

Movement-Based Interventions in Pre-Frail and Frail Older Adults: An Integrative Review of Clinical, Digital, and Implementation Evidence

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Background: Pre-frailty and frailty are dynamic and potentially reversible conditions in older adults, associated with increased risks of disability, hospitalization, and mortality. Evidence supports movement-based interventions as effective strategies to prevent and mitigate these outcomes.

Objective: This mini narrative review synthesizes recent scientific evidence on movement-based interventions for pre-frail and frail older adults, with emphasis on clinical outcomes, barriers to implementation, and digital innovations.

Methods: A structured and iterative search was conducted using the AI-based Consensus platform, which integrates major biomedical databases. From 1,049 identified records, 281 were screened, 205 assessed in full text, and 36 studies (systematic reviews, meta-analyses, and randomized controlled trials published between 2019 and 2025) met the inclusion criteria. Eligible studies evaluated movement-based interventions reporting outcomes such as strength, mobility, cognition, mood, or quality of life.

Results: Multicomponent, resistance, and mind-body exercises consistently improved muscle strength, balance, mobility, executive function, and psychological well-being. Digital strategies, including exergames and mobile applications, showed comparable effectiveness to traditional programs and enhanced accessibility. However, implementation remains constrained by adherence challenges, infrastructural and professional limitations, and the digital divide. Research gaps persist in institutionalized populations, long-term follow-up, and standardized protocols.

Conclusion: Movement-based interventions are safe, clinically effective, and scalable strategies to promote healthy aging in frail populations. To maximize their real-world impact, future research should prioritize standardized protocols, pragmatic long-term trials, inclusive recruitment, and equity-focused digital strategies aligned with global healthy aging policies.

Keywords: frailty, pre-frailty, older adults, exercise, physical activity, digital health, cognitive function, adherence, implementation, mini narrative review

Introduction

The rapid demographic transition toward an aging population has led to a marked increase in the number of older adults experiencing early stages of vulnerability, including pre-frailty and frailty.^{1,2} These conditions represent critical windows for intervention: while still potentially reversible, they are strongly associated with functional decline, multimorbidity, and loss of autonomy. Promoting independence through non-pharmacological strategies is therefore a cornerstone of healthy and active aging agendas worldwide.^{1,2}

Operationally, pre-frailty is commonly defined as the presence of one or two frailty criteria, whereas frailty corresponds to three or more criteria or equivalent classifications in validated tools (eg, Fried phenotype, Clinical Frailty Scale).¹⁻⁴ In this review, we use the terms “pre-frail” and “frail” to refer to older adults classified according to these standardized instruments or closely aligned multidimensional indices.¹⁻⁴

To our knowledge, no prior review has integrated clinical, implementation, and digital innovation evidence on movement-based interventions for pre-frail and frail adults in the post-pandemic era.^{2,3} By focusing on studies published between 2019 and 2025, this review captures a transformative period characterized by rapid digital health expansion and increasing use of implementation science frameworks—dimensions that remain largely overlooked in earlier syntheses.

Despite the growing body of evidence on exercise for frailty, most existing reviews have emphasized clinical efficacy alone, often predating the accelerated digital transformation triggered by the COVID-19 pandemic.^{1,2} This mini narrative review is innovative in three key ways. First, it focuses on the transformative 2019–2025 period, when digital health tools and implementation frameworks began reshaping intervention delivery.^{1–4} Second, it integrates clinical, digital, and implementation evidence within a single conceptual model, offering a multidimensional synthesis that has not been previously attempted. Third, it provides a policy-oriented perspective, highlighting translational opportunities to scale movement-based interventions in real-world health systems.^{1,2}

Among such strategies, movement-based interventions—including resistance training, walking, Tai Chi, dance, multicomponent exercise, and increasingly, digitally supported programs—have emerged as particularly promising approaches for pre-frail and frail populations.^{1–4} Over the past two decades, robust evidence from randomized controlled trials and systematic reviews has confirmed their efficacy in improving muscle strength, balance, mobility, cognitive function, and mental health.^{5–8} Additionally, these programs have demonstrated physiological benefits, such as reductions in inflammatory markers and risk of falls, fractures, and postoperative complications.^{4,9–12}

However, the landscape has shifted significantly in recent years. The COVID-19 pandemic, accelerated digital transformation in health systems, and growing attention to implementation science have brought new opportunities and challenges for translating evidence into scalable, context-sensitive interventions. Despite strong clinical efficacy, real-world implementation remains limited by persistent barriers: low adherence, shortage of trained professionals, infrastructural limitations, protocol heterogeneity, and inequitable access in vulnerable territories.^{1,13–16} Even within rigorous trials, methodological inconsistencies—such as heterogeneous inclusion criteria, intervention duration, and outcome measures—limit comparability and impede the formulation of standardized, sustainable policies.^{17–19}

Existing reviews have primarily focused on clinical outcomes and efficacy, often overlooking recent developments in digital delivery models, hybrid intervention formats, and implementation frameworks that are increasingly shaping research and practice in geriatric rehabilitation. As a result, there remains a critical gap in understanding how traditional and emerging movement-based interventions can be integrated, scaled, and adapted to diverse contexts, particularly for pre-frail and frail adults.

Given this scenario, this narrative mini-review aims to synthesize and critically analyze the most recent scientific evidence (2019–2025) on movement-based interventions in pre-frail and frail older adults. Specifically, we examine (i) clinical and functional outcomes, (ii) major barriers and facilitators for implementation, and (iii) emerging trends in digital and hybrid delivery. A total of 36 studies—including systematic reviews, meta-analyses, and randomized controlled trials—were analyzed, focusing on functional, cognitive, inflammatory, and adherence-related outcomes.^{1–3,5,10,14,17,19–21}

By integrating evidence on clinical effectiveness, implementation challenges, and digital innovation, this review seeks to provide a strategic overview to guide future research, policy, and practice in promoting functionality and well-being in old age. To guide the synthesis, [Figure 1](#) presents a conceptual model integrating movement-based interventions, mechanisms of action, and implementation contexts.

Unlike earlier reviews, this synthesis deliberately focuses on the transformative post-pandemic period (2019–2025), integrating digital health, implementation science, and clinical outcomes within a single analytical framework to inform scalable, equity-oriented strategies. Prior syntheses have not examined how implementation frameworks and digital modalities intersect with clinical evidence in this population, leaving a critical gap for policy translation — which this review addresses.

Methods

This mini narrative review synthesizes recent evidence on movement-based interventions for pre-frail and frail older adults, focusing on physical and cognitive outcomes, implementation barriers, and emerging digital strategies to enhance adherence and scalability. The methodological approach follows recommendations for structured narrative reviews, emphasizing iterative

Conceptual Framework for Movement-Based Interventions in Pre-Frail and Frail Older Adults

