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Exercise Prescription and Sport Selection as a Non-Surgical Strategy in Knee Osteoarthritis: A Narrative Review

Adam Surma[1], ORCID *https://orcid.org/0009-0002-8808-1281*

E-mail a.surma2001@gmail.com

[1]Mazowiecki Szpital Bródnowski, Warsaw, Poland

Maja Podziewska[2], ORCID *https://orcid.org/0009-0004-9715-2736*

E-mail maja.podziewska@stud.umed.lodz.pl

[2]Independent researcher, Łódź, Poland

Maria Magdalena Dzieniakowska[2], ORCID *https://orcid.org/0009-0000-7695-5231*

E-mail maria.dzieniakowska.dental@gmail.com

[2]Independent researcher, Łódź, Poland

Adrian Piotr Kobus[2], ORCID *https://orcid.org/0009-0008-9215-1514*

E-mail adi.kobus@gmail.com

[2]Independent researcher, Łódź, Poland

Aleksandra Bernaś[2], ORCID *https://orcid.org/0009-0005-1997-1733*
E-mail aleksandra.bernas@stud.umed.lodz.pl
[2]Independent researcher, Łódź, Poland

Jakub Adam Maciaszczyk[3], ORCID *https://orcid.org/0009-0003-0760-6451*
E-mail jakub.maciaszczyk@stud.umed.lodz.pl
[3]Medical University of Lodz, al. Tadeusza Kościuszki 4, 90-419 Łódź, Poland

Maja Warchoł[3], ORCID *https://orcid.org/0009-0004-1601-1246*
E-mail maja.warchol@stud.umed.lodz.pl
[3]Medical University of Lodz, al. Tadeusza Kościuszki 4, 90-419 Łódź, Poland

Robert Durski[3], ORCID *https://orcid.org/0009-0008-7440-0871*
E-mail robert.durski@stud.umed.lodz.pl
[3]Medical University of Lodz, al. Tadeusza Kościuszki 4, 90-419 Łódź, Poland

Kacper Strojec[4], ORCID *https://orcid.org/0009-0000-4572-4991*
E-mail kstrojec1@gmail.com
[4]National Medical Institute of the Ministry of the Interior and Administration, ul. Wołoska 137, 02-507 Warsaw, Poland

Julia Paulina Piecyk[2], ORCID *https://orcid.org/0009-0001-6970-057X*
E-mail julia.piecyk123@gmail.com
[2]Independent researcher, Łódź, Poland

Corresponding Author
Adam Surma, ORCID *https://orcid.org/0009-0002-8808-1281*
E-mail a.surma2001@gmail.com
Mazowiecki Szpital Bródnowski, Warsaw, Poland

Abstract

Background. Knee osteoarthritis (OA) is a leading cause of musculoskeletal disability. Exercise is recommended as first-line non-surgical treatment, yet no single exercise type, sport, or dose has been identified as clearly superior.

Aim. To review exercise modalities, recreational sport safety and selection, psychological barriers to activity, and exercise dosing in knee OA.

Material and methods. A narrative review of 39 publications identified in PubMed, Google Scholar and Cochrane Library (September 2026).

Results. No exercise modality proved clearly superior for pain or function, and patients rated stationary cycling and aquatic exercise as the most knee-friendly activities. Recreational running was not associated with higher odds of OA, whereas prior knee injury was a strong risk factor. Kinesiophobia and beliefs about joint "wear and tear" were linked to lower activity. Exercise benefits did not appear to depend on session frequency or total volume.

Conclusions. For knee OA, the goal is not to prescribe one ideal dose but to help patients choose exercise they prefer, can tolerate, and will keep doing, with reassurance along the way.

Key words: knee osteoarthritis, exercise prescription, sport selection, kinesiophobia, cycling, recreational running.

