Original Article

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Balance Exercises as a Fundamental Aspect of Functional Recovery in patients with Knee Osteoarthritis: A Systematic Review

Physiotherapy Section

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ABSTRACT

Introduction: Osteoarthritis (OA) in the knee causes pain, stiffness, and instability, which reduces mobility and quality of life. Exercises for balance are crucial for knee OA because instability caused by OA increases the risk of falls and functional loss. Exercises for balance may help increase mobility, reduce discomfort, and stabilise joints, but traditional therapies may not fully address these issues.

Aim: To examine the effect of balancing exercises on functional capacity, a sign of OA in the knee.

Materials and Methods: Reputable search engines like Web of Science (WoS), Embase, PubMed and Google Scholar were used to collect academic literature. To find solutions to the study questions, the literature search was conducted using "proprioception," "pain," "function," "knee OA," "balance training," and "quality of life" as keywords. A 100 papers were chosen for this systematic evaluation. They were thoroughly examined in accordance with the PRISMA principles. Thirteen studies were included in the final analysis. The Risk of Bias (RoB) in the included studies was assessed using the Quality in Prognosis Studies (QUIPS) instrument and Cochrane risk of bias assessment tool.

Results: Exercises for balance can successfully improve functional ability in patients with OA in the knee because they strengthen supporting muscles and enhance postural control. Balance exercises place less load on the knee joint than high-impact workouts while improving muscle activation and proprioceptive sensitivity around it. When treating OA, balance exercises are a safe, non-invasive method to increase a patient's mobility and quality of life. Clinically, they might reduce the risk of falls and enhance functional outcomes.

Conclusion: People with OA in their knees can function better with balance exercises. This training may be an easy and affordable way to improve their functional ability and quality of life.

Keywords: Interleukin-6, Muscle strength, Pain, Proprioception

INTRODUCTION

Millions of people globally suffer from knee OA, a widespread progressive joint disorder that primarily affects older people [1,2]. Knee OA, which is characterised by pain, stiffness, and cartilage degradation, has a major negative influence on mobility and general quality of life [3-5]. People find it more difficult to do everyday tasks like standing, walking, and climbing stairs as the illness worsens [6-8]. This increasing burden emphasises the necessity of efficient management techniques to reduce symptoms and enhance functional results for individuals with OA in the knee.

Exercise-based therapies are often advised for the treatment of knee OA, especially strength and aerobic exercises [8-12]. Though they can help with unstable joints and proprioceptive deficiencies, which are frequent in this population, balancing exercises have not been emphasised as much in the overall picture of knee OA [13,14]. The neuromuscular system is the focus of balance exercises, which improve posture control, coordination, and functional stability- all of which are essential for preserving joint health and reducing the chance of falling [15-17]. For those with knee OA, incorporating balance training may be crucial to improve physical function.

Knee OA affects millions of individuals globally and is characterised by pain, reduced mobility, and functional limitations. Strength training, joint preservation, and pain control are frequently the main goals of traditional knee OA care techniques [18,19]. However, the role of balancing exercises as a supplemental intervention to improve postural stability and treat proprioceptive deficits both of which are commonly affected in people with knee OA has drawn more attention. Balance exercises may provide a special therapeutic benefit for these individuals, who frequently have impaired neuromuscular control and an increased risk of falls [20,21].

Considering the importance of balancing for joint protection and mobility, the lack of focused research on the particular impacts of balance exercises in knee OA is a major gap. Few studies have singled out balance training to be a crucial component for treating knee OA symptoms, despite several investigating general exercise therapies [9,11,22]. This discrepancy emphasises the need for additional studies on the direct impacts of targeted balance exercises on the pain, stiffness, and functional abilities of people with OA in the knee.