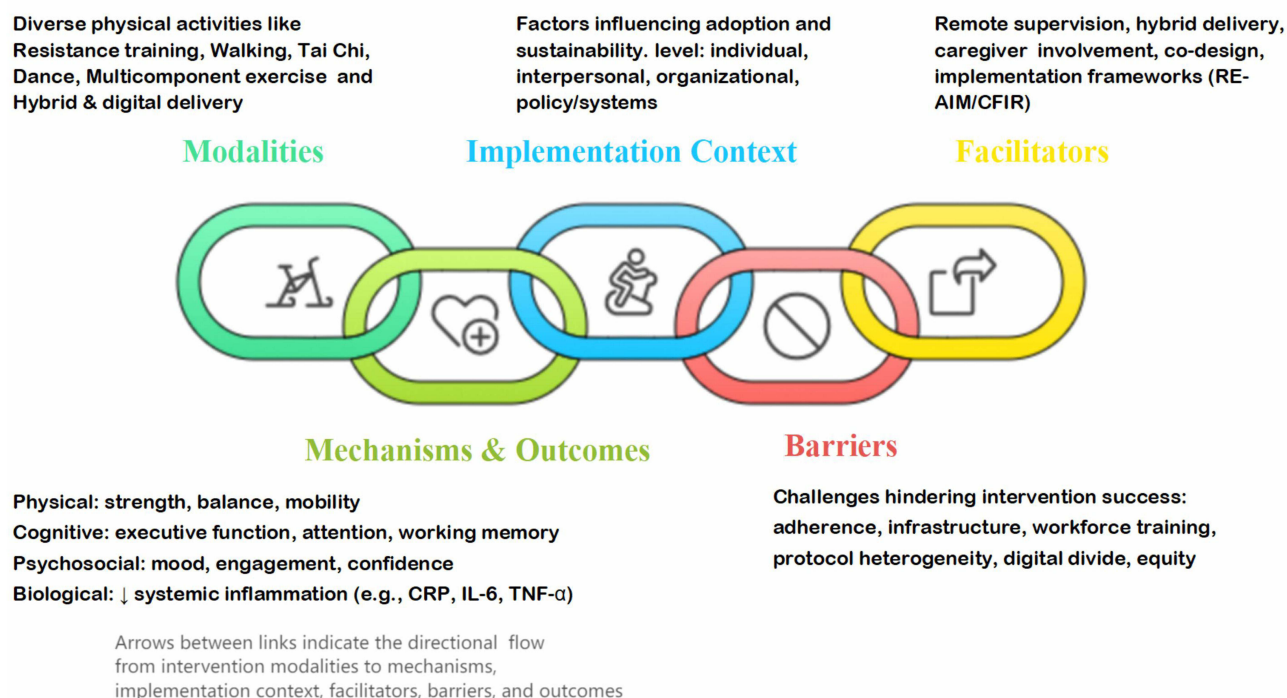


Figure 1 Conceptual model illustrating the integration of movement-based interventions, their mechanisms of action, and multilevel implementation contexts.

Notes: The model highlights how traditional, hybrid, and digital interventions influence physical, cognitive, psychosocial, and biological domains, while their scalability and sustainability are shaped by individual, interpersonal, organizational, and policy-level determinants.

searching, theoretical framing, and transparency.^{22,23} The guiding review question was: “In adults aged ≥ 65 years classified as pre-frail or frail, what movement-based interventions have been evaluated since 2019, and what clinical, digital, and implementation evidence is available in the post-pandemic context? Ethical approval was not required, and no protocol was preregistered.

Study Design and Rationale

A structured narrative review design was adopted rather than a formal systematic review because the underlying evidence is broad and heterogeneous, spanning randomized controlled trials, meta-analyses and systematic reviews, implementation and service studies, and evaluations of hybrid or fully digital modalities. Narrative synthesis is appropriate when interventions, comparators, settings, and outcomes differ substantially and when the goal is to connect clinical effectiveness with contextual and implementation determinants rather than to produce a single pooled effect size.^{22–27}

Conceptually, we worked with a priori domains—population (pre-frail/frail), intervention modality (eg, resistance, multicomponent, Tai Chi, walking, dance, exergames), outcome families (physical, cognitive, psychosocial, biological), and implementation determinants (adherence, feasibility, scalability).^{22,23} These domains were defined before searching and refined iteratively as terminology emerged from the included studies (eg, “hybrid delivery,” “tele-supervision”).^{22,23} Maintaining an explicit domain structure allowed consistent screening, extraction, and cross-study comparison while preserving the breadth needed for an integrative narrative approach.^{27–34}

Search Strategy

A structured literature search was conducted using the Consensus platform (<https://consensus.app>), an academic search engine that aggregates and ranks peer-reviewed publications using advanced semantic analysis. The platform integrates

content from major biomedical and health science databases, including PubMed, MEDLINE, Embase, Cochrane Library, Scopus, Web of Science, and Semantic Scholar, and prioritizes studies by relevance, citation strength, and methodological transparency.

The search involved 21 iterative query rounds, combining population terms (frailty, pre-frailty, older adults), intervention terms (resistance training, multicomponent training, Tai Chi, walking, dance, exergames, digital health), and implementation outcomes (adherence, barriers, feasibility, implementation). Filters restricted records to peer-reviewed articles from 2019–2025^(20–36) Each round refined retrieval through Boolean operators, synonyms, and modality-specific strings to maximize recall while keeping screening manageable. All query strings, filters, and iteration notes were logged to support reproducibility. Details of the iterative semantic search process, eligibility criteria, and quality appraisal are available in [Supplementary Material S1](#).

In addition to the Consensus-assisted search, we manually verified the coverage of key topics by screening reference lists of highly cited reviews and conducting targeted PubMed and Scopus searches for sentinel terms (eg, “frail older adults,” “pre-frailty,” “hybrid exercise program,” “digital Otago”). This triangulation was used to reduce the risk that reliance on a single platform would omit major trials or highly influential syntheses, while still capitalising on the efficiency of semantic search.

In total, 1,049 records were identified. The platform automatically excluded 768 entries that were duplicates or lacked sufficient metadata (eg, missing abstracts). The remaining 281 records proceeded to screening against predefined eligibility criteria. This semi-automated, theory-informed approach ensured reproducibility and efficiency while preserving critical human judgment in downstream screening and synthesis.

Eligibility Criteria and Selection Process

Eligibility criteria were defined a priori and are summarized in [Table 1](#). We included peer-reviewed systematic reviews, meta-analyses, and randomized controlled trials (2019–2025) targeting pre-frail or frail older adults (≥ 65 years), applying structured movement-based interventions (eg, multicomponent or resistance training, Tai Chi, walking, dance, exergames, hybrid/digital delivery), and reporting outcomes in at least one of the following families: physical function (eg, gait speed, SPPB, TUG, balance), cognition, mental health/quality of life, biological/inflammatory markers, or adherence/implementation.

Screening occurred in two stages. First, titles/abstracts ranked by the platform were assessed against inclusion criteria. Second, full texts were evaluated for population specificity (pre-frail/frail), intervention structure and dose (frequency, progression, duration), and outcome relevance. Heterogeneous frailty definitions (eg, Fried phenotype vs Clinical Frailty Scale) were accepted provided the cohort was explicitly described as pre-frail or frail and the intervention met minimal structure. Disagreements were adjudicated by consensus. Of 281 screened records, 205 full texts were assessed; the platform’s quality-ranking (citation metrics, recency, evidence strength, reporting transparency) prioritized 50 studies; a secondary manual check removed 14 for population or outcome mismatch, yielding 36 studies for synthesis. The selection pathway is depicted in the PRISMA-style flow diagram ([Figure 2](#)).³⁵

Table 1 Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies published between 2019 and 2025	Studies published before 2019
Peer-reviewed articles (systematic reviews, meta-analyses, RCTs)	Editorials, protocols, commentaries, narrative reviews without primary data
Interventions targeting <i>pre-frail</i> or <i>frail</i> older adults (≥65 years)	Interventions exclusively targeting robust older adults or other populations
Movement-based interventions (eg, resistance training, multicomponent exercise)	Non-exercise-based interventions (eg, nutrition-only, pharmacological only)
Reported clinical outcomes (eg, strength, mobility, cognition, quality of life)	Did not report health or functional outcomes
Articles written in English	Articles written in languages other than English