1. Introduction

Knee osteoarthritis (OA) is one of the main causes of musculoskeletal disability worldwide. In 2020, osteoarthritis at any site affected 7.6% (95% UI 6.8–8.4) of the global population, and the knee was the most commonly affected joint (1). In population-based studies using radiographic assessment, signs of knee osteoarthritis are detected in approximately 37% of individuals aged 60 and older (2). Compared with 2020, the number of knee osteoarthritis cases is projected to increase by 74.9% (95% UI 59.4–89.9), reaching approximately 642 million by 2050, mainly as a result of population growth and ageing (1).

In knee OA, the whole joint is affected, even though cartilage loss is fundamental and represents a failed repair response to joint damage (2); this failure of biological and mechanical repair processes deteriorates articular cartilage, causing fibrillation, fissuring, and ulceration, and leads to chronic pain, stiffness, restricted range of motion, and progressive muscle weakness (2).

Even in early clinical stages (Kellgren–Lawrence grades I–II), patients show a characteristic 'stiff-knee' gait, a pain-avoidance strategy marked by reduced sagittal-plane joint motion, lower peak angular velocity, and decreased flexor-extensor joint moments (3). The authors suggest that, as quadriceps weakness limits sagittal-plane propulsion, increased biceps femoris activation may be used to rotate the knee externally and stabilise the joint (3). This pattern is

accompanied by reduced gluteus medius and medial gastrocnemius activation (3), which may disturb medial–lateral muscle balance.

Exercise therapy has become the most extensively studied non-surgical intervention in knee OA (4). A network meta-analysis of 152 randomised controlled trials found no difference in pain relief between exercise and oral NSAIDs or paracetamol in knee or hip osteoarthritis (5). As part of non-pharmacological management, exercise improves core symptoms and may help delay or avoid total knee replacement (6).

Major international clinical guidelines recommend exercise as the first-line non-surgical treatment of knee OA (7,8), but they do not define the optimal type, dose or progression of exercise (8). Although exercise is as effective as analgesics (5), its average effect is modest and varies considerably between patients (9,10), which suggests that how exercise is selected and delivered may matter as much as whether it is prescribed.

Recent trials comparing higher and lower exercise doses (intensity, volume or frequency) have not shown greater improvements in pain or physical function with higher doses (9,11). The amount of exercise may therefore be less important than its type, and recent reviews have called for research on the exercises patients enjoy, prefer and are able to engage with, such as 'knee-friendly' aerobic activities (9,12).

Guidelines also give little practical direction on the safety and selection of recreational sports such as running or cycling, and uncertainty about how physical activity affects joint structure remains a barrier to recommending it (13); this also makes it difficult to counter patients' beliefs that activity causes 'wear and tear' (13). Finally, psychological factors limit the uptake of exercise: in people with knee OA, both knee flexor and extensor strength were associated with physical activity indirectly through kinesiophobia, but not through pain (14).

Research Objective. This narrative review therefore aims to summarise current evidence on the comparative efficacy of exercise modalities, the safety and selection of recreational sports, psychological factors affecting physical activity, and exercise dosing in knee osteoarthritis, and to discuss the practical implications of these findings for individualised non-surgical management.

2. Research materials and methods

This narrative review was based on a literature search of PubMed, Google Scholar and Cochrane Library, performed in September 2026. Search terms combined "knee osteoarthritis"

(MeSH) with terms related to exercise therapy, resistance and aerobic training, running, cycling, sports, kinesiophobia, fear avoidance, self-efficacy, adherence and exercise dose. Searches were limited to studies in humans published in English, mainly from 2020–2026. Additional articles were identified by screening the reference lists of key reviews. Systematic reviews, meta-analyses, randomised controlled trials and clinical guidelines were prioritised; cohort, cross-sectional and qualitative studies were included where higher-level evidence was lacking. Studies focusing on pharmacological, injection or surgical treatment were excluded. Older studies were included when they were the primary source of key data. In total, 39 publications were included. No formal risk-of-bias assessment was performed, which is a limitation of this review.