A comprehensive review is necessary for an adequate understanding of the current state of information regarding the effect of balancing exercises on knee OA symptoms. Knee OA is a common ailment that impairs quality of life and is characterised by stiffness, joint pain, and decreased mobility. To address proprioceptive impairments and functional instability in people with knee OA, current research has investigated balance training as a supplemental intervention. Traditional therapies often centre on alleviating pain and strengthening exercises. Nevertheless, there is still conflicting and dispersed evidence about its efficacy. Through an analysis of recent data, this study seeks to synthesise the results, pinpoint knowledge gaps, and offer a more comprehensive understanding of the function of balancing exercises in the management of knee OA. Such a review is required to direct professional practice and future research to ensure evidence-based treatments for this common and debilitating ailment.

This study aims to investigate and gather information on the outcome of balance exercises on knee OA symptoms, specifically functional ability. By filling this knowledge gap, the results could help guide therapeutic practice by shedding light on whether or not balancing exercises ought to be included in routine rehabilitation regimens for knee OA. If proven beneficial, balance training could be a simple, low-cost intervention to enhance functional capacity and quality of daily life for those with knee OA.

Research questions:

Research questions are based on the PICO framework.

- ✓ Is balance exercise helpful in knee OA in improving functional ability?
- ✓ If balancing exercises are beneficial, what is the process by which the advantages are generated?

MATERIALS AND METHODS

This systematic review used information from WoS, Embase, PubMed and Google Scholar to examine how balance training affected the symptoms of OA in the knee. The review complied with PRISMA regulations.

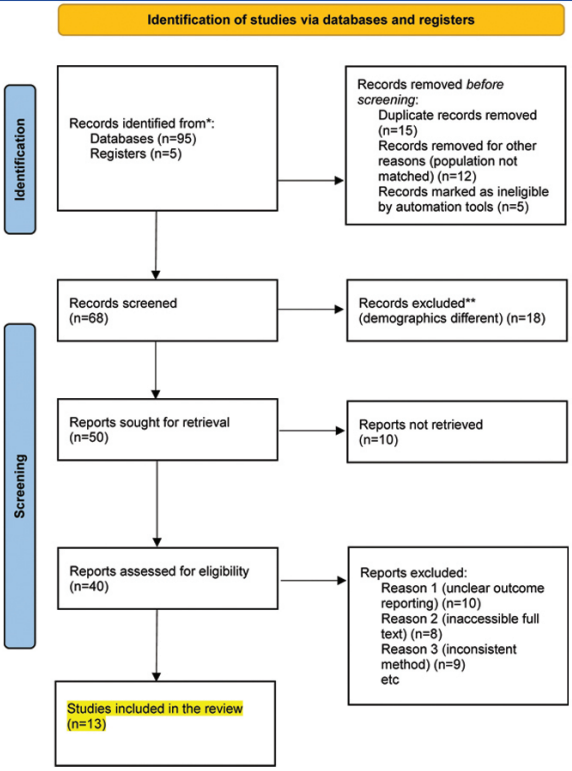
Search Strategy

The PubMed, WoS, Embase, and Google Scholar databases were thoroughly searched with an emphasis on research released up until July 2024. Among the search terms were "proprioception," "pain," "function," "knee OA," "balance training," and "quality of life." The search was narrowed down by Boolean operators (AND, OR). Included were only human subject studies conducted in English.

Inclusion and Exclusion criteria: For inclusion, peer-reviewed English-language studies evaluating the effects of balance training on knee OA symptoms, such as pain, function, or balance, were needed. The analysis includes studies conducted between 2000 and 2024. Studies that concentrated on non-OA circumstances, non-balance therapies, case studies, reviews, or animal research were excluded. Focused clinical research questions are created using the PICO framework, which facilitates the structuring of questions for evidence-based practice.

Selection of the Paper

Abstracts and titles were thoroughly examined. To verify eligibility, full-text publications from pertinent studies were examined. A 100 papers were chosen for this systematic evaluation after a thorough examination of publications related to our main keywords. Based on the inclusion and exclusion criteria that demonstrated their eligibility, these papers were selected for the investigation. [Table/Fig-1] displays a visual representation of the resultant search results for this analysis.



[Table/Fig-1]: PRISMA framework.