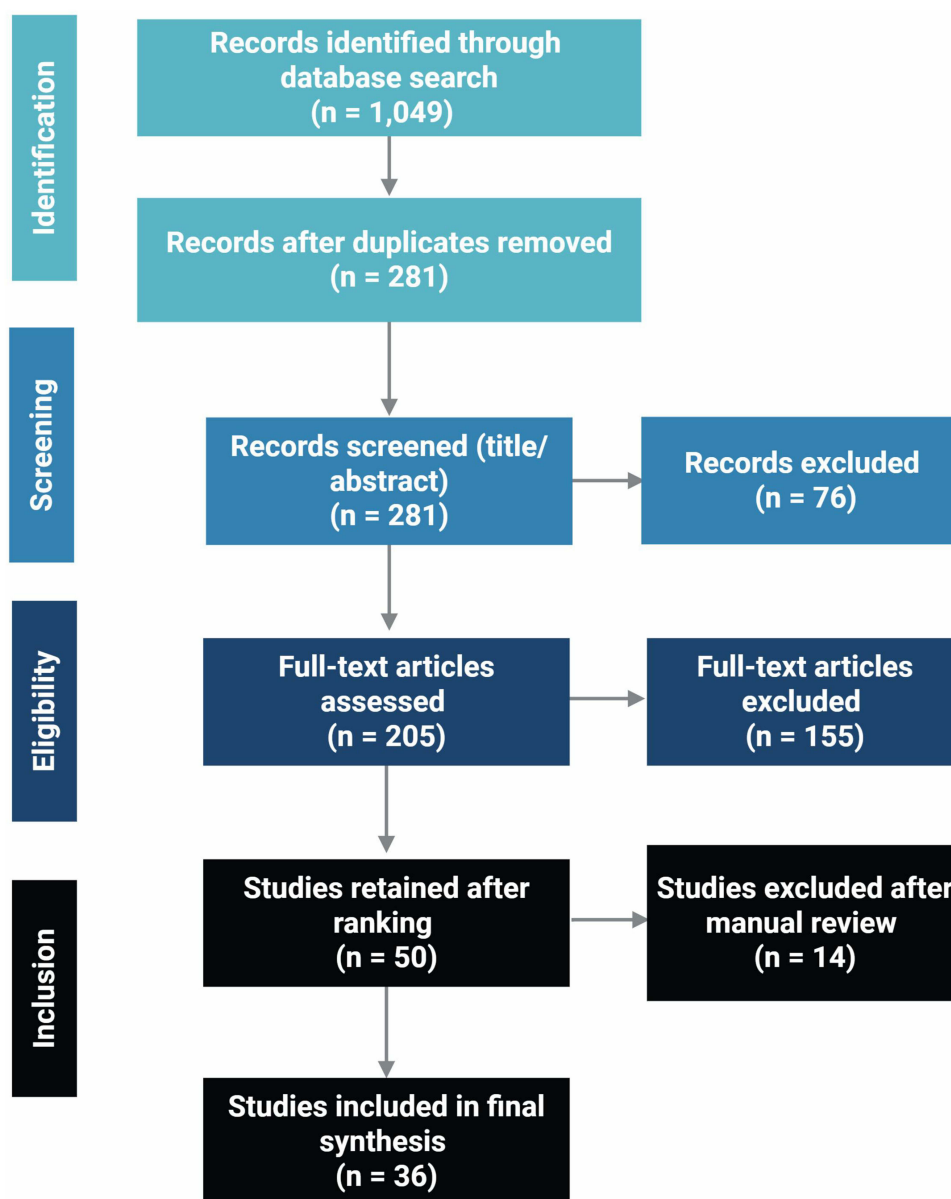


Figure 2 PRISMA flow diagram of the study selection process.

Notes: The initial search identified 1,049 records. After duplicate removal, 281 studies remained for title and abstract screening. A total of 205 full-text articles were assessed for eligibility, with 155 excluded for reasons such as population mismatch, lack of relevant outcomes, or non-exercise interventions. Fifty studies were retained after quality ranking, and 14 were further excluded during manual review. Finally, 36 studies were included in the narrative synthesis.

Data Extraction and Management

We developed a standardized charting form to extract study-level characteristics and outcome data. Fields included bibliographic details; country/setting; frailty definition and baseline severity; sample size and demographics; intervention modality and delivery model (traditional, hybrid, digital); session frequency, progression, and total duration; comparator type; outcomes and measurement instruments; follow-up; and implementation endpoints (adherence, retention, feasibility, fidelity, acceptability). Extraction was conducted by one reviewer and independently checked by a second reviewer, with discrepancies resolved by consensus.

Given heterogeneous instruments across studies, we recorded both direction of effect (improved/no change/worsened) and the most comparable metric when available (eg, gait speed m/s, SPPB points). For multi-arm trials, each movement-relevant arm was extracted separately and cross-referenced to avoid double counting. For reviews/meta-analyses with

overlapping primary trials, overlap was qualitatively mapped to prevent inflation of evidence counts. All extraction decisions (eg, harmonization rules; handling of variably defined adherence) were recorded in a shared log to ensure traceability.

Quality Appraisal/Risk of Bias

Although this is a narrative (non-meta-analytic) synthesis, we applied study-appropriate appraisal to contextualize confidence in the evidence. For systematic reviews/meta-analyses, we considered key domains consistent with AMSTAR 2 (eg, protocol availability; search adequacy; duplicate selection/extraction; consideration of primary-study bias; publication bias).³⁶ For randomized trials, we considered domains aligned with RoB 2 (randomization process; deviations from intended interventions; missing outcome data; outcome measurement; selective reporting).³⁷ Where non-randomized controlled designs were present among ranked records, we flagged serious confounding or selection risks following ROBINS-I.³⁸

Two reviewers independently judged each domain qualitatively (low/some concerns/high) based on information reported in the articles and, when available, [Supplementary Material S1](#). Disagreements were resolved by discussion. Appraisal results were used to nuance the narrative (eg, downgrading confidence where performance or detection bias was likely) rather than to compute quantitative weights.

Data Synthesis and Analytical Approach

We did not perform quantitative meta-analysis due to anticipated heterogeneity in populations, dosing, delivery models, and outcome measurement. Instead, we used a thematic narrative synthesis structured along two axes: (i) intervention modality (resistance, multicomponent, Tai Chi, walking, dance, exergames; traditional vs hybrid/digital delivery) and (ii) outcome families (physical, cognitive, psychosocial, biological), explicitly incorporating implementation endpoints (adherence, feasibility, fidelity). Effect contours were summarized by modality and by dose features (eg, ≥ 12 -week programs; progressive overload; supervised vs unsupervised; community- vs home-based).

To convey effect direction visually, we summarised net improvements or reductions in key outcomes (eg, strength, balance, falls, dropouts) using up- and down-arrows in the modality-level summary ([Table 2](#)) and in the claim–evidence matrix ([Table 3](#)). In [Table 2](#), arrows indicate direction of effects: $\uparrow$ improvement/favourable change; $\downarrow$ worsening/unfavourable change; $\leftrightarrow$ no consistent change; empty cells indicate that the outcome was not reported or was too heterogeneous to classify. This approach is analogous to effect direction plots recommended for narrative syntheses, allowing readers to rapidly appraise which modalities show consistent positive signals and where the evidence remains equivocal.

To enhance translational relevance, convergent patterns were interpreted through an implementation lens, drawing on established frameworks (RE-AIM and CFIR) to organize determinants and support generalizability across settings.^{39,40} When discussing macro-environmental context (eg, policy, workforce, digital infrastructure), we used a PESTEL scaffold (Political, Economic, Social, Technological, Environmental, Legal) to structure external factors that commonly affect reach, adoption, implementation, and sustainment of movement-based programs in aging populations.^{41,42}

Methodological Limitations

This review has limitations inherent to narrative syntheses. No preregistered protocol was filed and language was limited to English, which may introduce selection bias. Reliance on a single meta-engine (Consensus) could miss records not well indexed by its source databases, despite complementary reference-list screening. Heterogeneity in frailty definitions, intervention dosing, and outcome measures precluded quantitative pooling and increases the risk of interpretive subjectivity.