3. Research results

3.1. Comparative efficacy of exercise modalities

3.1.1. Is any exercise type superior?

An umbrella review of 58 systematic reviews found that muscle-strengthening (74.1%) and aerobic (48.3%) exercise were the most frequently investigated modalities in knee osteoarthritis, and most reviews reported benefits with few adverse events (15). However, a recent narrative synthesis of exercise management concluded that no single exercise type has been shown to be superior to another for pain or function in knee OA (9). Similarly, a systematic review comparing aquatic and land-based programmes reported comparable positive effects on pain and physical function (16). Taken together, these findings suggest that the choice of exercise modality may be less important than selecting an exercise the patient is willing and able to perform, although the absence of head-to-head superiority trials limits definitive conclusions.

3.1.2. Resistance training: does execution matter?

Among resistance training variants, a network meta-analysis found that isokinetic muscle strengthening produced greater pain relief (MD −1.33; 95% CI: −1.83 to −0.83) and functional improvement (WOMAC MD −12.24; 95% CI: −17.29 to −7.19) compared with conventional physiotherapy across 12 trials (17). In a secondary analysis of an RCT, both concentric and eccentric resistance training reduced functional pain during chair rise (−38.6% and −50.3%, respectively) and stair climb (−51.6% and −41.3%), but neither improved physical function more than control; these findings should be interpreted cautiously given the small sample (n =

53 analysed) and secondary analysis design (Table 1) (18). Addressing loading environment, the TARGET trial found no between-group difference in pain (NRS 0–10: MD 0.73; 95% CI: −0.05 to 1.50) or function (WOMAC 0–68: MD 2.80; 95% CI: −1.17 to 6.76) between weight-bearing and non-weight-bearing quadriceps strengthening in obese patients with medial knee OA, while weight-bearing exercise was associated with fewer adverse events (23% vs 39%) (Table 1) (19). This suggests that weight-bearing exercise is an acceptable option in this population.

Table 1. Randomised controlled trials comparing exercise modalities in knee osteoarthritis

Study	Participants (n)	Comparison	Duration	Main findings
Bennell et al., 2020	128 (NWB 66, WB 62); medial knee OA and BMI ≥30	Non-weight-bearing (NWB) quadriceps strengthening vs weight-bearing (WB) functional exercise	12 weeks	No between-group difference in pain (NRS 0–10: MD 0.73; 95% CI −0.05 to 1.50) or function (WOMAC 0–68: MD 2.80; 95% CI −1.17 to 6.76); fewer adverse events with WB (23% vs 39%)
Zhang et al., 2025	69 randomised, 52 analysed (Tai Chi 24, BPCT 28); KL II–III	Tai Chi vs balance and postural control training (BPCT)	12 weeks	Pain (VAS 0–10) decreased in both groups with no between-group difference (p = 0.216); BPCT reduced dual-task cost of cadence (p = 0.003) and speed (p = 0.038) during stair descent
Abafita et al., 2025	117 (yoga 58, strengthening 59)	Yoga vs strengthening exercise	12 weeks (follow-up 24 weeks)	Yoga non-inferior for knee pain at 12 weeks (VAS 0–100 mm: MD −1.1; 95% CI −7.8 to 5.7; margin 10 mm). At 24 weeks, greater improvement with yoga in WOMAC pain (MD −44.5 mm; 95% CI −70.7 to −18.3) and function (MD −139 mm; 95% CI −228.3 to −49.7)†
Vincent and Vincent, 2020*	88 randomised, 53 analysed (CNCRT 17, ECCRT 19, CON 17); aged 60–85, KL II–III	Concentric resistance training (CNCRT) vs eccentric resistance training (ECCRT) vs control (CON)	4 months	No difference in physical function. Functional pain (NRS 0–10) decreased with both resistance training types vs control during chair rise (−38.6% CNCRT, −50.3% ECCRT vs +10.0% CON) and stair climb (−51.6%, −41.3%)
Øiestad et al., 2023	168 randomised, 161 analysed (SE 54, AE 53, UC 54); aged 35–70, KL II–III	Strength exercise (SE) vs aerobic exercise (AE; stationary cycling) vs usual care (UC)	12 weeks (follow-up 1 year)	No difference in knee-related QoL at 1 year vs usual care (KOOS QoL 0–100: SE MD 6.5; 95% CI −0.9 to 14; AE MD 5.0; 95% CI −2.7 to 12.8); both exercise groups had better quadriceps strength and VO_2max at 4 months

Source: own elaboration based on the cited studies.