Risk of Bias (RoB) Assessment

This systematic review evaluated the RoB in the included studies using the QUIPS instrument and Cochrane risk of bias assessment tool. It has six main areas of bias. By assisting in the identification of potential biases that can compromise the validity and reliability of the results, the use of QUIPS guarantees a thorough evaluation of methodological quality [23]. The paper was categorised as low RoB (green) if all domains were categorised as having low RoB or up to one moderate RoB. This publication was identified as having a high RoB (red) if one or more domains were categorised as having a high RoB or ≥3 as having a moderate RoB. Every subsequent paper was categorised as having a moderate RoB (yellow). The Cochrane RoB tool is used for assessing the risk of bias in Randomised controlled trials. It is structured into a fixed set of domains of bias, focussing on different aspects of trial design, conduct, and reporting [24].

RESULTS

The investigation of the effects of performing balance exercises on OA of the knee is presented in the [Table/Fig-2] [25-33].

How Balance Exercises will Impact the Functional Limitation of the Affected Person

Because joint pain, stiffness, and oedema limit movement and everyday activities, OA in the knee significantly affects functional ability [34,35]. Joint mechanics are hampered by cartilage degradation and alterations in surrounding tissues, making it difficult to walk, climb stairs, and get out of a seated posture [36,37]. Muscle weakening and proprioceptive impairments further impair stability and balance, raising the risk of falls and reducing physical independence [38]. These limitations ultimately result in a decline in the standard of life and activity levels, which hastens the onset of OA [38]. Therefore, a thorough examination of the mechanism underlying the alleviation of functional limits in individuals with knee OA was required. The examination of the included research articles is enclosed in the [Table/Fig-3] [39-42].

By addressing deficiencies in stability, proprioception, and muscle strength- all of which are prominent in OA due to joint degradation and related symptoms including pain and stiffness, balance exercises help alleviate functional limits in knee OA. By lowering IL-6, physical activity-including balancing exercises- has anti-inflammatory effects that indirectly improve joint function and decrease the progression of illness.

The QUIPS tool assesses the RoB in prognostic studies across six domains, including study participation, attrition, and outcome measurement. The results of the QUIPS assessment tool have been presented in [Table/Fig-4] [27,29,39,42].

DISCUSSION

The review's findings suggest that enhancing functional capacities in individuals with OA of the knee requires balance exercises. Knee OA frequently results in proprioceptive deficiencies and decreased joint stability, which affect daily functional tasks like standing, walking, and negotiating uneven terrain [43]. Smoother and more stable movement patterns are made possible by balance exercises, which address these deficiencies by enhancing joint alignment, coordination, and postural control [44,45]. According to the review's studies, patients may perform everyday tasks more easily and safely by doing balance exercises, which also dramatically reduce discomfort and improve mobility.

For individuals with knee OA, especially those with severe symptoms or limited mobility, balance training provides clear advantages over more conventional therapies like strength training and minimal-impact aerobic exercises [46,47]. Balance exercises improve activation of muscles and proprioceptive sensitivity around the knee joint while putting less strain on it than high-impact workouts [48,49]. For a variety of OA patients, including those who may have functional impairments that limit their capacity to undertake

