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REVIEW ARTICLE

The effect of Pilates exercises on functional movement screening: A systematic review

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Abstract

The objective of this systematic review was to examine the effects of the Pilates method on the results of functional movement analysis in sedentary individuals and athletes. The research was conducted by searching peer-reviewed scientific journals in the Web of Science (WOS), PubMed, and Scopus databases, employing the PICO criteria typically utilized for systematic reviews and meta-analyses. A total of 5,313 articles were identified based on the keywords. Following a review of the titles and abstracts of the identified studies (n = 3216), 1353 studies were excluded due to their overlap with other studies. Following a further review of 474 eligible studies, 466 articles not applicable to the topic, eight articles related to Pilates and functional movement screening were identified for inclusion in this study. A comprehensive examination of the included studies revealed that the Pilates method, when administered for duration of either four or 15 weeks, resulted in enhancements in certain sports parameters and functional movement screening scores. These findings suggest that the Pilates method may help to reduce the risk of injury. A review of the literature revealed that Pilates methods can be employed to mitigate the adverse effects of a sedentary lifestyle and muscle loss associated with aging. Moreover, the regular practice of Pilates has been demonstrated to positively impact the physical health and performance of athletes, while also reducing the risk of injury. In light of these findings, it can be recommended that Pilates be included in the training programs of athletes by physiotherapists, trainers, and sports specialists.

Introduction

The Pilates method, developed by Joseph Hubertus Pilates, is based on the principle of Contrology, which aims to coordinate the balance of the body, mind, and spirit. Furthermore, this method is designed to enhance concentration, strength, and mobility (Pilates, 1998). The method trains the musculoskeletal system with versatile movements performed in various starting positions, which has been demonstrated to increase strength, endurance, flexibility, and neuromuscular coordination (Mętel et al., 2012). Pilates has been demonstrated to enhance flexibility, balance, stability, and core muscle strength, while also improving the control of movement (Muscolino & Cipriani, 2004; Park et al., 2016). The fundamental principles of Pilates can be distilled into six key elements: control, concentration, flow, breathing, precision, and centering (Muscolino & Cipriani, 2004). Pilates exercises are performed with the individual's body weight initially, followed by the use of equipment (De Siqueira Rodrigues et al., 2010; Loigerot & Adamany, 2004). Pilates has been demonstrated to have a beneficial impact on several physiological and physical fitness parameters. It is therefore important to prevent possible injuries by identifying any asymmetry and weaknesses in the individual and to reach the target in the least time (Perry & Koehle, 2013). Therefore, it aligns with the fundamental principles of functional movement. The primary objective of functional movement is to maintain equilibrium through the harmonious integration of mobility and balance during the execution of movement patterns (Mills et al., 2005). The basic components required to perform functional movement correctly are flexibility, endurance, strength, coordination, movement efficiency, and balance (Cook et al., 2006). The functional movement screening (FMS) test necessitates that the body exhibits the requisite posture and stability to accurately perform its fundamental movement patterns (Okada et al., 2011), in addition to the advancement of proprioception (body awareness) and balance in athletes (Cowen, 2010).

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The FMS test, as developed by Cook et al. (2006), comprises seven distinct movements: deep squatting, hurdle stepping, sequential lunge, shoulder mobility, push-ups, and active straight leg rising, and rotational stability. Each of the aforementioned movements is assigned a score between 0 and 3, with the highest possible score being 21. The scoring system utilized in FMS is as follows: "3: The movement is performed in its entirety without any discomfort." 2: The movement is performed in its entirety, yet the form is compromised, that is, if it is compensated for by the use of an alternative muscle group. 1: The desired form is not achieved, and the movement is not performed in its entirety. "The movement is unable to be performed due to the presence of pain." It has been demonstrated that athletes with a score below 14 points on the FMS test (Teyhen et al., 2012) are at an elevated risk of injury. The primary objective of the functional screening test is to identify deficiencies and the potential for injury. It is an accessible and cost-effective test battery (Perry & Koehle, 2013). A review of the literature reveals articles examining the effects of Pilates exercises on various health outcomes. These include physical fitness (Cancela et al., 2014), body composition (Aladro-Gonzalvo et al., 2012), balance (Barker et al., 2015), cardiovascular fitness (Pessôa et al., 2023), sleep quality (Chen et al., 2020), and sports performance (Yılmaz et al. 2023). İn addition, no review study has been identified that investigates the effects of Pilates on functional movement capacity. These two methods complement each other in enhancing individuals' physical performance. In this context, an in-depth examination of the synergy between FMS and Pilates can provide a novel perspective on movement assessment and improvement approaches, contributing to both theoretical knowledge and practical applications. Accordingly, the objective of this systematic review is to examine the impact of Pilates exercise on functional movement capacity in both sedentary individuals and athletes.