Notes: AE, aerobic exercise; BMI, body mass index; BPCT, balance and postural control training; CI, confidence interval; CNCRT, concentric resistance training; CON, control; ECCRT, eccentric resistance training; KL, Kellgren–Lawrence grade; KOOS, Knee injury and Osteoarthritis Outcome Score; MD, mean difference; NRS, numerical rating scale; NWB, non-weight-bearing; OA, osteoarthritis; QoL, quality of life; SE, strength exercise; UC, usual care; VAS, visual analogue scale; VO_2max, maximal oxygen uptake; WB, weight-bearing; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

* Secondary analysis of a randomised controlled trial.

† WOMAC reported in millimetres (pain 0–500, function 0–1700).

3.1.3. Mind-body and balance training as alternatives

Mind-body modalities may offer comparable benefits to conventional strengthening. In a randomised trial, yoga was non-inferior to strengthening for VAS pain at 12 weeks (MD −1.1 mm; 95% CI: −7.8 to 5.7; non-inferiority margin 10 mm), with greater improvements in WOMAC pain (MD −44.5 mm) and function (MD −139 mm) at 24 weeks (Table 1) (20). A network meta-analysis of 67 RCTs ranked Pilates highest for overall WOMAC score and Tai Chi highest for direct VAS pain relief; however, the SUCRA ranking output used an inverted scale (placebo scored 87.2%), so these findings should be interpreted as comparative rankings rather than proof of absolute superiority (21). In a separate RCT, Tai Chi and balance training produced similar reductions in pain ($p = 0.216$), while balance training selectively reduced dual-task costs for cadence ($p = 0.003$) and speed ($p = 0.038$) during stair descent under cognitive load (Table 1) (22). These results should be interpreted with caution given the small analysed sample (52 of 69 randomised) and a 31% dropout rate in the Tai Chi group. Nevertheless, mind-body and balance approaches may be useful for patients who prefer non-traditional exercise formats or who require improved postural stability.

3.1.4. Aerobic versus strength training and summary

In a three-arm RCT, neither strength exercise nor stationary cycling improved knee-related quality of life compared with usual care at 1 year (KOOS QoL: SE MD 6.5; 95% CI: −0.9 to 14; AE MD 5.0; 95% CI: −2.7 to 12.8), although the authors note that the trial may have been underpowered (Table 1) (23). An integrated rehabilitation framework has been proposed that combines resistance, aerobic, and neuromuscular training with nutritional and biomechanical optimisation (6). Overall, because the available evidence indicates similar efficacy across modalities, the choice of exercise may depend on patient preference, comorbidities, and local availability. This provides a rationale for the following section on sport selection, in which individual tolerability and preference become central.

3.2. Sport selection and recreational activities

3.2.1. Which activities do patients tolerate best?

Although aerobic exercise is recommended in knee OA, knee pain is often a barrier to participation (12). In an international three-phase survey, 'knee-friendly' aerobic exercises were

defined as activities that elicit desirable cardiorespiratory responses without provoking symptom flare-ups persisting beyond 24 hours (12). From 154 activity descriptions, a standardised 30-item catalogue was developed. Patients most frequently identified stationary cycling (82% consensus, 285/349 respondents) and aquatic exercise (70% consensus, 246/349 respondents) as the most knee-friendly activities (12).

Consistent with these preferences, a randomised trial found that 12 weeks of stationary cycling (2–3 sessions/week, 30 minutes at 70–80% HRmax) improved VO_2max (3.0 mL/kg/min; 95% CI 1.9–4.1), quadriceps strength (10.1 Nm; 95% CI 0.9–19.3) and KOOS symptoms (7.4; 95% CI 0.4–14.4) compared with usual care at 4 months, although knee-related quality of life did not differ at 1 year (Table 1) (23).