We mitigated these risks by pre-specifying domains, documenting search iterations, conducting two-step screening with adjudication, using standardized extraction with independent checking, applying study-appropriate quality appraisal, and transparently reporting selection counts ([Figure 2](#)). Overall, the approach balances breadth (to capture clinical and implementation evidence) and rigor (to support trustworthy, context-sensitive conclusions). This review is, to our knowledge, the first to leverage an AI-based semantic search engine (Consensus) in combination with RE-AIM/CFIR and PESTEL frameworks to structure both the evidence synthesis and macro-environmental analysis.^{37–42} This integrated approach enables the identification of translational levers for scale-up, beyond traditional efficacy-focused reviews.

Table 2 Characteristics of Included Studies and Interventions (Summary by Modality)

Modality	Study Designs Represented	Typical Dose & Duration*	Delivery Model/ Supervision	Primary Outcomes Reported	Summary of Effects (Direction)**	Adherence & Feasibility (Qualitative)
Resistance training (machines, free weights, elastic bands)	RCTs; SRs/MAs	2–3 sessions/week; progressive overload; ≥8–24 weeks	Mostly supervised (clinic/ community); some home-based with remote check-ins	Strength (handgrip, knee extensors), SPPB, TUG, gait speed	↑ Strength (moderate–large); ↑ SPPB/ TUG/gait when ≥12 weeks and progressive	Higher with supervision and clear progression; logistics and transport can limit access
Multicomponent (strength + balance + endurance ± flexibility)	RCTs; SRs/MAs	2–5 sessions/week; circuit or station-based; ≥12 weeks typical	Clinic/community; hybrid models increasingly used	SPPB, balance tests, gait speed, falls	↑ Global function (SPPB); ↓ Falls when balance+strength combined; benefits scale with duration	Good feasibility in groups; requires scheduling, space, and staff
Mind–body (Tai Chi, Baduanjin, Qigong)	RCTs; SRs/MAs	2–4 sessions/week; 8–24 weeks	Group classes (community) or guided home practice	Balance, postural control, gait; fear of falling; QoL	↑ Balance/postural control; ↓ Fear of falling; some gains in gait	Acceptable and enjoyable; learning curve mitigated by instruction and pacing
Walking programs (structured, progressed)	RCTs; SRs	3–5 sessions/week; step-count or time goals; ≥8–24 weeks	Community/home; occasional tele-coaching	Endurance, gait speed, mobility confidence	↑ Endurance/gait; variable balance effects unless paired with balance/ strength	Easy to implement; adherence improves with feedback/goals; safety education needed
Dance (ballroom, folk, adapted)	RCTs; small trials	2–3 sessions/week; 8–16+ weeks	Group sessions (community); some hybrid	Motor-cognitive, balance, mood, social engagement	↑ Coordination, balance, motivation; benefits in mood/cognition	High acceptability; depends on music/preferences; space and instructor needed
Exergames/digital exercise (game-based balance/strength)	RCTs; pilots	2–4 sessions/week; 8–16+ weeks	Home or clinic with remote monitoring	Balance, executive function, adherence proxies	↑ Engagement; ↑ Balance/motor-cognitive tasks; effects improved with guidance	Sensitive to digital literacy; onboarding and tech support critical
Hybrid/tele-supervised (in-person onboarding + remote follow-up)	RCTs; implementation studies	Frequency mirrors in-person; remote check-ins; ≥8–24 weeks	Mixed: clinic/community + home with telehealth/apps	Same as above + adherence/feasibility	Comparable outcomes to in-person when remote supervision is present; ↓ dropouts vs fully unsupervised	Improves access; requires connectivity and simple interfaces; privacy/safety protocols

Note: *Dose ranges reflect typical protocols reported across included studies (2019–2025). **Direction of effects synthesized narratively from studies included in this review; see Section 3.2 for outcome-specific details and Figure 2 for selection flow. ↑ = improvement in the outcome; ↓ = reduction in an undesirable outcome (eg, falls, dropouts).

Abbreviations: SPPB, Short Physical Performance Battery; TUG, Timed Up and Go; QoL, Quality of Life; RCT, randomized controlled trial; SR/MA, systematic review/meta-analysis.

Table 3 Claims and Evidence

Claim	Evidence Strength	Reasoning	References
Movement-based interventions improve strength, balance, and mobility in pre-frail/frail older adults	Strong	Meta-analyses and systematic reviews of RCTs consistently demonstrate improvements in strength and function	[1,3,5,6,19,25]
Multicomponent and resistance exercises reduce depressive symptoms and improve cognition	Strong	Positive effects on mental health and cognition shown in multiple studies	[1,6,8,21,27–30]
Barriers such as low adherence, structural limitations, and lack of standardization hinder implementation	Moderate	Recurring reports of practical and social implementation challenges	[1,13–16,23,33]
Digital interventions and exergames are promising to increase access and adherence	Moderate	Recent studies show good feasibility and results comparable to conventional exercise	[13,17,20]
No conclusive evidence of sustained improvement in quality of life	Moderate	Mixed results and need for more long-term studies	[11,25,28,36]
Lack of standardization and protocol heterogeneity limits comparability and implementation	Weak	Diversity in methods and outcomes hampers synthesis and recommendations	[16–19]
Movement-based programs are generally safe with low rates of serious adverse events	Moderate	Reported adverse events are typically minor and transient; however, inconsistent reporting limits certainty	[11,12]
Dosing and supervision moderate functional gains and fall reduction	Moderate	Repeated signals across RCTs/SRs that dosing and supervision moderate effects on function and falls	[2,19,26,31]
Hybrid/digital delivery can enhance reach but requires usability support and privacy safeguards	Moderate	Feasible and comparable when onboarding, simple interfaces, and remote supervision are in place	[13,17,19,20]
Long-term maintenance and effects on institutionalization/mortality remain uncertain	Weak	Few studies with ≥12-month follow-up and limited economic/implementation evaluations	[34,35]

Results

Characteristics of Included Studies and Interventions

This review included 36 peer-reviewed studies (2019–2025), comprising systematic reviews, meta-analyses, and randomized controlled trials. All included participants were adults aged ≥ 65 years, classified as pre-frail or frail using criteria like the Fried phenotype or Clinical Frailty Scale.^{1,3,21,22} Interventions were delivered in clinical, community, and home-based settings.^{10,11,23}

Although heterogeneous, interventions shared a focus on physical activity to address frailty-related decline. Common approaches included resistance training, multicomponent programs (strength, balance, endurance, flexibility), mind–body practices (Tai Chi, Baduanjin, Qigong), walking, and dance. Several studies integrated digital tools like exergames, mobile apps, and telehealth.^{5,6,20,24,25} Program durations ranged from 8 weeks to 24 months, with 2–5 sessions/week and progressive intensity. Sample sizes ranged widely, and baseline status varied from mild to advanced frailty. Most studies included both sexes, though some had predominantly female samples.

Across studies, intervention delivery models clustered into three formats: (i) supervised in-person sessions (clinic, community centers), (ii) hybrid models (periodic face-to-face plus remote follow-up), and (iii) fully home-based programs with telemonitoring or app-based guidance.^{5,6,20,24,25} Supervision intensity (individual vs small groups) and professional background (physiotherapists, exercise specialists, community health workers) varied by setting,^{10,11,23} with hybrid models increasingly employed post-pandemic to reduce travel burden while maintaining oversight.

Frailty was operationalized with diverse tools beyond Fried and CFS (eg, performance composites and sarcopenia proxies), and inclusion often encompassed pre-frail strata to target earlier reversibility.^{1,3,21,22} Dosing parameters were commonly progressive (frequency and/or resistance load), but progression criteria and adherence definitions were inconsistently reported, complicating between-study comparison of “effective dose” and fidelity. To enhance transparency, key study descriptors are summarized in Table 2 (study design, setting, frailty definition, modality, dose, supervision, adherence).

