Current Physiotherapy-Focused Approaches to Sustainable Exercise

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To Cite This Chapter:
Takı, F. N., & Akdağ, K. Ç. (2025). Current physiotherapy-focused approaches to sustainable exercise. In S. Erten & C. A. Aksoy (Eds.), *Current studies in basic sciences, engineering and technology 2025* (pp. 350–359). ISRES Book Series. ISRES Publishing.

Introduction

The Purpose Of Sustainable Exercise Within Physiotherapy Practice

Physiotherapy stands as a key discipline in the comprehensive management of a wide array of conditions, encompassing musculoskeletal disorders, neurological diseases, and chronic pain states (O'Halloran et al., 2014). Despite established protocols for acute phase management, the discipline faces a persistent, highly challenging, and economically consequential hurdle: securing long-term adherence (adherence) to the prescribed exercise regimen and ensuring the sustained maintenance of functional gains after acute symptoms have subsided and direct clinical oversight has concluded.

This chapter's primary objective is to present a comprehensive, evidence-based Biopsychosocial (BPS) model designed to mitigate the prevailing high rates of exercise non-adherence and program dropout within physiotherapy. This proposed model systematically harmonizes biomechanical sensitivity with established behavioral sciences, including Cognitive Behavioral Therapy (CBT) and Motivational Interviewing (MI), alongside strategic technological integration. Successful long-term clinical outcomes are fundamentally dependent on a professional paradigm shift where the physiotherapist's role evolves dramatically from being solely an "exercise prescriber" to functioning as a "behavioral coach" who actively nurtures and supports the patient's capacity for autonomy and self-management (Morley et al., 1999).

The Concept of Exercise Sustainability in the Physiotherapy Process

Exercise sustainability is conceptually defined as the patient's active, enduring commitment to continuing rehabilitation goals, maintaining independent functional capacity, and proactively preventing secondary injuries long after the therapeutic guidance of the physiotherapist has ceased (O'Halloran et al., 2014). This definition implies a commitment beyond the mere mechanical execution of assigned exercises. Crucially, it necessitates the individual's successful adaptation of acquired skills and knowledge into the complexities of their daily life and the effective utilization of self-management skills to proactively handle potential setbacks, such as pain recurrence or the inevitable decline in motivation (Morley et al., 1999).

Dropout Rates and Clinical Outcomes

The correlation between high patient participation and adherence with superior clinical outcomes is direct and well-documented. However, adherence rates for unsupervised home exercise programs (HEPs) remain distressingly low, rendering high dropout rates a significant concern for the clinical utility and cost-effectiveness of physiotherapy interventions (O'Halloran et al., 2014).

Quantitative meta-analytic evidence confirms specific risks associated with exercise dosing: for patients with Type 2 Diabetes Mellitus (T2DM), high-intensity exercise training protocols carried a notably higher risk of program abandonment compared to moderate-intensity protocols, quantified by an Odds Ratio (OR) of 1.81 ($p=0.01$) (Ríos-Rodríguez et al., 2019). This finding suggests that even if a high-intensity protocol is biologically optimized for maximal physiological efficiency, its potential efficacy can be profoundly undermined by the psychological barrier created by the patient's perceived difficulty or effort required. Consequently, the sustained success of a prescription requires balancing biological potential with feasibility and the patient's psychological compliance, rather than aiming for maximal tolerable intensity alone.

Furthermore, the choice of exercise modality significantly influences long-term adherence rates. A systematic review focused on pediatric oncological rehabilitation demonstrated that dropout rates in programs featuring more enjoyable modalities—specifically strength training or exergaming (8.6%–8.7%)—were nearly halved compared to traditional multi-component programs (18.4%) (Fernández-Álvarez et al., 2024). This highlights the critical role of hedonic and contextual factors (such as enjoyment and social engagement) in promoting sustained behavioral effort. The implication is clear: incorporating elements that foster intrinsic desire, or joy, into the exercise design is essential for long-term behavioral maintenance, shifting the therapeutic focus from mandatory compliance to self-selected sustained participation.

