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Reformer Pilates vs Mat Pilates and Muscle Mass: Current State of Knowledge

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Abstract

Background: Pilates is widely implemented in sport, rehabilitation, and health-oriented exercise programs. While consistent improvements in strength, flexibility, balance, and functional performance are well documented (Aladro-Gonzalvo et al., 2012; Wells et al., 2014), the extent to which Pilates induces skeletal muscle hypertrophy remains unclear. Distinctions

between mat-based and reformer-based Pilates may be particularly relevant given their differing capacities for external loading and progressive resistance.

Aim: To summarize and critically evaluate the current state of knowledge regarding the effects of mat and reformer Pilates on muscle mass–related outcomes.

Material and methods: This narrative review synthesizes evidence from randomized controlled trials, comparative studies, and systematic and narrative reviews examining Pilates interventions with outcomes related to lean body mass, appendicular lean mass, fat-free mass, or muscle size.

Results: Evidence for clinically meaningful increases in muscle mass following Pilates training is inconsistent across populations and study designs. Mat Pilates generally demonstrates limited effects on lean mass, whereas reformer Pilates appears mechanistically better positioned to elicit hypertrophy, although empirical support remains limited and heterogeneous.

Conclusions: Pilates reliably improves strength and functional outcomes, but robust increases in muscle mass are not consistently demonstrated. Reformer Pilates may offer advantages over mat Pilates for muscle mass accretion when progressive resistance is emphasized; however, higher-quality hypertrophy-focused trials are required.

Key words: Pilates; muscle hypertrophy; lean body mass; reformer Pilates; mat Pilates; body composition

Content

1. Introduction

1.1. Pilates in Sport, Health, and Rehabilitation Contexts

Pilates has become a widely adopted exercise modality across sport, clinical rehabilitation, and general fitness settings (Latey, 2001; Wells et al., 2014). Originally developed as a system emphasizing controlled movement, postural alignment, and breathing, Pilates has evolved into a diverse set of practices applied in both performance-oriented and therapeutic contexts. In sport, Pilates is frequently used to enhance trunk stability, movement efficiency, and injury resilience. Despite its broad application, the physiological mechanisms underpinning some of its purported benefits remain incompletely understood.

1.2. Importance of Muscle Mass as an Outcome

Skeletal muscle mass is a critical determinant of athletic performance, metabolic health, injury resilience, and functional independence across the lifespan (Phillips & Winett, 2010). In athletic populations, greater muscle mass is often associated with improved force production and power, while in older adults it is closely linked to functional capacity and reduced morbidity. Consequently, exercise interventions are often evaluated based on their ability to preserve or increase muscle mass. Understanding whether Pilates meaningfully contributes to this outcome is therefore of substantial practical relevance.

1.3. Rationale for Comparing Mat and Reformer Pilates

A key distinction within Pilates practice is between mat-based Pilates and apparatus-based Pilates, particularly reformer Pilates, which incorporates adjustable spring resistance (Kloubec, 2010). These modalities differ substantially in their capacity to provide external loading, regulate intensity, and implement progressive overload. Such differences suggest that mat and reformer Pilates may not be physiologically equivalent with respect to muscle mass adaptation. Comparing these modalities is essential for evidence-based exercise prescription.

2. Conceptual Framework: Muscle Mass Adaptation and Exercise Modality

Understanding the effects of Pilates on skeletal muscle mass requires situating the method within established frameworks of exercise-induced adaptation. Muscle hypertrophy is a specific structural outcome that depends on well-characterized physiological stimuli. Exercise modalities that differ in loading characteristics, intensity regulation, and progression capacity should therefore not be expected to produce equivalent muscle mass responses. This section outlines the key mechanisms underlying hypertrophy and their relevance to mat and reformer Pilates.

2.1. Physiological Determinants of Muscle Hypertrophy

Skeletal muscle hypertrophy is primarily driven by mechanical tension, training volume, and progressive overload, which together stimulate muscle protein synthesis and structural remodelling (Schoenfeld, 2010; Morton et al., 2016). Mechanical tension arises when muscle fibers generate force against resistance, particularly when loads are sufficiently high or sustained over time. Training volume, commonly expressed as the product of sets, repetitions,

and load, further modulates the hypertrophic response by determining cumulative mechanical stress.