Main Effects of Movement-Based Interventions

Movement-based interventions consistently demonstrated positive outcomes across multiple domains of health and function in pre-frail and frail older adults. Muscle strength gains—especially handgrip and quadriceps—were commonly reported and linked to reduced disability.^{3,5} Functional performance gains were observed in gait speed, balance tests, and composite scores such as the Short Physical Performance Battery (SPPB) and the Timed Up and Go (TUG) test.^{2,19,26} Such improvements were generally more significant in interventions that included a progressive overload component and lasted at least 12 weeks.

Multicomponent and mind–body programs were particularly effective in preserving or enhancing balance and mobility, especially in populations with high fall risk.^{20,25} For example, Tai Chi and Baduanjin exercises were associated with enhanced proprioception and postural control, which translated into better performance in dynamic balance tasks.^{8,27} Dance also improved coordination and motivation.^{18,28}

In the domain of cognitive health and emotional well-being, several studies demonstrated that regular movement, especially when it involved cognitive engagements in dance or exergaming, was associated with improvements in executive functions, working memory, and attention.^{21,29} These benefits were often accompanied by reductions in depressive symptoms and anxiety, suggesting that the psychosocial aspects of group exercise and motor–cognitive integration may be especially beneficial in frail populations.^{6,22,30}

Falls and fracture prevention emerged as a major outcome in 13 studies. Programs combining balance + strength reduced fall incidence and improved confidence in mobility-related activities.^{7,31,32} Supervision (clinic or tele-supervised) and adjunct home safety education were associated with the greatest reductions in fall-related events.^{7,31,32} Where reported, fear of falling declined alongside functional gains, supporting a mechanism of improved self-efficacy.

Some studies examined biological markers. Reductions in systemic inflammation—C-reactive protein (CRP), interleukin-6 (IL-6), tumor necrosis factor alpha (TNF- α)—were reported after structured training, especially among frail adults post-illness or surgery.^{9,11,12} These findings align with evidence that exercise mitigates chronic low-grade

inflammation and may partially mediate improvements in mobility and fatigue.^{9,11,12} Importantly, several meta-analyses also suggested favorable changes in frailty status and sarcopenia classification when strength/endurance components were combined, occasionally with brief nutrition education.^{6,21,22} While full reversal of frailty was uncommon, clinically meaningful gains in reserves and independence were frequently documented.

A practical dose–response signal was observed: interventions of ≥ 12 weeks, with explicit progression and at least 2–3 sessions/week, more consistently improved performance metrics than shorter or non-progressive programs.^{2,19,26} Subgroup trends suggested larger gains in pre-frail vs established frailty, and in supervised vs unsupervised delivery, although heterogeneity in dosing and adherence precluded firm stratified estimates. Where follow-up existed beyond the active phase, partial maintenance of gains was reported, particularly when programs included booster sessions or self-management prompts.

Barriers to Implementation

Despite promising effects, implementation in real-world contexts remains challenging. Low adherence—especially among individuals with cognitive or emotional challenges—was a major barrier.^{1,16} Transportation difficulties, lack of social support, fear of injury, and reduced motivation were repeatedly cited as deterrents^{14,15}. Facilitators included structured group settings, family involvement, and supervision by trained professionals.^{1,16}

At the structural level, the absence of adapted spaces, trained personnel, and funding for long-term programs was reported in both high- and low-income settings.^{23,33} Community centers and primary care facilities frequently lacked resources to implement comprehensive programs for older adults, especially tailored to pre-frail or frail subgroups.

A key limitation is the lack of standardization. The heterogeneity in exercise type, duration, intensity, frequency, and outcome measures hinders meta-analytic synthesis and the formulation of universal guidelines^{17–19}. For instance, “multicomponent training” may refer to markedly different interventions across studies, limiting generalizability and scalability.

The digital divide emerged as a salient barrier. While digital aids (apps, tele-exercise, exergames) can reduce travel and increase touchpoints, many older adults have limited digital literacy, device access, or broadband connectivity—issues that disproportionately affect rural and low-income areas.^{13,20} Programs that failed to address onboarding, caregiver support, or usability often experienced higher dropout^{13,20}. Conversely, hybrid models that paired initial in-person training with remote supervision, simple interfaces, and technical support reported better continuity.

Reporting on adverse events and program costs was inconsistent. Where described, adverse events were typically minor (eg, transient musculoskeletal soreness), but under-reporting limits inferences about safety profiling in advanced frailty. Cost elements (staff time, equipment, remote platforms) were seldom quantified, constraining assessments of economic feasibility and scalability. To aid translation, barriers and facilitators are summarized in Table 4 (adherence, resource needs, delivery logistics), and cross-referenced in the PESTEL conceptual mapping (macro-level determinants are presented in the PESTEL diagram in the Discussion (Figure 4).

When mapped onto implementation frameworks, most of these obstacles cluster within the Reach and Adoption dimensions of RE-AIM (limited identification and referral of pre-frail/frail adults, exclusion of those with severe cognitive or mobility impairments), the Implementation dimension (insufficient staff training, lack of fidelity monitoring, digital usability problems), and the Maintenance dimension (absence of long-term funding or institutionalisation in routine workflows). Within CFIR, they correspond to outer-setting issues (fragmented policies, unstable funding, digital infrastructure), inner-setting constraints (competing priorities, limited physical space and equipment), intervention characteristics (complexity of multicomponent and hybrid programmes), and individual-level determinants (motivation, fear of injury, caregiver burden). This framing helps explain why efficacious models remain underused in many real-world services.

Innovations and Emerging Trends

This section highlights recent trends that represent a paradigm shift in how movement-based interventions are delivered and evaluated.

Table 4 Implementation Barriers and Facilitators Mapped to PESTEL/Implementation Domains, with Practical Mitigation Strategies

Domain (PESTEL/ Implementation)	Specific Issues Reported	Practical Mitigation Strategies (Actionable)	Implications for Scale-Up
Individual (Social/Clinical)	Low motivation; fear of falling; cognitive symptoms (depression, anxiety); multimorbidity; fatigue	Brief motivational interviewing; graded exposure to challenging tasks; safety education; individualized targets; caregiver inclusion	Improves initial uptake and reduces early dropout; requires brief training for staff
Program design (CFIR – Intervention characteristics)	Heterogeneous dosing; unclear progression; low fidelity; limited reporting of adverse events	Define minimum effective dose (≥ 12 weeks; progression rules); session checklists; fidelity logs; AE reporting templates	Supports replication and guideline development; enables quality assurance
Supervision & workforce (Organizational)	Limited trained personnel; variable supervision intensity; group size constraints	Task-sharing (train CHWs/fitness staff); small-group formats; instructor training packages; supervision algorithms	Expands capacity without loss of quality; enhances safety and adherence
Space & equipment (Environmental/Organizational)	Lack of adapted spaces/equipment (weights, balance tools); scheduling conflicts	Low-cost kits (elastic bands, chairs, cones); mobile carts; shared community spaces; scheduling blocks	Reduces capital barriers; facilitates community adoption
Access & transport (Social/Environmental)	Travel burden; rural distance; weather barriers	Hybrid delivery; transport vouchers; community hubs; local walking circuits; home-safety add-ons	Increases reach and equity; supports continuity during disruptions
Digital literacy and tech access (Technological)	Limited device familiarity; connectivity gaps; complex interfaces	In-person onboarding; caregiver tech support; simple UI; telephone/video alternatives; printed guides	Enables hybrid/home programs at scale; lowers digital exclusion
Data privacy and safety (Legal/Policy)	Concerns with tele-supervision liability; data protection	Written protocols; consent and privacy notices; incident workflows; secure platforms	Builds trust; eases institutional approval and reimbursement
Cost & reimbursement (Economic)	Unclear costs; limited funding; sustainability	Micro-costing; cost-per-participant dashboards; integrate with primary care; partnerships (municipal/community)	Supports business cases and long-term funding
Community & social support (Social/CFIR – Outer setting)	Low social engagement; caregiver overload	Group formats; peer support; flexible scheduling; respite integration	Improves adherence and satisfaction; strengthens community ties
Reporting & evaluation (RE-AIM)	Inconsistent adherence metrics; limited long-term follow-up	Standardize adherence definitions; set 3–6–12-month follow-ups; simple outcome sets (SPPB, TUG, falls)	Improves comparability; informs maintenance and policy decisions

Abbreviations: AE, adverse events; CHW, community health worker; CFIR, Consolidated Framework for Implementation Research; RE-AIM, Reach, Effectiveness, Adoption, Implementation, Maintenance; UI, user interface.