Physiological And Biomechanical Foundations Of Sustainable Exercise

Breaking the Pain-Kinesiophobia Cycle

Kinesiophobia (Fear of Movement) and the Fear-Avoidance Model (FA Model)

Kinesiophobia is medically defined as an irrational, excessive, and functionally debilitating fear directed toward movement or physical activity due to the anticipation of pain or re-injury (Vlaeyen et al., 1995). The Fear-Avoidance (FA) Model posits that when an individual interprets a painful event as fundamentally threatening, this interpretation precipitates catastrophizing cognitions—the exaggerated and negative forecast that any movement will inevitably lead to greater pain and harm (Vlaeyen & Linton, 2000). This maladaptive perceptual process sustains a vicious cycle of disuse, chronic disability, and avoidance behavior (Vlaeyen & Linton, 2000). Research indicates that the mediatory role of pain-related fear tends to be more potent and pronounced in older populations suffering from chronic pain.

Exposure-Based Approaches (Exposure Therapy)

Graded Exposure (GE) therapy is a specialized Cognitive Behavioral Therapy (CBT) technique specifically designed to address kinesiophobia (Vlaeyen et al., 1995). The treatment progresses through systematic exposure to feared activities, which are initially organized according to a patient-specific fear hierarchy (Vlaeyen & Linton, 2000). The therapeutic objective is the attenuation of pain perception through the repeated, experiential proof that movement, when performed under controlled conditions, is safe (Vlaeyen et al., 1995).

GE is commonly contrasted with Graded Activity (GA), which aims for a general increase in activity levels based on pre-set quotas (Vlaeyen et al., 1995). Comparative analyses of Randomized Controlled Trials (RCTs) indicate that there are no statistically significant differences in outcomes concerning disability or pain intensity between GE and GA at either post-treatment or six-month follow-up periods (Wang et al., 2022). This finding suggests that the core mechanism of therapeutic change may not be narrowly restricted to the extinction of a specific phobia, but rather involves the broader therapeutic achievement of re-establishing general movement confidence and increasing functional tolerance. Consequently, successful, symptom-guided, progressive loading may fulfill the necessary behavioral and cognitive restructuring requirements without the strict hierarchical protocols traditionally associated with specialized phobia treatments.

Individual Loading Capacity and Optimal Dosage

The physiological foundation for long-term sustainable exercise is the principle of optimal loading. This principle requires the clinician to prescribe the precise exercise stimulus that maximizes positive tissue adaptation while simultaneously minimizing the inherent risk of future injury (Wilson et al., 2021).

The prescription of exercise intensity, volume, and frequency must be acutely sensitive to the non-uniform and complex recovery kinetics of different musculoskeletal tissues (Gabbett & Oetter, 2025). For instance, muscle tissue incurring eccentric damage typically requires a resting period of 72 hours for full recovery following high-stress activities. Tendons exposed to high-tensile stretch-shortening cycles (SSC) require a 48-hour refractory period before they can safely absorb a similar loading dose. Conversely, bone cells rapidly desensitize to repetitive load, requiring only a short resting period of 4–8 hours before load reapplication to sustain optimal adaptation. In the context of multi-tissue injuries, the program's frequency must be conservatively adjusted to align with the regeneration time of the slowest healing tissue involved (Gabbett & Oetter, 2025). Neglecting these differential recovery rates—for example, by loading a tendon at a bone adaptation frequency—will inevitably lead to accelerated micro-trauma and subsequent pain relapse, which in turn reinforces avoidance behavior and leads to program abandonment.