Progressive overload is essential for continued adaptation, as muscles rapidly accommodate to unchanging stimuli. Traditional resistance training explicitly incorporates these principles through systematic load progression and intensity manipulation. Exercise modalities that lack clear mechanisms for load quantification or progression may fail to provide a sufficient hypertrophic stimulus, even if they improve strength or endurance.

2.2. Neural Versus Structural Adaptations to Training

Increases in strength do not necessarily reflect increases in muscle mass. Early-phase training adaptations are often neural in nature, involving improved motor unit recruitment, firing frequency, synchronization, and intermuscular coordination (Behm & Sale, 1993). These adaptations can substantially increase force production without measurable changes in muscle cross-sectional area.

Pilates emphasizes controlled movement execution, precision, postural alignment, and coordination. As a result, many strength and performance gains observed following Pilates interventions likely reflect enhanced neuromuscular efficiency rather than structural hypertrophy. This is particularly relevant for mat Pilates, where external loading is limited and resistance is largely bodyweight-based.

2.3. Implications for Evaluating Pilates Outcomes

Mat and reformer Pilates differ substantially in their capacity to deliver hypertrophy-relevant stimuli. Mat Pilates primarily relies on bodyweight resistance and lever manipulation, which may increase muscular endurance and control but often provides limited mechanical tension relative to resistance training. In contrast, reformer Pilates incorporates adjustable spring resistance, enabling higher external loads and greater potential for progression.

From a theoretical standpoint, reformer Pilates is therefore more likely than mat Pilates to meet the physiological requirements for muscle hypertrophy. However, whether this theoretical advantage translates into measurable increases in muscle mass depends on program design, progression strategies, and total training volume. Evaluating Pilates outcomes through this mechanistic lens is essential for accurate interpretation of the evidence.

3. Methodological Considerations in Pilates Muscle Mass Research

Interpretation of existing research on Pilates and muscle mass is complicated by substantial methodological heterogeneity. Differences in outcome measurement, intervention design, reporting quality, and comparator selection all influence observed results. Addressing these issues is critical for understanding the limitations of the current evidence base and for guiding future research.

3.1. Measurement of Muscle Mass

The method used to assess muscle mass strongly influences conclusions regarding hypertrophy. Dual-energy X-ray absorptiometry (DXA) is widely regarded as the reference standard in exercise research, providing reliable estimates of total and regional lean mass, including appendicular lean mass (Heymsfield et al., 2014). DXA is particularly relevant for detecting clinically meaningful changes in populations at risk of sarcopenia or muscle loss.

Despite this, many Pilates studies rely on bioelectrical impedance analysis (BIA), which is less sensitive to small changes in lean mass and is affected by hydration status, recent activity, and prediction algorithms (Kyle et al., 2004). As a result, reported increases or decreases in lean mass may reflect measurement variability rather than true structural adaptation.

3.2. Intervention Design, Load Quantification, and Progression

A major limitation of Pilates research is insufficient reporting of intervention characteristics. Key variables such as resistance magnitude, exercise intensity, repetition range, and progression strategies are often poorly described or omitted entirely (Yamato et al., 2016). This limits reproducibility and prevents meaningful evaluation of hypertrophic potential.

In mat Pilates, resistance is typically implicit and derived from bodyweight, leverage, and time under tension, making quantification challenging. In reformer Pilates, resistance can be manipulated via spring settings; however, many studies fail to report spring configurations or progression criteria.

3.3. Comparator Selection and Interpretation of Effects

Comparator selection varies widely across Pilates studies and significantly affects interpretation of outcomes. Comparisons with inactive control groups may exaggerate the apparent effectiveness of Pilates, whereas comparisons with other active interventions, particularly resistance training, provide a more stringent benchmark. Studies comparing Pilates with resistance training, as well as systematic evidence on resistance exercise, consistently demonstrate superior hypertrophic outcomes in resistance training groups (Schoenfeld, 2010; Schoenfeld et al., 2017).

4. Evidence on Mat Pilates and Muscle Mass

Systematic reviews and meta-analyses consistently report limited and inconsistent effects of mat Pilates on lean body mass and fat-free mass (Aladro-Gonzalvo et al., 2012; de Souza Cavina et al., 2020). While improvements in strength, flexibility, and balance are robust, changes in muscle mass are typically small and not statistically significant.