Recent years have witnessed growing interest in technology-enhanced interventions for frail older adults. Digital tools—wearable sensors, video-guided sessions, exergames, and AI-based coaching—have demonstrated potential to maintain engagement, facilitate real-time feedback, and personalize progression.^{13,17} Notably, digital adaptations of established programs (eg, Otago) have shown similar or superior outcomes when delivered remotely, provided that remote supervision and appropriate guidance are in place.²⁰

Across digital and hybrid interventions, several “active ingredients” emerged as plausible drivers of adherence and effectiveness. These included remote supervision and coaching via video calls or messaging, automated reminders and progress feedback, simple gamification elements (eg, points, challenges, visual progress bars), integration with wearable sensors or inertial measurement units for real-time monitoring, and asynchronous libraries of exercise videos that participants could access on demand. Studies that combined these components with clear safety scripting and opportunities for human support tended to report better dose attainment, higher satisfaction, and fewer dropouts than low-touch or purely self-directed digital formats.

Emerging trends also include deliberately hybrid models that integrate in-person “anchors” (for assessment, onboarding, and progression) with remote follow-up, messaging, or exergames between sessions. Such architectures appear particularly promising for frail or post-acute populations, as they blend the reassurance and tailoring of supervised care

with the flexibility and reach of home-based practice, paving the way for more personalised and scalable exercise prescriptions.¹⁹ In addition, some platforms have begun applying predictive algorithms to profile users and anticipate individual response, paving the way for precision exercise prescriptions.^{18,22}

A concurrent methodological shift is the adoption of implementation science frameworks to evaluate reach, adoption, fidelity, and sustainment. Several studies employed RE-AIM and CFIR to structure evaluation and inform scale-up strategies under routine conditions.^{14,33} This shift supports pragmatic outcomes (eg, adherence, provider workload) alongside clinical endpoints, and aligns with co-design approaches that incorporate patient/caregiver input to improve usability and equity.

Importantly, many of these innovations were accelerated by the COVID-19 pandemic, which forced rapid reconfiguration of services and temporarily widened acceptance of remote and hybrid care. However, very few studies explicitly examined how these system-level shifts influenced equity, long-term sustainability, or integration into routine care pathways. Post-pandemic, there is a risk that digital components remain fragmented “projects” rather than being consolidated into enduring service models aligned with primary care and geriatric networks.

Finally, the convergence of low-tech solutions (printed guides, phone calls, community volunteers) with selective digital layers (asynchronous video, simple reminders) is a practical innovation for equity—bridging access gaps while retaining personalization. Future research directions emerging from these trends include (i) minimum effective dose and progression rules by frailty severity, (ii) strategies for long-term maintenance beyond 6–12 months, and (iii) core reporting standards for adherence, fidelity, and adverse events to reduce heterogeneity and accelerate guideline development.

Discussion

The findings of this mini review support movement-based interventions as safe and effective strategies for promoting physical and cognitive health in pre-frail and frail older adults. Across 36 studies, improvements in muscle strength, balance, mobility, executive function, and psychological well-being were consistently observed, particularly when interventions began in early decline stages. These benefits were evident across various settings, community, hospital, and home, and across different modalities, from resistance training to digital programs.^{1,3,20,21,25} Unlike earlier reviews that largely predate the post-pandemic expansion of hybrid/digital delivery and implementation science, our synthesis deliberately concentrates on 2019–2025 and integrates clinical, digital, and translational evidence within a single framework. This period captures the inflection toward remote supervision, app-supported progression, and explicit use of RE-AIM/CFIR to address adoption and sustainment in routine care, offering a more implementation-ready perspective than prior efficacy-centric summaries.

Multicomponent approaches target multiple systems and showed greater benefits. Programs combining aerobic and resistance components, as well as balance and coordination exercises, consistently demonstrated superior functional outcomes.^{6,22} Mind-body activities like Tai Chi also promoted cognitive and emotional well-being.^{8,18,27} Benefits observed across modalities are consistent with multi-level mechanisms: (i) neuromuscular adaptations (motor unit recruitment, rate of force development) supporting strength and postural control; (ii) anti-inflammatory effects and improved metabolic efficiency that may partially mediate fatigue and mobility gains; and (iii) motor–cognitive coupling, attentional engagement, and social reinforcement (particularly in mind–body and dance interventions) that plausibly underlie changes in executive function, mood, and fear of falling. These convergent pathways help explain why multicomponent and mind–body programs frequently outperform single-domain prescriptions.

A notable strength of recent literature is the growing integration of digital health solutions, exergames, remote supervision, and mobile apps, which have shown comparable effectiveness to traditional modalities while offering added benefits in terms of accessibility and personalization.^{13,17} These strategies may be particularly valuable for addressing structural barriers such as transportation issues, reduced mobility, and geographic isolation. However, the implementation of digital interventions must be accompanied by adequate support for digital literacy and access, particularly in underserved populations.^{16,20} Comparable effectiveness of digital or hybrid programs hinges on usability and trust. In practice, older adults benefit from brief in-person onboarding, simplified interfaces, caregiver/peer support, and clear safety scripts for home exercise. Written privacy notices, secure platforms, and incident workflows are essential to address liability

concerns and increase acceptance in primary-care and community settings, particularly where digital literacy and connectivity vary.

Challenges remain especially adherence due to fear of injury, low motivation, and depression symptoms that hinder regular participation.^{14,15} Strategies to improve adherences such as goal setting, motivational interviewing, caregiver involvement, and culturally tailored programs—should be prioritized in future research and implementation efforts. Consistent with behavioral science, programs that combine goal setting, action planning, self-monitoring (logs or simple step targets), timely feedback, and social support (group sessions or buddy systems) achieve better continuity than information-only approaches. Where feasible, “booster” contacts after program completion (eg, monthly check-ins, brief refresher blocks) support maintenance of functional gains and reduce regression toward baseline. Embedding these elements *a priori*—as part of the intervention “dose”—should be routine for pre-frail and frail populations.

Another persistent challenge is the heterogeneity of intervention protocols. Considerable variation exists in the frequency, intensity, duration, and content of exercise programs, even among studies classified under the same category (eg, multicomponent training). This lack of standardization limits cross-study comparability and poses a barrier to the development of clinical guidelines and scalable public health strategies.^{18,19} Outcome measures are inconsistent, with some studies focusing exclusively on physical function, while others assess biochemical, cognitive, or psychosocial parameters. This heterogeneity limits the comparability of findings and the formulation of standardized recommendations. The adoption of unified, patient-centered outcome frameworks could enhance the rigor and applicability of future trials.^{18,19}

In addition to these limitations, methodological concerns must also be acknowledged. Risk of bias remains a relevant issue, particularly in studies with small sample sizes, lack of blinding, or reliance on self-reported outcomes, which may overestimate effectiveness. Moreover, selective exclusion of participants with advanced frailty, cognitive impairment, or multimorbidity introduces systematic bias and limits the generalizability of findings to those most in need of interventions.^{11,12} Variability in trial quality, including inadequate reporting of adherence, adverse events, and fidelity of intervention delivery, further hampers robust synthesis. Addressing these methodological gaps through rigorous design, transparent reporting, and inclusive recruitment will be essential for advancing the field and informing clinical guidelines.