Functional Movement Screening and Biomechanical Analysis

Biomechanical analysis, which includes monitoring the accumulation of stress and strain over time, constitutes the foundational element for individualizing exercise prescription and ensuring adherence to the optimal loading paradigm (Wilson et al., 2021). Clinically, the appropriate optimal loading dosage is primarily guided by monitoring symptoms. Optimal load is practically defined as the highest level of load that does not elicit symptoms either during the activity, immediately following, or on the subsequent day (Wilson et al., 2021). This strategy of symptom-guided loading is not only a physical safeguarding measure but also a critical psychological intervention. By engineering controlled experiences of pain-free success, it effectively dismantles the patient's catastrophic belief that movement is dangerous, thereby directly combating the Fear-Avoidance cycle (Vlaeyen & Linton, 2000). Biomechanical precision, therefore, functions as a powerful, experience-based mechanism for building foundational self-efficacy.

Patient-Centered Current Approaches

Self-Efficacy and Exercise Adherence

Self-Efficacy, defined as an individual's conviction in their capability to successfully execute necessary tasks 4, is widely recognized as the most reliable psychological predictor of long-term exercise sustainability (O'Halloran et al., 2014). A fundamental shift in the physiotherapist's core responsibility involves not merely instructing exercises, but actively cultivating the patient's capacity for self-management—the ability to independently govern their symptoms and their exercise regimen. This empowerment directly bolsters the patient's sense of internal control and self-efficacy (Morley et al., 1999).

Empirical evidence confirms that therapeutic programs incorporating behavioral interventions, such as Motivational Interviewing (MI), significantly increase not only overall compliance but also the self-efficacy levels of patients managing chronic conditions (O'Halloran et al., 2014). As articulated by Bandura's theory, the primary catalyst for self-efficacy is the mastery experience (Morley et al., 1999). Accordingly, goal setting must ensure that targets are realistic, achievable, and functionally congruent with the patient's expectations. The deliberate use of SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound) enables patients to accumulate continuous, minor successes, thereby profoundly reinforcing their belief in their increasing physical capabilities. These controlled successes, established through optimal loading and graded exposure techniques, serve as a potent counter-mechanism against negative, kinesiophobia-derived beliefs (Morley et al., 1999).

Integration of Cognitive Behavioral Therapy (CBT) Principles

CBT provides a structured, highly evidence-based methodology that is utilized extensively in both pain management and the promotion of behavioral adherence within physiotherapy (George et al., 2007). The organized, systematic nature of the CBT process exhibits a high degree of compatibility with the standard examination and evaluation procedures used by physiotherapists, positioning them optimally to deliver CBT-informed education and intervention.

Targeting Catastrophizing and Modifying Negative Beliefs

Catastrophizing is defined as a cognitive bias characterized by excessive rumination on painful experiences, an exaggeration of anticipated negative outcomes, and intense feelings of helplessness.141 Elevated levels of catastrophizing actively diminish resilient behaviors, accelerating and strengthening the avoidance cycle. CBT directly addresses this through cognitive restructuring (CR), a technique that helps patients identify ingrained, automatic errors in their exercise-related thoughts and systematically replace them with more realistic and balanced cognitions (George et al., 2007). Meta-analyses consistently demonstrate that cognitive restructuring maintains a robust and large effect size in diminishing the intensity of chronic pain (Pintea & Maier, 2024). Importantly, data suggests that even behavioral interventions rooted primarily in exercise, lacking explicit cognitive components, can still lead to a simultaneous reduction in pain catastrophizing alongside decreases in disability and pain intensity (George et al., 2007). This correlation implies that the successful act of moving safely and mastering a physical task provides a powerful, non-verbal cognitive intervention that empirically disproves the patient's catastrophic expectations.

Motivational Interviewing (Motivational Interviewing - MI)

Motivational Interviewing (MI) is a rigorously patient-centered communication style developed specifically to enhance the intrinsic motivation of individuals struggling with ambivalence toward behavior change.71 Physiotherapists leverage MI's core communication skills—known by the acronym OARS (Open-ended Questions, Affirming, Reflective Listening, Summarizing)—to assist the patient in resolving their internal conflict (ambivalence) and eliciting change talk—statements reflecting the patient's own reasons for wanting to change (Zhou et al., 2024).

