed by the Psychology and Counseling System Organization of that country and qualified to work professionally in sports by the Specialized Psychology Center of that sports organization), With strict confidentiality and ethical commitment, they can monitor team psychological status and mental readiness and also support managerial decision-making.

Participatory decision-making

A professional manager is not the sole decision-maker, They create a calm, safe space where relevant experts middle managers, technical staff, coaches, psychologists, medical staff, and athletes (or their designated representatives) can contribute and brainstorm. This participatory style reduces cognitive error,

strengthens belonging, and enhances motivational alignment toward the delegation's shared goals. Even in defeat, the team becomes more cohesive and developmentally stronger.

Managing external pressures

Hidden yet influential forces outside the team include media, federations, families, expectations, and public opinion. Given the particular psychological considerations for athletes with disabilities, the sensitivity is heightened. A professional manager observes the following:

(a) Maintain personal and team composure.
(b) Provide media-literacy skills training across the delegation as a preventive mental-health measure.
(c) Preempt rumor formation by timely, accurate, and appropriate communication within teams during incidents.
(d) Distinguish data from interpretation: Is the information accurate, or someone's inference?
(e) Use a delay principle: the quicker a decision is made under intense pressure, the greater the likelihood of error.
(f) Ensure intra-team transparency: if the team does not know why a decision was made, trust erodes.

The manager's mind and important decision-making

Foresighted managers build mental templates for critical moments and ask themselves:

(a) If a coach or manager under pressure speaks or decides poorly, how will I help them recover?
(b) If a key athlete with a disability is suddenly injured, what is my plan?
(c) If unforeseeable external problems arise, what is my first step?
(d) If two athletes conflict, which conflict-resolution model will I deploy?

***Having a mental checklist and fallback strategies is a reliable path from confusion to efficient, effective management.**

Decision Map

Designing a decision map (mental or visual map) of decision processes for high-pressure situations helps managers avoid hasty, emotion-driven choices. Before competition begins, draft a decision map for each domain (disciplinary, psychological, medical, etc.), specify who is responsible at each step, and define intervention thresholds and timing.

Reframing

Changing the angle of view on a crisis re-describing the problem in simple yet realistic terms—reduces stress and facilitates solution-finding. Under crisis, the mind can catastrophize. Reframing normalizes the issue, restores cognitive resources, and rebuilds confidence. In practice, restate the message without loaded words. Instead of "We no longer have a chance," say "It just got harder, but a path may still exist." Instead

of “That was our last hope,” say “It was one option, not all of them; we still have alternatives.” Whether written or spoken, reframing reduces tension for you and your team.

Emotional Management

Insert a brief pause to regulate heightened affect prior to key decisions. Elevated, unchecked emotion (anger, fear, stress, even excessive elation) impairs working memory and rational evaluation. In acute moments, take 60–90 seconds of deliberate silence to recentre attention (attention reset), practice deep breathing, and ask: “What are the aim and consequences of this decision?” Then decide.

Problem-solving: from “why” to “what/how”

In the wake of an event (minor or major) professional managers shift from assigning blame (“why”) to constructing solutions (“what” and “how”) and invite others to do the same. This prevents magnification of issues and protects individual and collective performance. For example: “What is the best next action right now?”, “What resources can compensate or stabilise the situation?”, “How exactly will we solve this?”

The role of creativity in crisis situations

A professional manager may use a brief, shared team mantra (aligned with team goals) to foster empathy, cohesion, and cognitive control during crises. Examples include: “Whatever happens, we are together,” “We are one team,” “We move forward together,” “We came together, we return together,” “Wins and losses are on me—focus on your job on the field,” “I will handle the outside noise—stay on task.” If, for any reason, words might inflame tension, silence can be the better tactic of a professional manager.

Conclusion

Success among elite athletes with disabilities emerges from a complex, systemic interaction among individual capabilities, technical and psychological support, and strategic management. Informed, effective management by coaches and team leaders is fundamental to building supportive structures and strengthening psychological resilience and optimal performance. Especially in high-stakes, multidimensional events such as the Paralympic Games, team managers and Chefs de Mission require comprehensive situational awareness, high emotional intelligence, and mental-management skills. These capacities enable timely identification and regulation of environmental, psychological, and social variables that shape performance and help prevent coordination breakdowns and motivational decline.

Crisis decision-making must rest on scientific frameworks and rehearsal through simulation to reduce cognitive biases and to increase the precision and speed of responses. Continuous collaboration among managers, sport psychologists, and technical staff creates targeted mental-support systems that guard against psychological harm. At a broader level, national and international sport authorities must recognise the importance of sustained investment in psychological, educational, and managerial infrastructures across delegations. Such an integrated, interdisciplinary approach underpins durable sporting success, athlete mental health, and the international standing of nations.

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