Methods

Objective

This study was conducted as a systematic review of articles published in peer-reviewed scientific journals across various platforms and databases. The objective of the study was to examine the effects of Pilates on functional movement.

Protocol and Registration

The systematic literature review by Moher et al. (2015) was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Figure 1).

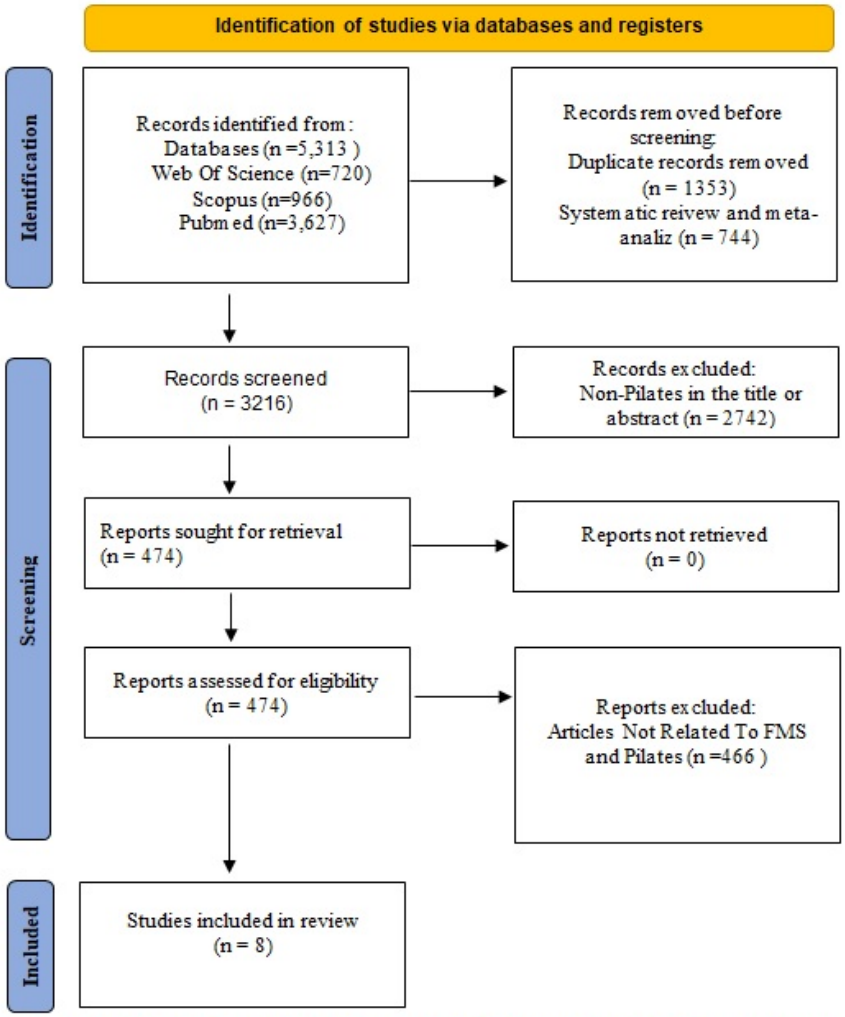

Figure 1. PRISMA flow diagram showing the identification and screening of the relevant study in the systematic review.