Long-term effects on outcomes like institutionalization and mortality remain understudied. Only a minority of the included studies followed participants beyond six months, and few incorporated economic evaluations or real-world implementation assessments^{34,35}. As such, future studies should adopt longer follow-up periods, pragmatic designs, and cost-effectiveness analyses to support health policy decisions and health system planning. To reduce heterogeneity and accelerate translation, future trials should pre-specify: (i) minimal effective dose rules (duration, progression, supervision intent); (ii) a core outcome set spanning function (eg, gait, SPPB/TUG), mood, and participation; (iii) a common adherence definition with numerator/denominator and reasons for missed sessions; (iv) fidelity checks (delivery, receipt, enactment); and (v) complete adverse-event reporting. Attention to publication bias and small-study effects is warranted given the preponderance of modest sample sizes; routine use of prospective registration and publicly accessible protocols/supplements would improve interpretability.

Although most included studies were high quality, mainly systematic reviews or meta-analyses, many excluded individuals with severe frailty, cognitive impairment, or multimorbidity, who most need interventions.^{11,12} Broader inclusion is essential for equity.

Finally, the field is beginning to benefit from implementation of science frameworks. Studies that incorporate tools such as RE-AIM and CFIR^{39–42} are better positioned to identify multilevel barriers and facilitators, engage stakeholders, and design interventions that are both effective and feasible in real-world systems.^{14,33} This shift is especially relevant in the context of aging populations and constrained health budgets, where scalable and sustainable interventions are urgently needed.

For health systems planning, three levers are immediately actionable:¹ triage and referral pathways in primary care that route pre-frail/frail adults to multicomponent programs with built-in progression and balance work;² task-shifting with training packages for community health workers/fitness staff under physiotherapist oversight, expanding reach without compromising safety; and³ reimbursement and commissioning models that recognize supervised hybrid delivery

Movement-Based Interventions: PESTEL Analysis

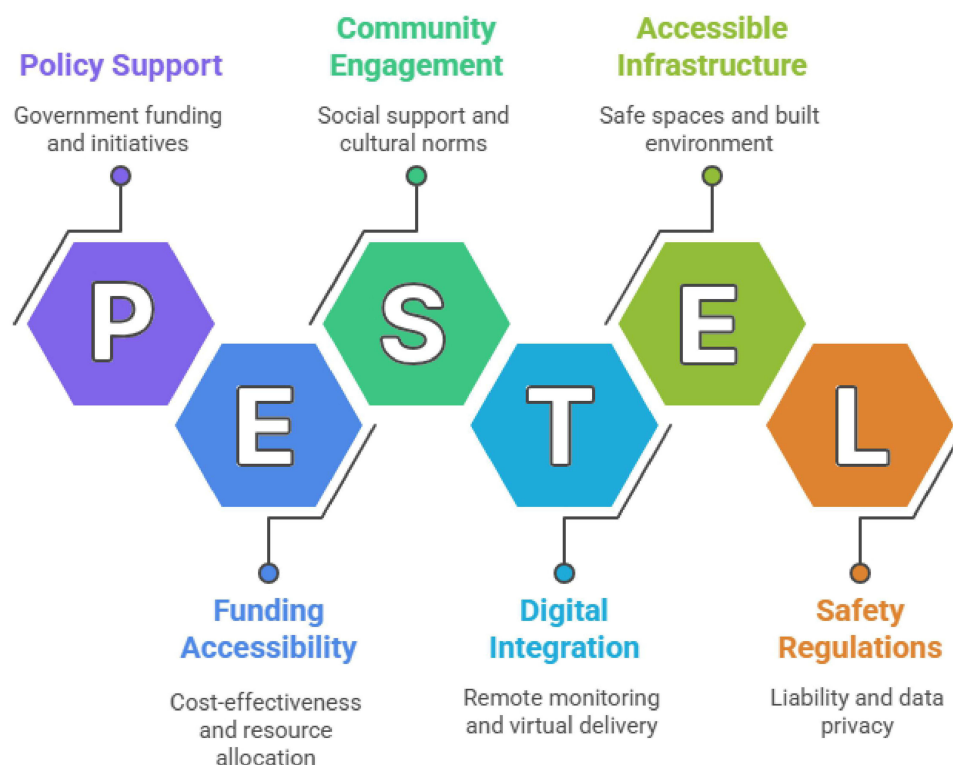


Figure 3 PESTEL analysis of movement-based interventions for pre-frail and frail older adults.

Notes: The diagram summarizes macro-environmental determinants—Policy (government initiatives), Economic (funding, cost-effectiveness), Social/Community (social support, cultural norms), Technological (digital integration, remote monitoring/tele-exercise), Environmental/Infrastructure (safe spaces, built environment), and Legal/Safety (liability, data privacy)—that shape program reach, adoption, implementation, and sustainment. See Table 3 for actionable strategies mapped to each domain.

and low-cost equipment kits. Mapping these levers to RE-AIM/CFIR determinants and the PESTEL canvas can guide scale-up under resource constraints.^{39–42}

To situate these findings within the macro-environment that enables or constrains scale-up, Figure 3 presents a PESTEL analysis (Political, Economic, Social, Technological, Environmental, Legal) highlighting how policy support, funding/accessibility, community engagement, digital integration, infrastructure, and legal/safety regulations influence reach, adoption, implementation, and maintenance.^{39–42}

In summary, movement-based interventions represent a cornerstone of frailty prevention and management strategies. Their multifaceted benefits, physical, cognitive, emotional, and systemic, are well established in controlled environments. However, translating this evidence into widespread, equitable, and lasting real-world impact will require continued investment in standardization, innovation, and implementation research.

Research Gaps and Future Directions

Despite consistent evidence supporting the benefits of movement-based interventions for pre-frail and frail older adults, several critical gaps remain. Addressing these gaps is essential to ensure that interventions are not only effective in controlled settings but also scalable, sustainable, and equitable in real-world contexts. The priorities below outline a practical research agenda.

Long-Term Pragmatic Trials

Most included studies reported outcomes over short- to medium-term periods (<6 months), limiting conclusions about durability. Few trials incorporated ≥12-month follow-up or assessed institutionalization, morbidity, and mortality.^{34,35}

Future pragmatic trials should include extended follow-up and health-economic evaluations to strengthen policy recommendations and guide resource allocation.^{34,35}

Standardization of Intervention Protocols

Marked heterogeneity in frequency, intensity, duration, and content—especially within “multicomponent” and “resistance” programs—reduces comparability and complicates guideline development.^{17–19} Protocol templates specifying progression rules, supervision intent, and safety scripting would enhance synthesis and translation.^{18,19}

Core Outcome and Reporting Standards

To reduce heterogeneity further, studies should adopt a core outcome set spanning function (eg, gait speed, SPPB/TUG), cognition, mood/quality of life, participation, and adverse events, alongside a minimal reporting checklist for adherence and fidelity. Standardized definitions (numerator/denominator; reasons for missed sessions) and routine fidelity checks would enable meta-research and accelerate guideline formation.^{18,19}

Maintenance and Booster Testing

Evidence suggests more consistent gains with progressive programs of ≥ 12 weeks, yet maintenance beyond the active phase is underexplored.^{2,19,26} Trials should pre-specify maintenance phases (eg, 6–12-month boosters), criteria for clinically meaningful change/decay, and low-burden strategies (brief check-ins, refresh blocks) to support long-term function.