Randomized trials in sedentary and older adult populations similarly report minimal changes in lean mass following mat Pilates interventions (Fourie et al., 2013). These findings persist across intervention durations and measurement methods.

Collectively, available evidence suggests that mat Pilates provides insufficient mechanical loading to reliably induce hypertrophy. Its primary adaptations appear neuromuscular and functional in nature.

5. Evidence on Reformer Pilates and Muscle Mass

Reformer Pilates incorporates adjustable spring resistance, allowing greater external loading and potential for progressive overload (Kloubec, 2010). This suggests a greater theoretical capacity to influence muscle mass outcomes compared with mat Pilates.

However, systematic reviews examining Pilates interventions, including those incorporating apparatus-based exercises, indicate that observed improvements in body composition are largely driven by fat mass reduction rather than increases in lean mass (Wang et al., 2021). Direct evidence demonstrating clinically meaningful hypertrophy attributable to reformer Pilates alone remains limited.

Accordingly, reformer Pilates should be considered mechanistically better positioned than mat Pilates to influence muscle mass, but current empirical evidence does not support definitive hypertrophic effects.

6. Direct Comparisons: Reformer Versus Mat Pilates

Direct head-to-head comparisons between mat and reformer Pilates remain scarce. Available evidence indicates that Pilates interventions do not produce substantial increases in lean mass when contrasted with resistance training, although they consistently improve functional and strength-related outcomes (Aladro-Gonzalvo et al., 2012; de Souza Cavina et al., 2020; Schoenfeld et al., 2017). The lack of consistent differences between Pilates modalities in terms of muscle mass outcomes underscores the importance of load magnitude and progression, rather than modality alone, in driving hypertrophy.

7. Pilates Compared with Resistance Training

Resistance training remains the gold standard for inducing skeletal muscle hypertrophy because it consistently delivers the primary physiological stimuli required for muscle growth, including high mechanical tension, sufficient training volume, and progressive overload (Schoenfeld, 2010; Schoenfeld et al., 2017). These elements are explicitly manipulated in resistance training programs through quantifiable external loads and structured progression schemes.

In contrast, Pilates-based interventions—both mat and reformer—are typically designed to emphasize movement quality, trunk control, coordination, and postural alignment rather than maximal loading. Randomized controlled trials of Pilates interventions generally report improvements in strength and functional performance with minimal or no corresponding increases in lean mass (Fourie et al., 2013).

Accordingly, Pilates should not be considered an alternative to resistance training when muscle hypertrophy is a primary objective. Instead, it is best positioned as a complementary modality that may enhance movement efficiency, trunk stability, and injury resilience, thereby supporting overall training quality.

8. Special Populations and Contexts

8.1. Older Adults and Sarcopenia Risk

In older adults, preservation of skeletal muscle mass and function is critical for maintaining independence, reducing fall risk, and preventing disability. Pilates interventions in this population consistently demonstrate improvements in balance, gait speed, trunk endurance, and overall functional performance, even when measurable increases in lean mass are absent (Cruz-Jentoft et al., 2019; Engers et al., 2016; Bullo et al., 2015). This pattern suggests that Pilates may primarily enhance muscle quality, defined as functional performance or strength relative to muscle mass, rather than muscle quantity. Such outcomes are clinically meaningful, particularly given that sarcopenia frameworks emphasize function alongside mass, and improvements in stability and movement confidence can increase overall physical activity participation (Cruz-Jentoft et al., 2019). From a practical standpoint, Pilates may serve as a safe and accessible entry-point intervention for older adults who are not prepared for higher-load resistance training, while still supporting functionally relevant adaptations.

8.2. Overweight and Obese Populations

In overweight and obese populations, Pilates interventions frequently lead to improvements in body composition driven primarily by reductions in fat mass rather than increases in lean mass (Wang et al., 2021). These changes are often accompanied by improvements in strength, flexibility, and cardiometabolic markers, suggesting a broadly favourable health impact. Importantly, lean mass preservation during weight reduction is clinically valuable, as loss of fat-free mass can negatively affect metabolic rate, functional capacity, and long-term weight maintenance (Wang et al., 2021). The limited evidence for lean mass accretion in this population may reflect short intervention durations, suboptimal progression, and reliance on less sensitive measurement tools. Therefore, in this context, Pilates may be positioned as an effective modality for improving body composition and function, with lean mass preservation as a realistic and evidence-consistent objective.