Eligibility Criteria

This study presents a systematic review of the extant peer-reviewed scientific literature investigating the effects of Pilates training on functional movement characteristics in individuals. The present review exclusively focused on studies that examined the impact

of Pilates-based interventions or training on functional movement performance, encompassing both functional and structural aspects within their research protocols. The review exclusively included experimental studies. No restrictions were imposed on the demographic characteristics (i.e., sex, age) or the nature of the movement activities assessed in the included articles. This study only included participants engaged in Pilates training programs.

Search Strategy

In this study, journal articles published between 01.01.2013 and 01.01.2025 were examined using the keywords "Pilates exercise", "Pilates training" and ''functional movement screen'' in databases such as Web of Science (WOS), PubMed, and Scopus to determine the effects of Pilates on the FMS test (Table 1). The reviewed articles were standardized to form the dataset of this study. The data were restricted to articles published in English and openly available in the databases, and they were analyzed by PRISMA screening. In the literature review, 5313 articles matching the keywords were identified. After excluding articles that did not meet the criteria, 474 articles out of 3216 were deemed eligible. Following a detailed examination, 8 articles were included in this study (Figure 1).

Data Extraction

The keywords "Pilates training," "Pilates exercise," and "Pilates and functional movement" were searched in the Scopus, WOS, and PubMed databases. All retrieved articles were imported into the EndNote software in RIS format and subsequently grouped. Duplicate records were removed, and the remaining articles were screened for eligibility based on their titles. Following this initial screening, the abstracts of the remaining articles were reviewed to identify studies relevant to the research topic. Finally, the full texts of the selected articles were thoroughly examined for comprehensive analysis and included in the systematic review.

Results

According to Table 2, it was observed that the Pilates method generally increased the FMS results. When comparing different modalities, including Mat Pilates, Reformer Pilates, and Yoga, the results did not reveal a significant difference among these methods. However, more improvement has been observed in mat Pilates than other exercises. This suggests that, regardless of the specific approach used, all three exercise forms provide similar benefits in terms of functional movement enhancement. The lack of a substantial difference may indicate that the fundamental principles shared by these methods—such as controlled movement, core engagement, and flexibility—are the primary contributors to the observed improvements. A more detailed breakdown of these findings, including possible explanations for the similarities and slight variations among the groups, is provided in Table 3 (the effect rates were calculated by the researcher).

Discussion

The objective of this study was to conduct a systematic review of the literature to examine the impact of Pilates exercises on the FMS test. Pilates is an exercise program that has been demonstrated to positively impact flexibility, balance, strength, and movement. The FMS test is a reliable test battery that is used to measure and evaluate the quality of movements (Cook et al., 2014).

Table 1
Search strategy for all databases.

Databases	Keywords	Search Strategy	Results
Web of Science	Pilates exercise	Free full text, English, from 2013-2025	494
	Pilates training		215
	Pilates and functional movement screen		11
Scopus	Pilates exercise	Free full text, English, from 2013-2025	584
	Pilates training		316
	Pilates and functional movement screen		66
PubMed	Pilates exercise	Free full text, English, from 2013-2025	371
	Pilates training		3232
	Pilates and functional movement screen		24

Table 2
Pre and post test results of individuals' FMS scores.

