

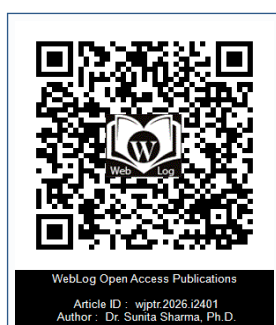


Muscle Strength as Medicine: Physiotherapy as the Fourth Pillar in the Global War on Diabetes: A Perspective Review

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Abstract

Diabetes mellitus is conventionally managed through a triad of pharmacotherapy, nutrition, and self-monitoring, with physical activity relegated to a generic “lifestyle advice” bullet point rather than a prescribed, supervised intervention. This perspective argues that physiotherapy deserves recognition as a fourth, distinct pillar of diabetes care - not merely because exercise lowers blood glucose, but because physiotherapists are uniquely positioned to individualize movement as medicine across the entire disease trajectory: from insulin-resistance prevention, to glycemic control via resistance and aerobic training, to neuropathy-related balance and fall prevention, to diabetic foot preservation, to cardiac and post-amputation rehabilitation. Drawing on recent physiological and clinical literature, we outline the mechanistic rationale for physiotherapy involvement, map its underused touchpoints across the diabetes continuum, and identify the structural and attitudinal barriers - referral pathways, funding models, and interprofessional awareness - that keep physiotherapy at the periphery of diabetes teams. We close with a call for embedding physiotherapists directly within diabetes care pathways rather than treating them as a downstream referral for complications that have already occurred.

Keywords: Diabetes Mellitus; Physiotherapy; Exercise Prescription; Diabetic Neuropathy; Diabetic Foot; Glycemic Control; Rehabilitation

Introduction

Diabetes mellitus continues to expand as a global health burden, and its complications - neuropathy, retinopathy, nephropathy, cardiovascular disease, and lower-limb amputation - remain the primary cause of disability and cost among affected populations [1]. Most clinical pathways position exercise as patient-directed advice: a line in a discharge summary rather than a titrated, monitored therapy. Yet physiotherapy is, at its core, the clinical discipline of prescribing movement with the same rigor that endocrinology prescribes medication - dosed, progressed, and adjusted to the individual's physiology and risk profile.

This perspective is built on a simple but underexploited premise: skeletal muscle is not just the tissue exercise happens to affect, but the body's largest site of glucose disposal, and physiotherapists are the professionals trained to condition it safely in people who often also have cardiovascular disease, neuropathy, or reduced mobility. We synthesize current evidence on the physiological rationale, map physiotherapy's role across four clinical touchpoints in the diabetes journey, and examine why - despite this rationale - physiotherapy remains a peripheral rather than integrated service in most diabetes care models.

The Physiological Rationale: Muscle as the Body's Glucose Disposal Engine

The case for physiotherapy in diabetes is not merely lifestyle rhetoric; it rests on well-characterized muscle physiology. Skeletal muscle accounts for roughly 80% of insulin-mediated glucose disposal in the postprandial state, and this capacity is markedly blunted in people with type 2 diabetes [2, 3].

Exercise improves glycemic control through two complementary pathways. The first is insulin-dependent: chronic training increases GLUT-4 transporter expression and improves insulin signaling within muscle. The second, and clinically important, pathway is insulin-independent - muscle contraction itself drives glucose uptake through AMPK-mediated signaling, a route that

continues to function normally even in insulin-resistant tissue [4, 5]. In practical terms, this means that a well-dosed exercise program can lower blood glucose through a pathway that diabetes has not yet damaged, regardless of how impaired a patient's insulin sensitivity has become.

Resistance training in particular has drawn growing attention: because skeletal muscle mass and quality directly determine glucose disposal capacity, building and maintaining muscle is not a cosmetic outcome of exercise but a direct metabolic intervention. Structured strength training has been shown to meaningfully improve insulin sensitivity and glycemic markers, reinforcing that resistance exercise prescription - a core physiotherapy skill - is a legitimate, mechanistically grounded therapy rather than an adjunct to "real" treatment [6-8].