Author	Place/Year of study	Aim of the study	Study design	Outcome measures	Sample size	Findings	Limitations
Jahanjoo F et al., [25]	Imam Reza Hospital, Iran (2019)	To assess how well balance training works for patients with knee OA when combined with physical modalities.	Randomised controlled trial (RCT)	Western Ontario and McMaster Universities OA (WOMAC), Timed Up and Go (TUG) test Lequesne index, Biodex Medical Systems (BBS), Visual Analogue Scale (VAS)	60	The balance training group improved their functional abilities and reduced their discomfort more.	Long-term follow-up was absent. Other study limitations include the absence of a control group receiving no therapy and the use of drugs other than those included in the exclusion criteria.
Ince B et al., [26]	Izmir Bozyaka Training and Research Hospital, Turkey (2022)	To look into how proprioception and balance activities affect people with OA in their knees.	A randomised trial with three parallel arms	Overall stability index and the modified Clinical Test of Sensory Interaction and Balance, 30-s chair stand test and 40-metre fast-paced walk test, VAS, Knee Injury and OA Outcome Score (KOOS)	89	Dynamic balance and movement pain may be improved more by biodex training and traditional exercise, respectively.	Studies with higher sample numbers are necessary.
Rogers MW et al., [27]	Florida, USA (2011)	To ascertain whether Kinaesthesia, Balance, and Agility (KBA) exercises, isolated from strength training, could enhance function in individuals with OA in the knee.	Pilot study	WOMAC scale, the Self-Efficacy for Exercise (SEE) scale, the Human Activity Profile (HAP)	20	A brief regimen of exercises for agility and balance may improve physical function, lessen knee instability, and increase physical activity levels.	Small sample size.
Takacs J et al., [28]	Canada (2017)	To look into the effects of a targeted balance training programme on those with medial compartment knee OA's self-reported functional abilities and dynamic balance.	RCT	WOMAC scale, Community Balance and Mobility Scale (CB&M)	40	Self-reported knee discomfort, physical performance, and fear of movement have all improved; however, the CB&M did not show any change in dynamic balance.	No research has been done on objective measures of balance.
Al-Khlaifat L et al., [29]	United Kingdom, (2016)	To examine how well a lower extremity muscle group exercise programme combined with dynamic balance education utilising the Star Excursion Balance test (SEBT) works for knee OA.	Experimental pilot study design	Star Excursion Balance Test	14	Because people with knee OA are more likely to fall as they age and experience changes from their condition, this programme may be able to lower the rate of falls by improving their dynamic balance.	A disadvantage of this study is that it used an experimental pilot design with limited participants and three individuals had clinical evaluations of knee OA rather than radiographic ones.
Diracoglu D et al., [30]	Turkey, (2005)	Examining how kinaesthesia and balance training can help people with knee OA in the short term.	RCT	WOMAC, proprioceptive sensation levels, SF-36 Form, isokinetic quadriceps muscle strength, times for performing activities of daily living	66	Exercises for balance and kinaesthesia have been shown to have additively positive effects on knee OA.	Long-term effectiveness is not quantified.
Rogers MW et al., [31]	Florida, USA, (2012)	To find out if Kinaesthesia, Balance, and Agility (KBA) exercises performed at home could help people with knee OA who were at least 50 years old with their symptoms.	RCT	community activity level, 15 m Get Up and Go walk (GUG), self-report knee stability, and WOMAC exercise self-efficacy	33	These findings suggest that home exercise regimens involving KBA, RT, or a combination can effectively improve the symptoms and quality of life of individuals with knee OA.	This study does not provide information on other functional measurements, such as stair climbing or biomechanical assessments of gait quality. Additionally, there is no measurement of lower extremity strength.
Tirasci E et al., [32]	Adana, Turkey, (2020-2021)	To determine how well balancing exercises affected individuals with OA in the knees in terms of balance, functional status, pain, and central sensitisation.	RCT	VAS, WOMAC, Central Sensitisation Inventory (CSI), Berg Balance Scale, and Y Balance Test	40	For individuals with knee OA, balancing exercises may help with dynamic balance, central sensitisation, pain during activity, and function.	Long-term follow-up was not done. Information on the participants' normal exercise routines and dietary health is lacking. A placebo group could not be established, and the participants were not blind to the treatment.

Chen Z et al., [33]	Guangzhou, China, (2021)	To look into how backward walking affected KOA patients' static stability, proprioception, pain, and physical function.	RCT	WOMAC, NRS	32	Static stability was improved and pain and functional disability were reduced more when backward walking training was combined with traditional treatment.	An extended period of intervention and follow-up is absent. Sample size is small.

[Table/Fig-2]: Analysis to determine the impact of balance exercises on knee OA [25-33].