			FMS Test Score		
	Age		Pre	Post	Cohen's *d*
(Bastik & Cicioglu, 2021)	35.33±7.38	Mat Pilates (n =21)	13.90±2.84	16.90±2.76	-1.07
	35.40±7.56	Reformer Pilates (n = 20)	13.40±2.11	16.40±1.31	-1.70
	36.18±6.54	Control (n = 17)	12.47±2.45	12.18±2.46	0.11
(Lim & Park, 2019)	30-40	Pilates (n = 30)	10.36±2.27	12.43±2.13	-0.94
		Yoga (n = 30)	9.60±2.24	10.63±2.13	-0.47
		Control (n = 30)	9.63±2.19	9.30±1.95	0.15
(Ünver & Aras, 2023)	30.87±4.45	Reformer Pilates (n = 15)	12.27±2.05	15.80±1.86	-1.80
	31.13±4.27	Mat Pilates (n = 15)	11.80±2.76	16.67±2.29	0.05
	30.60±4.42	Control (n = 15)	11.47±3.09	11.33±3.24	0.04
(Schwartzkopf-Phifer et al., 2023)	23.20 (4.35)	NEATS (n = 17)	NA	NA	NA
	24.79 (7.05)	Mat Pilates (n = 19)	NA	NA	NA
(Lim et al., 2024)	21.00 ±0.82	Mat Pilates (n = 10)	9.60 ±1.58	16.50 ± 2.17	-3.63
	19.50 ±1.27	Yoga (n = 10)	9.00 ±1.41	15.40 ± 1.84	-3.90
(Šniurevičienė et al., 2022)	18.25 ± 0.45	Mat Pilates (n = 12)	12.58	13.92	NA
(Xi et al., 2014)	NA	Mat Pilates (not available)	16.22 ±1.10	19.00 ±1.05	-2.58
(Laws et al., 2017)	NA	Mat Pilates (n = 40)	13.4±2.4	17.0 ± 1.7	-1.73

The impact of Pilates on the FMS test (FMS) was assessed, revealing that the holistic Pilates approach and the incorporation of control-based movements were instrumental in enhancing the quality of functional movements. The articles included in this review demonstrated that Pilates resulted in a notable improvement in FMS test scores. Laws et al. (2017) conducted a study on 40 runners and found that six weeks of clinical Pilates significantly enhanced FMS.

A study compared the effects of mat Pilates and NEATS (Novel Experimental Approach to Trunk Stability) training on FMS. No significant difference was observed between the Pilates and NEATS groups on FMS. However, pilates group Pilates group had significantly improved in FMS (Schwartzkopf-Phifer et al., 2023). Unver & Aras (2023) have investigated that effects of mat Pilates and reformer Pilates on FMS. In this study, mat Pilates group exhibited greater improvement than reformer Pilates (Ünver & Aras, 2023). In a study involving sedentary women, Pilates exercises performed on both reformer and mat apparatuses were found to be effective in addressing muscle asymmetries and weaknesses, improving flexibility, enhancing certain physical parameters, and preventing posture disorders and other adverse effects associated with a sedentary lifestyle (Bastik & Cicioglu, Šniurevičienė et al., 2022 stated that pilates exercise improved FMS in young young professional handball players. Lim et al. (2024) compared the effects of mat Pilates and yoga exercises. There is no significant difference was observed between the effects of yoga and Pilates (Lim et al., 2024). In this study pilates group pre-post test result showed significant impovment on FMS (Lim et al., 2024). In a smilar study, pilates exercise provide better enhance than yoga (Lim & Park, 2019). 2021). In a study involving sedentary women, both mat Pilates and reformer pilates exercise provided significant improvement on FMS. Moreover, reformer pilates exercise better improvement than mat pilates exercise (Bastik & Cicioglu, 2021). Similarly, exercises designed to enhance core strength have been demonstrated to improve posture and FMS test scores in individuals with low levels of physical activity (Kim et al., 2020). A study conducted on female university students revealed that their high rates of sitting in classrooms contributed to an inactive lifestyle and it has been stated that prolonged sitting in schools leads to fatigue and weakness in trunk muscles such as the waist, abdomen, and back. Nevertheless, Pilates has been demonstrated to rectify posture disorders and enhance FMS test scores (Xi et al., 2014).