3.2.2. Running: does it harm the knee?

Concerns that running accelerates joint degeneration remain widespread, yet quantitative imaging and observational evidence challenge this assumption (24). A meta-analysis of MRI studies in healthy adults found that a single running session induced small reductions in cartilage volume within 20 minutes, ranging from 3.3% (95% CI: 2.6–4.1) for femoral to 4.1% (95% CI: 3.2–4.9) for tibial cartilage in the tibiofemoral joint and 4.9% (95% CI: 3.6–6.2) for patellar cartilage, with T2 relaxation times returning to baseline within 91 minutes (24). The authors interpreted these changes as reflecting altered cartilage hydration and considered running safe for healthy knees; however, data in people with, or at risk of, OA were insufficient for pooling, and one included study reported a prolonged increase in T2 relaxation times of up to 90 minutes after running in individuals with knee OA (24).

At the population level, a meta-analysis of observational studies found that recreational running was associated with lower odds of hip and knee OA compared with non-running sedentary controls (3.5% vs 10.2% prevalence, OR = 0.66; 95% CI: 0.57–0.76) (25). This estimate should be interpreted cautiously: the pooled analysis combined hip and knee OA and cannot establish causality. Competitive runners showed a higher raw prevalence (13.3%), but their odds ratio compared with non-runners did not reach statistical significance (OR = 1.34; 95% CI: 0.97–1.86) (25). In a survey of 3,804 marathon runners, cumulative running history was not associated with self-reported hip or knee arthritis, whereas a history of hip/knee injury that prevented running (OR = 5.04; 95% CI 3.45–7.34) and previous hip/knee surgery (OR = 5.85; 95% CI 4.33–7.92) were strong independent risk factors (26).

Narrative reviews report that recreational running of approximately 25 miles per week is not associated with increased risk of structural progression of knee OA (13); however, this should not be interpreted as a safe upper limit, as the amount of running that is safe for the joints could not be determined (25). Current recommendations therefore emphasise a gradual increase in running load with adequate recovery between sessions, particularly in individuals with a previous knee injury (13).

3.2.3. The role of joint injury

Elite-level participation in certain sports, including soccer, weightlifting and wrestling, has been associated with higher odds of knee OA, although these associations may be confounded by the risk of knee injury inherent to these sports (13). Prior knee injury is itself a strong independent risk factor for knee OA (OR = 4.20; 95% CI 3.11–5.66) (13), whereas recreational sports participation has not been consistently related to OA progression (13). This distinction is clinically important, as it shifts the focus from restricting sport participation to preventing and managing knee injury.

3.2.4. Walking and daily activity

For patients seeking low-impact daily activity, walking remains highly accessible. A systematic review and meta-analysis of 18 walking intervention studies (13 included in the pooled analysis) showed that walking interventions induced only a minimal increase in the first peak knee adduction moment (KAM, SMD = 0.18) and did not alter the cumulative KAM impulse (SMD = −0.01), suggesting that walking does not meaningfully increase medial knee loading (27). In addition, higher walking frequency was associated with faster gait speed (β = 0.37) (27). With respect to daily activity, a multicentre cross-sectional study found that regular knee exercises were associated with lower odds of flexion contracture (OR = 0.43; 95% CI: 0.25–0.75) (28). Commuting by bicycle or car was also associated with lower odds of flexion contracture (OR = 0.49; 95% CI: 0.28–0.85) (28), although this variable combined motorised and non-motorised transport and does not provide evidence for cycling as a sport discipline.

3.2.5. Master athletes and future research directions

In active older athletes, preserving sports participation requires prevention and injury management strategies tailored to individual needs (29). Direct comparisons of recreational sports with respect to knee OA progression are still lacking; the ongoing LoaD cohort study aims to address this by following 300 participants with early knee OA who engage in running,

cycling, tennis or hiking for 24 months, using GPS-based activity tracking and MRI (MOAKS) assessment (30).