Inclusion of Vulnerable and Underrepresented Populations (Equity-by-Design)

Many trials excluded individuals with severe frailty, cognitive impairment, multimorbidity, sensory deficits, or social vulnerability, thereby limiting both generalisability and equity. Future programmes should adopt equity-by-design principles: co-designing content and delivery with pre-frail/frail adults and caregivers; actively recruiting those in lower socioeconomic strata, rural areas, and long-term care; incorporating flexible formats (eg, seated options, shorter bouts, pacing strategies); and building in support for caregivers and community health workers. Implementation studies should routinely report equity-relevant stratifiers (eg, age, sex/gender, education, income, living arrangement, digital literacy) and assess whether benefits differ across subgroups.^{11,12}

Digital Inclusion and Technological Adaptation

While digital tools, exergames, and remote programmes show feasibility and promising effects, they also risk amplifying disparities if not deliberately adapted.^{13,14,33} Digital inclusion requires low-complexity interfaces, options for audio or large-print content, offline or low-bandwidth modes, and the possibility of caregiver-mediated use. Ethical considerations include transparent communication about data use, secure platforms that protect privacy, and attention to potential algorithmic biases (eg, step-count or movement-recognition thresholds that under-detect very slow gait or assistive device use). Pilot work should explicitly assess usability, acceptability, and perceived safety among the oldest and frailest participants, not only among digitally confident early adopters.^{14,33,39–42}

Integration of Implementation Science

Only a minority of studies used formal implementation frameworks. Embedding RE-AIM/CFIR from design through evaluation yields more actionable insights on reach, adoption, fidelity, and sustainment, and supports scale-up under real-world constraints.^{14,33,39–42}

To complement this agenda, [Figure 4](#) presents a matrix of research gaps across outcomes (eg, strength, cognition, quality of life) and subpopulations (community-dwelling, frail, institutionalized). Darker cells indicate denser evidence; “GAP” cells highlight underexplored domains—particularly digital strategies, institutionalized populations, and long-term quality-of-life trajectories—mirroring calls for longer follow-up,^{34,35} broader inclusion,^{11,12} and targeted digital solutions to bridge the “digital divide”.^{13,20}

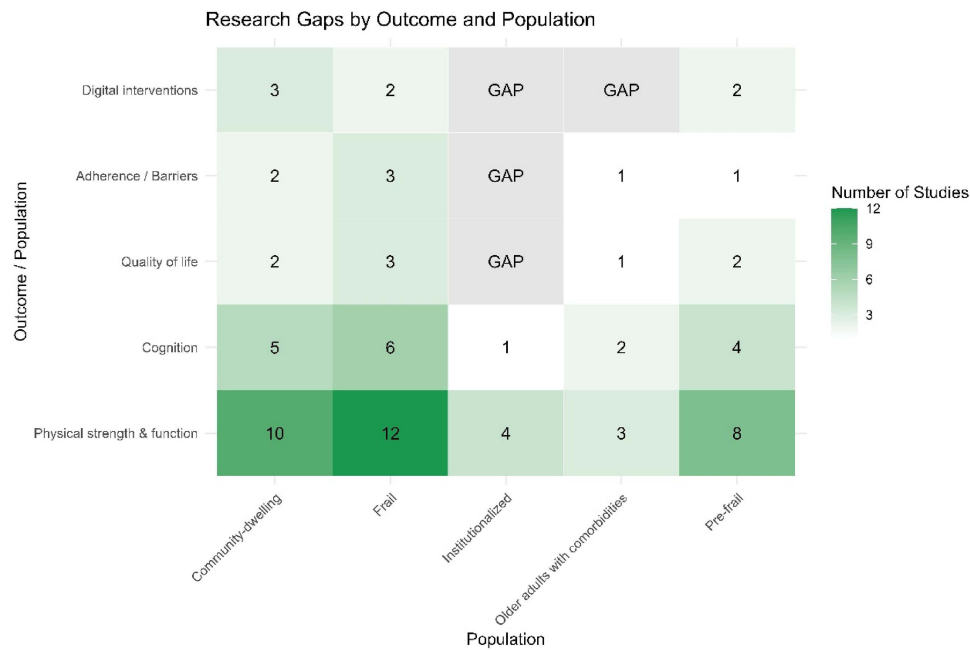


Figure 4 Matrix of research gaps across intervention outcomes and older adult subpopulations.
Notes: The matrix depicts the distribution of evidence across key outcomes (eg, strength, mobility, cognition, quality of life) and population groups (eg, community-dwelling, pre-frail, frail, institutionalized). Darker cells indicate denser evidence. Cells marked as “GAP” highlight underexplored domains, particularly digital interventions, institutionalized populations, and long-term quality-of-life trajectories, emphasizing priorities for future research.

Claims and Supporting Evidence

To synthesize the findings of this mini-review and facilitate a clearer understanding of the most relevant patterns, we summarized the main claims emerging from the included studies along with the strength of supporting evidence. The claims were grouped thematically, based on recurring topics such as improvements in physical and cognitive outcomes, adherence challenges, and the potential of digital interventions.

Each claim is evaluated in terms of:¹ strength of evidence, based on the consistency and design of supporting studies;² underlying rationale, grounded in the theoretical or empirical reasoning presented across studies; and³ key references that substantiate the claim. This structured synthesis helps identify areas of consensus, ongoing controversy, and future research needs, key claims and strength of evidence are summarized in Table 3.

Conclusion

This mini narrative review confirms that movement-based interventions—particularly multicomponent and resistance-based programmes—consistently improve strength, balance, mobility, and related functional outcomes in pre-frail and frail older adults, with additional benefits for cognition, mood, and inflammatory markers in selected populations. At the same time, important evidence gaps remain for highly frail, multimorbid, and institutionalised groups, as well as for long-term quality-of-life and economic outcomes.

To maximise impact in the post-pandemic era, future efforts should (i) standardise and transparently report intervention dose, progression, and core outcome sets; (ii) prioritise hybrid models that combine supervised anchors with flexible home-based practice and low-tech options; (iii) embed programmes within routine primary care and geriatric pathways using RE-AIM and CFIR to guide scale-up; and (iv) adopt equity-by-design and digital inclusion strategies that address the needs of the most vulnerable older adults. Movement-based interventions will only fulfil their potential as a cornerstone of healthy ageing if they are not only clinically effective, but also feasible, sustainable, and equitably available across diverse health and social care contexts.

Declaration of AI Tool Use

During the preparation of this work, the author(s) used ChatGPT (OpenAI) to assist with drafting, language editing, and formatting of sections of the manuscript, including suggestions to improve clarity and structure in English. After using this tool, the author(s) reviewed and edited the content as necessary and take full responsibility for the content of the publication.

Data Sharing Statement

Data sharing is not applicable to this article, as no new datasets were generated or analyzed during the current study. All references used are publicly available in the cited literature.

Ethics Approval and Consent to Participate

Not applicable. This study is a narrative review and did not involve human participants, data, or biological material.

Consent for Publication

Not applicable. No individual person's data are included in this article.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Andressa Crystine da Silva Sobrinho (ACSS) conceived and designed the review, led the literature search, data extraction and narrative synthesis, and drafted the first version of the manuscript. Guilherme Da Silva Rodrigues (GDSR) contributed to study selection, data extraction and synthesis of results. Grace Angélica Oliveira Gomes (GAOG) provided gerontology expertise, contributed to the interpretation of findings and critically revised the manuscript, particularly the sections on implementation barriers and facilitators. Carlos Roberto Bueno Júnior (CRBJ) supervised the project, provided conceptual and methodological input and critically revised all versions of the manuscript.

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Disclosure

The authors declare that they have no competing interests.

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