Meta-analyses confirm the strong quantitative efficacy of MI, reporting statistically significant positive effects on physical activity (Odds Ratio: 1.76) and general treatment adherence (OR: 1.38). Furthermore, MI-inclusive interventions have been associated with significant short-term gains in total physical activity (an average increase of 1,323 steps per day) and in participation in moderate-to-vigorous physical activity (an increase of 95 minutes per week) (Zhou et al., 2024). MI also provides substantial support for long-term exercise self-efficacy (Rous et al., 2019).

A critical observation regarding MI effectiveness is that despite strong initial effects, the behavioral improvements frequently do not maintain persistence beyond one year (Zhou et al., 2024). This temporal limitation emphasizes a crucial gap between the initiation of intrinsic motivation achieved during therapy and the need for structural support systems necessary to maintain that behavior long-term. This necessitates the integration of continuous environmental and technological supports.

Technology And Environmental Integration For Long-Term Adherence

Tele-Rehabilitation and Mobile Applications

Tele-rehabilitation serves as a critical structural solution for overcoming geographical barriers, enabling the maintenance of adherence to the Home Exercise Program (HEP) well into the post-rehabilitation phase (Wang et al., 2022). Virtual platforms and mobile applications are potent compliance boosters, offering features such as remote monitoring capabilities, exercise video libraries, and automated reminders (Wang et al., 2022).

For patients managing chronic diseases, the utilization of wearable devices provides real-time, patient-centered health data, significantly empowering them to make independent, informed decisions regarding self-management (Bérubé et al., 2024). In specialized fields such as cardiac rehabilitation, tele-rehabilitation programs incorporating real-time monitoring of biometric data (e.g., heart rate, respiration rate, and accelerometry) via chest-worn sensors have achieved outcomes that are either comparable or superior to those of traditional in-person rehabilitation models (Wang et al., 2022). These systems guarantee both the safety and efficacy of exercise outside of a supervised laboratory setting. A systematic review assessing tele-rehabilitation interventions concluded that approximately 50% of the included studies demonstrated a positive impact on pre-defined primary outcome measures (Wang et al., 2022).

Objective Feedback through Wearable Technologies

Wearable technologies, including activity trackers and biosensors, expand the clinical reach of physiotherapy by providing objective, real-time data to support the self-management of chronic conditions (Bérubé et al., 2024). While the overall impact of these devices on objective physiological metrics, such as body mass index (BMI) or quantifiable physical activity levels, has been mixed, approximately 83% of studies that employed subjective measures (e.g., patient experience or quality of life) reported positive effects (Wang et al., 2022).

This divergence between objective and subjective findings indicates that the primary clinical value of wearables is not merely in measuring compliance but in facilitating patient empowerment and behavioral/cognitive change through enhanced self-awareness (Wang et al., 2022). Therefore, clinicians should position these tools to patients as mechanisms for gaining control and supporting self-management, rather than simply as tools for compliance tracking, to maximize their adherence benefits. Looking forward, the integration of Artificial Intelligence (AI) and Machine Learning (ML) is expected to provide transformative predictive insights and highly personalized treatment algorithms within this technological framework (Wang et al., 2022).

Community and Social Support Systems

Individual-level interventions, however robust, are insufficient alone to guarantee long-term participation; they must be complemented by community and social support systems. Structured group exercise programs designed for chronic conditions are particularly effective, as they boost participation rates by establishing crucial social cohesion and external accountability (Fernández-Álvarez et al., 2024). The phenomenon of group members observing and acknowledging one another's achievements—known as vicarious experience—provides indirect reinforcement that strengthens individual self-efficacy and belief in their self-management capabilities (O'Halloran et al., 2014). This social context offers the necessary structural and persistent environment for motivation and reinforcement, effectively solving the critical retention problem observed with Motivational Interviewing interventions beyond the one-year mark (Zhou et al., 2024). Sustainable motivation must transition from being therapist-dependent to being peer-group supported.