8.3. Interaction with Nutrition and Training Status

Nutrition, particularly adequate protein intake, is a key modulator of muscle protein synthesis and hypertrophy in response to exercise (Morton et al., 2018). While this interaction

is well established in resistance training research, dietary intake is rarely controlled or reported in Pilates studies, limiting interpretation of muscle mass outcomes and complicating between-study comparisons. Training status also modifies responsiveness: untrained individuals and those returning from inactivity may experience meaningful improvements in strength and body composition from lower loading thresholds than trained athletes. In such cases, Pilates may support improvements in function and potentially help preserve lean mass, but clear hypertrophy claims remain premature without trials combining rigorous body composition measurement, progression documentation, and dietary control.

9. Practical Implications for Sport and Exercise Practice

From an applied perspective, Pilates should be prescribed with explicit expectations regarding its likely outcomes. Mat Pilates is well suited for improving neuromuscular control, trunk endurance, movement efficiency, and postural stability, all of which can support athletic performance and injury risk management. However, based on current evidence, it should not be relied upon as a primary strategy for increasing skeletal muscle mass.

Reformer Pilates is mechanistically better positioned to influence muscle mass because it can incorporate adjustable external resistance and progression (Kloubec, 2010). In practice, this means reformer-based programming may be useful for lean mass preservation or modest improvements in untrained or clinical populations, particularly when progression and sufficient training volume are explicitly incorporated. Nevertheless, for individuals pursuing hypertrophy as a primary objective, Pilates should complement, not replace, structured resistance training (Schoenfeld, 2010; Schoenfeld et al., 2017). A pragmatic model is to use Pilates to enhance movement competency, trunk control, and recovery capacity while resistance training serves as the primary driver of structural adaptation.

10. Future Research Directions

Future research should prioritize muscle mass as a primary endpoint and employ sufficiently sensitive measurement methods, ideally DXA-based assessments, to detect clinically meaningful changes. Given common limitations in Pilates studies, clear reporting of resistance magnitude, progression strategies, session intensity, and adherence is essential for interpretability and replication (Yamato et al., 2015). This is particularly relevant for reformer Pilates, where resistance is adjustable but often poorly documented, preventing evaluation of dose–response relationships.

Longer intervention durations (e.g., ≥12–24 weeks) are recommended, as meaningful hypertrophy typically requires sustained progressive loading over time. Additionally, studies should incorporate comparators that match the research question: for hypertrophy-focused outcomes, resistance training comparators provide the most informative benchmark (Schoenfeld, 2010; Schoenfeld et al., 2017). Finally, nutritional control or assessment—especially protein intake—should be integrated into study designs to clarify whether the absence of lean mass gains reflects a true limitation of the modality or modifiable contextual factors (Morton et al., 2018). Collectively, these improvements would substantially strengthen the evidence base and support more precise, population-specific recommendations.

11. Conclusions

This narrative review synthesizes current evidence on mat versus reformer Pilates in relation to skeletal muscle mass outcomes and highlights important distinctions between functional and structural adaptation. Across populations and study designs, Pilates interventions reliably improve strength, movement quality, balance, and functional performance, supporting their use in sport, rehabilitation, and health contexts (Engers et al., 2016). However, evidence for clinically meaningful increases in muscle mass remains limited and inconsistent, particularly for mat-based Pilates, and reported improvements often reflect neuromuscular adaptations rather than hypertrophy.

Reformer Pilates is theoretically better positioned than mat Pilates to influence muscle mass due to its capacity for adjustable resistance and progression (Kloubec, 2010). Nonetheless, current empirical evidence does not support equivalence with resistance training for hypertrophy-focused outcomes, reinforcing resistance training as the primary modality for increasing muscle mass (Schoenfeld, 2010; Schoenfeld et al., 2017). The practical value of Pilates may be most apparent when goals emphasize movement efficiency, trunk control, injury risk management, and functional performance, or when populations require lower-load entry points into structured exercise.

In summary, Pilates should be positioned as a complementary modality within comprehensive training programs: mat Pilates for neuromuscular control and movement quality, and reformer Pilates as a potentially more loadable variant that may support lean mass preservation under appropriate programming. Higher-quality trials with rigorous measurement, transparent reporting, longer durations, and dietary consideration are required to clarify the true extent of muscle mass–related adaptations attributable to Pilates.

Disclosure

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have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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