3.3. Psychological drivers and adherence

3.3.1. Kinesiophobia, muscle strength and motor control

Although pain is widely accepted as a key symptom of knee OA, it is not strongly associated with OA-related structural changes (14). Aydemir et al. used cross-sectional data from 37 subjects (age 58.8 ± 8.6 years, 25F/12M, BMI 33.5 ± 6.4 kg/m²) with knee OA to examine whether kinesiophobia (pain-related fear of movement/(re)injury) or pain mediates the relationship between knee muscle strength and physical activity. Physical activity was assessed with the University of California, Los Angeles (UCLA) activity rating scale, fear of movement with the Tampa Scale for Kinesiophobia (TSK), and knee pain with the Knee Injury and Osteoarthritis Outcome Score (KOOS) pain subscale. In a parallel mediation analysis, lower knee flexion strength was associated with lower physical activity indirectly through higher kinesiophobia (indirect effect 2.98; 95% CI: 1.10 to 5.69), and a similar indirect effect was observed for knee extension strength, whereas the indirect effect through pain was not significant (14). One possible explanation is that muscle weakness increases fear during weight-bearing activities, leading to movement avoidance; however, the cross-sectional design does not allow causal conclusions.

Fear-avoidance beliefs may alter motor control during demanding tasks. Appropriate muscle co-contraction serves to stabilise and protect the joint, but excessive co-contraction may increase the risk of progressive degeneration of articular cartilage (31). In a cross-sectional surface electromyography study of patients with knee OA (n = 20), kinesiophobia (TSK-11) correlated with the medial muscle co-contraction ratio during stair descent after adjustment for BMI and femorotibial angle ($r = 0.54$; $p < 0.05$), whereas no association was found during level walking or stair ascent (31). Pain catastrophizing was not correlated with co-contraction in any task (31). This finding is consistent with the 'stiff-knee' gait pattern observed in early knee OA (3). However, the cross-sectional design, small sample and the use of low (8 cm) steps preclude causal inference.

A distinction should be made between physical capacity and daily physical activity. In a cross-sectional study of women with knee OA (n = 49), maximal isometric quadriceps strength was associated with performance on the 6-minute walk test (6MWT; $R^2 = 0.27$), whereas

kinesiophobia showed no direct association with walking distance (32). Taken together with the findings of Aydemir et al. (14), these results suggest that kinesiophobia may mainly affect whether patients choose to engage in daily physical activity, rather than limiting their maximal walking capacity when formally tested. As both studies were cross-sectional, this interpretation requires confirmation in longitudinal studies.

3.3.2. Beliefs about joint damage and diagnostic communication

Diagnostic communication may shape patients' beliefs about the need for surgery. In a three-arm online randomised controlled trial, 617 adults aged ≥45 years were presented with a hypothetical scenario of knee pain and watched a short video of a general practitioner explaining knee OA (33). Compared with a clinical explanation without X-rays, a radiographic explanation that included showing X-ray images increased beliefs that joint replacement surgery was necessary (MD = 1.1; 95% CI: 0.5 to 1.8; $p < 0.001$), whereas beliefs about the helpfulness of exercise did not differ (MD = −0.4; 95% CI: −0.9 to 0.1) (33). However, participants who saw the X-ray explanation more strongly believed that exercise could damage the knee (MD = 0.6; 95% CI: 0.2 to 1.1; $p = 0.008$) and reported greater fear of movement (MD = 1.0; 95% CI: 0.3 to 1.7; $p = 0.005$) (33). Although these findings are based on a hypothetical scenario, they suggest that the way imaging results are communicated may reinforce fear-avoidance beliefs and discourage engagement in exercise therapy. Consistently, a qualitative study of patients who did not improve after an exercise programme found that non-responders described beliefs that their joint was 'wearing out' (34).