Author	Aim of the study	Study design	Outcome measures	Sample size	Findings	Limitations
Tunay V et al., [39]	To ascertain the effects of proprioceptive and strength exercise programmes, both at home and in hospitals, on pain, proprioception, and functional ability in patients with OA of the knee.	Comparative	WOMAC, VAS, Monitorised Functional Squat System-Proprioceptive Test (MFSS), TUG	60	When WOMAC, TUG test scores, and pain intensity were assessed before and after therapy, both groups showed a significant improvement. Proprioceptive measures improved more in the hospital-based group.	Long-term effects are not studied
Braghin RD et al., [40]	To evaluate the function and balance of individuals with and without knee OA and look into the impact of exercise.	RCT	WOMAC	42	Both function and discomfort have improved in knee OA	Samples are limited
Levinger P et al., [41]	To compare the feasibility, safety, and patient satisfaction of a high-speed resistance workout programme along with or without balance exercises to a control group in patients with knee OA.	RCT	WOMAC, Numerical Pain Rating Scale	30	Exercises for balance help reduce falls and enhance proprioception and pain.	Small sample size and shorter duration as the study is a pilot study
Aguiar GC et al., [42]	To ascertain how an exercise therapy regimen affects inflammatory indicators, pain perception, and physical performance in knee OA.	Longitudinal	Interleukin-6 (IL-6), WOMAC, VAS	22	Pain and function have improved, and IL-6 has decreased.	Small sample size

[Table/Fig-3]: Analysis to identify the process by which functional ability is enhanced by balance exercises [39-42].

Study	Study participation bias	Attrition bias	Prognostic factor measurement bias	Outcome measurement bias	Study cofounding bias	Statistical analysis and reporting bias
Rogers MW et al., [27]	Low	High	Moderate	Low	High	High
Al-Khlaifat L et al., [29]	Moderate	Low	Moderate	Low	Moderate	Moderate
Tunay V et al., [39]	Low	Low	Low	Low	Moderate	Low
Aguiar GC et al., [42]	Low	Low	Moderate	Low	Moderate	Low

[Table/Fig-4]: Risk of Bias (RoB) assessment [27,29,39,42].

other exercises, this makes them both accessible and beneficial. Additionally, studies demonstrate that balancing exercises can be successfully integrated with other therapy modalities to create a holistic programme that optimises gains in strength and mobility [50].

The variety of balance training methods used in different research was one of the review's difficulties. It was challenging to make direct comparisons because of the wide variations in the length, frequency, and kind of balance exercises. Simple static balancing exercises were part of some therapies, whereas dynamic and intricate functional activities were part of others. This variation emphasises the necessity of consistent protocols to maximise balance training for the rehabilitation of knee OA. Furthermore, there were differences in the studies' methodological quality. Findings from a few of the studies were not as broadly applicable because they lacked sufficient sample sizes or thorough explanations of exercise regimens. For more proof, future studies should concentrate on extensive, superior randomised controlled trials with clearly defined balance training regimens.

Limitation(s)

Despite these benefits, several limitations in the available data make it challenging to assess the lasting impact of balance training on functional ability, particularly when it comes to the range of exercise routines and short follow-up times. Future studies with standardised protocols, larger sample sizes, and longer follow-up periods would strengthen the body of data and clarify the long-run advantages of balancing exercise for knee OA. All things considered, the evaluation emphasises balance exercises as a viable, low-risk method of enhancing functional results in patients with knee OA, indicating that they might be useful elements of multidisciplinary OA care plans.

CONCLUSION(S)

In conclusion, for people with OA in their knees, balance exercises are essential for enhancing their functional abilities and general quality of life. These exercises enhance mobility, reduce discomfort, and lower the risk of falls, that frequent in this population, by improving muscle coordination, joint stability, and proprioception. An affordable, non-invasive, and easily accessible method of treating knee OA is to include balance training in rehabilitation programmes. To maximise results for a variety of patient groups, future research should concentrate on refining exercise regimens, evaluating long-term advantages, and investigating tailored therapies.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
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- iThenticate Software: Feb 22, 2025 (9%)

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