Conclusion

Key Implications Specific to Physiotherapy

The successful attainment of sustainable exercise behaviors necessitates a sophisticated, integrated approach that seamlessly fuses contemporary biomedical and biomechanical knowledge with expertise in behavioral science.

The fundamental clinical implication for physiotherapy practice is the necessity of ensuring that exercise prescription is managed with absolute biomechanical precision. This requires strict adherence to the Optimal Loading Principle, which dictates that load advancement must be paced according to the regeneration kinetics of the slowest-recovering tissue (Gabbett & Oetter, 2025). Furthermore, loading must be guided by patient symptoms (pain-free progression) to generate the necessary safety experiences that effectively extinguish kinesiophobia (Wilson et al., 2021).

This sound physiological foundation must be substantially augmented by high-level behavioral coaching. This involves using Motivational Interviewing (MI) techniques to maximize adherence and self-efficacy (O'Halloran et al., 2014) , and systematically employing Cognitive Behavioral Therapy (CBT) principles, specifically cognitive restructuring, to target and modify maladaptive cognitions such as catastrophizing (Pintea & Maier, 2024; George et al., 2007).

Finally, the guarantee of long-term compliance is secured by external, continuous support systems: the objective and subjective data provided by wearable technologies (Bérubé et al., 2024) combined with the continuous remote monitoring and environmental support facilitated by tele-rehabilitation and dedicated community support groups (Wang et al., 2022).

Future Perspectives

Future clinical development and advanced research in exercise sustainability must strategically focus on enhancing the efficacy and persistence of current multi-modal approaches.

It is imperative that advanced research investigates the effectiveness of sustained reinforcement interventions—such as digital support systems or periodic 'booster sessions'—necessary to institutionalize and maintain the short-term behavioral gains achieved through Motivational Interviewing, addressing the problem of long-term retention (Zhou et al., 2024).

Furthermore, a crucial future direction involves the development of Artificial Intelligence (AI) supported algorithms. These sophisticated systems must be designed to integrate and analyze physiological, biomechanical, and psychological risk factors (e.g., kinesiophobia scores, adherence rates, tissue recovery kinetics). Such algorithms would possess the capability to predict patient dropout probability and deliver dynamically personalized, optimized exercise prescriptions (Wang et al., 2022).

In the biomechanical domain, definitive randomized controlled trials and advanced biomechanical analyses are still necessary to precisely determine and validate the physiological boundaries of optimal loading dosages for high-risk, slow-adapting tissues, including ligaments and sites prone to bone stress injuries.

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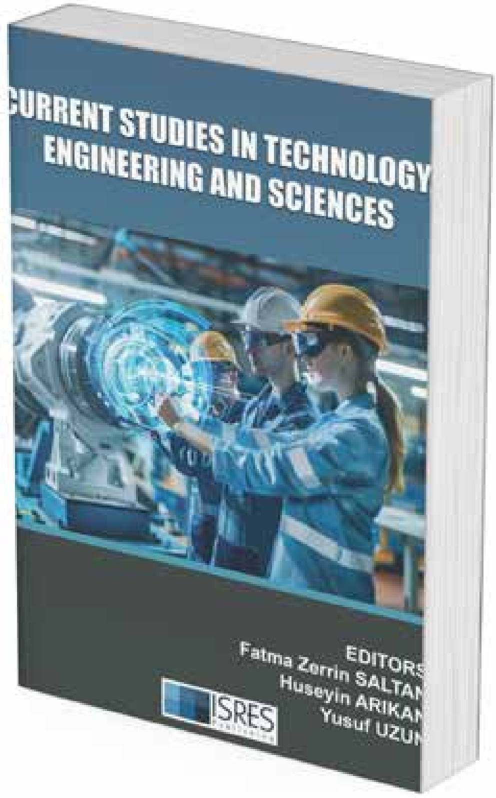

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