Communication-based interventions may help counter these maladaptive beliefs. In an online randomised trial (N = 589), a 12-minute empowerment-focused video shifting the narrative away from 'wear and tear' towards 'motion is lotion' produced greater improvements in self-efficacy for managing OA pain (MD = 0.4; 95% CI: 0.2 to 0.6; $p < 0.001$) and greater reductions in fear of movement (MD = 1.6; 95% CI: 1.1 to 2.0; $p < 0.001$) compared with a video focused on structural joint damage (35). However, the minimal clinically important differences for these measures are unknown (35), and outcomes were measured immediately after the intervention, so whether brief educational videos lead to sustained behavioural change remains uncertain. In clinical practice, how clinicians talk about osteoarthritis and reassure patients that movement is safe may be as important as the choice of exercise itself.

3.4. Dosing frameworks and exercise prescription

Determining the optimal exercise dose in knee osteoarthritis requires balancing session frequency, total exercise volume and intervention duration. A systematic review of 12 randomised controlled trials of land-based resistance training found that large effect sizes for WOMAC pain and function were most frequently observed with 20–36 exercise sessions, most commonly 24, across interventions lasting from 4 weeks to 18 months (mean 27 weeks) (36). However, subsequent dose-response trials and meta-regressions have challenged the assumption of a linear dose-response relationship.

In the QUADX-1 dose-response trial, 140 patients eligible for total knee replacement were assigned to a home-based, single knee-extensor exercise programme performed 2, 4 or 6 times per week for 12 weeks (11). Intention-to-treat analyses showed no statistically significant between-group differences in isometric knee-extensor strength gains or symptom improvement. After the intervention, 67.5% of assessed patients (79 of 117, across all exercise groups combined) chose to postpone surgery (11). Because the trial did not include a non-exercising control group, this postponement rate cannot be attributed to exercise frequency alone; it likely reflects a combination of physiological adaptation and regular clinical follow-up. These findings suggest that a low dose may be sufficient to produce clinically relevant benefit, consistent with evidence that exercise therapy may delay total knee replacement independently of exercise dose (37).

These observations are reinforced by a systematic review and meta-analysis of 280 trials of land-based resistance exercise in knee and hip osteoarthritis (38). Interventions lasting 3–6 months conferred moderate, statistically significant benefits for pain (ES = −0.38; 95% CI: −0.56 to −0.21) and physical function in daily activities (ES = −0.32; 95% CI: −0.50 to −0.15), and meta-regression found no association between total exercise volume or adherence and the magnitude of effect (38). Similarly, high-intensity exercise does not appear to reduce knee pain or knee joint compressive forces more than low-intensity exercise or attention control (37). In practice, the exercise dose should be based on an initial assessment and progressed when appropriate, and may need to be modified if pain levels are unacceptable to the patient (37).

Beyond its biomechanical effects, resistance exercise may also influence OA through systemic immunometabolic pathways, as contracting skeletal muscle releases myokines with anti-inflammatory effects that may counterbalance adipokines derived from excess adipose tissue;

however, human data remain limited, and irisin appears to act as a modulator or marker of exercise efficacy rather than a proven therapeutic mediator (39).

4. Discussion

The main finding of this narrative review is that the clinical success of exercise therapy in knee osteoarthritis depends less on the specific modality chosen or the weekly volume achieved, and more on whether the patient sustains the programme over time. Comparative trials have not identified a single exercise type as clearly superior for pain or function, which suggests that patient preference and enjoyment may reasonably guide modality selection (9). Among recreational sports, low-impact activities, particularly stationary cycling and aquatic exercise, are the options patients tolerate best, in other words 'knee-friendly' exercises (12). Recreational participation in sports such as running has not been observationally associated with accelerated joint degeneration, provided that acute structural joint injury is absent (13,25). Unfortunately, participation in physical activities can be constrained by psychological factors: kinesiophobia and iatrogenic beliefs that the joint is 'wearing out' can reduce engagement in daily activity, even when physical capacity is preserved (14,32–34). Direct dose-response evidence further suggests that maintaining a moderate, low-threshold programme may be more important than maximising frequency or total volume (11,37,38). Taken together, these four lines of evidence point to a single conclusion: the clinician's task is not to identify the optimal exercise prescription, but to help the patient find a tolerable regimen they can sustain and to support patients in managing their condition.