Table 3
Characteristics of the studies included in this review

References	Research Group		Application Period (Week/frequency)		Tests	Results
(Lim et al., 2024)	F (n=20)	PG (n=10) YG (n=10)	8 week	2-day / 50 Min	FMS	Although no significant difference was observed between the groups, a significant increase in stability scores was noted for each item of the FMS test, including the deep squat, obstacle step, inline lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotational stability.
(Schwartzkopf-Phifer et al., 2023)	SW (n=36)	NEATS (n=17) PG (n=19)	8 week	NA	FMS	The findings of the study indicated that both the Pilates and NEATS programs resulted in a notable enhancement in FMS scores among active women.
(Ünver & Aras, 2023)	SW (n=45)	MT (n=15) RPG (n=15) CG (n=15)	12 week	NA	FMS	Both groups demonstrated improvement in the FMS. The Pilates group exhibited greater improvements in shoulder and leg mobility.
(Bastik & Cicioglu, 2021)	SW (n=58)	RPG (n=20) MPG (n=21) CG (n=17)	8 week	3-day / 60-75 Min	FMS	It was thus determined that eight weeks of mat and reformer Pilates exercises led to an enhancement in the total FMS screening scores of adult, healthy, sedentary women. Of the two forms of exercise, the reformer Pilates exhibited the most pronounced improvement.
(Šniurevičienė et al., 2022)	HP (n=12)	NA	8 week	2-day/60 Min	FMS	The application of the pilates method resulted in a statistically significant improvement in the total score on the FMS test.
(Lim & Park, 2019)	SW (n=90)	PG (n=30) YG(n=30) CG (n=30)	8 week	3-day/1 hour	FMS	The FMS results demonstrated that the Pilates group exhibited greater improvement than the yoga and control groups.
(Laws et al., 2017)	AR (n=40)	NA	6 week	NA	FMS	A six-week clinical Pilates course was found to enhance functional movement test scores in amateur runners.
(Xi et al., 2014)	Female College Students	MPG	15 week	1-day/ 2 hour	FMS	The implementation of Pilates exercises was observed to enhance the FMS test scores of female university students.

PG: Pilates Group, YG: Yoga Group, CG: Control Group, CS: Core Stability, RPG: Reformer Pilates Group, MPG: Mat Pilates Group, HP: Handball Player, AR: Amateur Runner F: Fencer, NA: Not Available, N: Sample, SW: Sedantery Women, MT: Matt Pılates, Min: Minute, NEATS: Novel Experimental Approach to Trunk Stability, FMS: Functional movement screening.

Pilates emphasizes the enhancement of core strength via controlled movements that target the hip, waist, abdominal, pelvic and back muscles (Isacowitz, 2022). Improving core strength in these muscle groups can facilitate the performance of many activities, such as seven movements in FMS, with enhanced control and precision. Kisel et al. (12) indicated that a total score below 14 have a greater risk of injury compared to those with a score over 14. Physiotherapists, coaches and performance specialists can increase FMS scores by implementing Pilates exercises. Consequently, they can protect athletes or other sedentary individuals from the risk of injury.

Limitations

This review must be assessed in light of several limitations of the study. This review exclusively includes research examining the benefits of Pilates on FMS. Secondly, only publications searched from the Web of Science, Scopus, and PubMed databases were incorporated into the analysis. Third, differences within studies (e.g., participant demographics, Pilates program content, assessment methodologies) may hinder the synthesis of results and influence interpretation.

While the current literature highlights the importance of Pilates exercises in their effects on functional movement capacity, more research is needed to determine optimal training strategies, practices, and outcomes. Future studies should focus on comparing Pilates exercises across sports, age demographics, different training protocols and different Pilates practices.

Conclusion

It can thus be concluded that Pilates exercises enhance physical parameters and FMS test scores in athletes and individuals with sedentary lifestyles, thereby reducing injury rates. Furthermore, it was determined that Pilates exercises can be incorporated into training programs by coaches and sports specialists, as they assist in the prevention of injuries associated with a sedentary lifestyle and facilitate the enhancement of physical functions in individuals with sedentary lifestyles.

In the future, research on Pilates should prioritize standardizing protocols and diversifying participant demographics to enhance the reliability and applicability of findings. A significant limitation of current Pilates research is its narrow focus on healthy adults or individuals with specific conditions. To ensure the generalizability of findings, it is essential to extend the scope of research to include diverse age groups, fitness levels, and professional athletes. Future research should also consider individualized approaches based on biomechanics, injury history, and specific goals. Advancements in wearable technology and motion analysis hold promise for further refining Pilates interventions by providing real-time feedback and data-driven adjustments.

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