While writing this narrative review, we found several contradictions in the literature. An earlier systematic review by Turner et al. (36) suggested that large clinical benefits require a cumulative threshold of at least 24 sessions; however, this conclusion was based on indirect comparisons across trials of different designs and populations. Direct head-to-head evaluation in a randomised dose-response trial by Husted et al. (11) found no significant differences in strength or symptoms across 2, 4 and 6 weekly sessions, and a meta-analysis of 280 trials by Marriott et al. (38) found no association between total exercise volume or adherence and treatment effect. Direct evidence therefore does not support a rigid session threshold. Similarly, the relationship between kinesiophobia and physical function appears inconsistent: Aydemir et al. (14) showed that kinesiophobia mediated daily physical activity levels on the UCLA scale, yet Machado et al. (32) found no direct association with 6-minute walk test distance, which was associated with quadriceps strength. On the other hand, these findings do not need to be

contradictory: kinesiophobia may simply influence whether a patient chooses to be active, whereas maximal physical capacity during formal testing is more closely related to muscle strength.

Based on these findings, we can suggest four practical steps. First, the patient should choose an activity based on their preferences and joint tolerance, prioritising low-impact options such as stationary cycling, aquatic exercise or walking (12,27). Second, clinicians should thoroughly interview the patient about prior knee injury or surgery before advising on sport participation (26), as uninjured individuals can be reassured that recreational sport has not been consistently associated with OA progression (13). Third, empowerment communication should replace pathoanatomical language such as 'wear and tear' with positive movement messaging (35), and clinicians may consider whether showing X-ray images is necessary and how imaging findings are explained, given the potential for iatrogenic kinesiophobia (33). Fourth, dosing should emphasise moderate, low-threshold regimens, for example two strength sessions per week (11), sustained over months, with workload adjusted according to symptom response (37).

This review has several limitations. As a narrative synthesis, it did not employ a systematic search protocol or formal risk-of-bias assessment. Much of the included evidence is cross-sectional or observational, with small samples (e.g., n = 37 and n = 20) (14,31), and several key meta-analyses pooled knee and hip osteoarthritis together (25,38). In several studies, outcomes were measured only shortly after the intervention or a single exercise bout, so the durability of effects remains uncertain (24,35). The randomised trial by Lawford et al. (33) used a hypothetical scenario rather than a real clinical encounter. Only English-language publications were considered.

Future work should prioritise prospective cohorts combining objective activity tracking with repeated MRI assessment, such as the ongoing LoaD study (30); randomised trials testing whether brief digital empowerment interventions produce sustained behavioural change (35); long-term follow-up studies evaluating whether low-threshold exercise regimens maintain their benefit beyond 12 months; and dedicated studies of running and other recreational sports in individuals with established knee osteoarthritis rather than healthy adults or mixed athletic cohorts.

5. Conclusions

No single exercise modality is clearly superior for pain or function in knee osteoarthritis, so patient preference and enjoyment may reasonably guide the choice. Among recreational activities, low-impact options such as stationary cycling and aquatic exercise are best tolerated, and recreational sport does not appear to accelerate joint degeneration in the absence of prior injury. Psychological barriers, particularly kinesiophobia and iatrogenic beliefs about joint 'wear and tear', are still major constraints on participation and may be addressed through empowerment-based communication. The benefits of exercise appear to depend less on session frequency or total volume than on maintaining a tolerable, low-threshold programme over time. Clinically, the priority should be to help each patient find an activity and dose they can sustain, rather than to enforce a single optimal prescription.

Disclosure

Author Contributions

Conceptualization, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; methodology, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; investigation, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; resources, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; data curation, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; writing – original draft preparation, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; writing – review and editing, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP; visualization, AS, AK, MD, MP, AB, JM, MW, RD, KS and JP. All authors have read and agreed with the published version of the manuscript.

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