Mapping Physiotherapy Across the Diabetes Continuum

Physiotherapy's relevance to diabetes is rarely confined to a single intervention; it recurs at multiple, distinct points along the disease trajectory. We outline four of the most evidence-supported touchpoints below.

Prevention and glycemic control: Exercise as titrated therapy

For people with prediabetes or newly diagnosed type 2 diabetes, physiotherapists can design individualized aerobic and resistance programs that account for comorbidities - obesity, joint pain, cardiovascular risk - that generic "30 minutes a day" advice does not address. Programs that combine both training modes, appropriately progressed in frequency and intensity, are associated with better glycemic outcomes than exercise mode or intensity alone would predict, underscoring the value of a professional who can structure dose and progression rather than issue a one-line instruction [9].

Diabetic peripheral neuropathy: Balance, gait, and fall prevention

Reduced sensation, diminished reflexes, and impaired proprioception from peripheral neuropathy compromise balance and gait, elevating fall risk. Physiotherapy-led balance retraining, proprioceptive exercise, and gait correction directly target this mechanism - a domain almost entirely outside the scope of pharmacological management, and one where physiotherapists have no substitute within the typical diabetes care team [10, 11].

The diabetic foot: Shifting from amputation response to prevention

Diabetic foot complications are frequently framed as a wound-care or surgical problem, addressed only once ulceration has occurred. Physiotherapy perspectives on diabetic foot management emphasize an earlier role: offloading strategies, gait and pressure-distribution correction, footwear assessment, and targeted strengthening to correct the biomechanical patterns that predispose to ulceration in the first place. Repositioning physiotherapy - which is currently activated after tissue damage - as a preventive service earlier in the pathway represents one of the clearest opportunities for impact [12].

Cardiovascular, functional, and post-complication rehabilitation

Where diabetes has already produced cardiovascular disease or lower-limb amputation, physiotherapists deliver cardiac rehabilitation, prosthetic gait training, and functional reconditioning

that restore independence and quality of life. Regular, structured physiotherapy input has particular relevance for older adults with type 2 diabetes and multiple comorbidities, where generic exercise advice is least safe to self-administer and professional dosing matters most [13, 14].

The Perspective Gap: Why an Evidence-Backed Discipline Stays on the Periphery

The disconnect is not one of evidence but of integration. A recent qualitative study of physiotherapists practicing across Canadian community and outpatient settings found that physiotherapists are not consistently regarded as part of the core type 2 diabetes management team, despite participants identifying a clear gap in the medical pathway - particularly in structured exercise education and prescription - that physiotherapy is positioned to fill. The same study pointed to a needed evolution in how physiotherapy services are structured, referred to, and funded if this gap is to close [15].

Several structural patterns sustain this gap:

- Referral timing: physiotherapy is typically triggered by a complication (a fall, an ulcer, an amputation) rather than built into the initial diabetes care plan.
- Professional visibility: diabetes is rarely coded or funded as a stand-alone reason for physiotherapy referral, even where clinicians recognize its relevance.
- Fragmented ownership: exercise advice is often given verbally by physicians or diabetes educators without the capacity to individualize dose, progression, or safety modifications - the exact skill set physiotherapy training provides.
- Underuse of insulin-independent exercise pathways: prescribing is rarely tailored to exploit the contraction-mediated glucose uptake route, which remains functional even in advanced insulin resistance and would benefit most from professionally dosed activity.

Reimagining the Role: Toward Integrated, Not Adjunct, Care

Repositioning physiotherapy within diabetes care does not require new evidence so much as new architecture. Three shifts follow from the evidence reviewed above. First, diabetes diagnosis - not just its complications - should be a standing indication for physiotherapy assessment, in the same way it already triggers referral to dietetics. Second, exercise prescription for people with diabetes should be treated as a titrated therapy with defined dose, intensity, and progression criteria, mirroring how medication is prescribed, rather than as general encouragement to "stay active." Third, diabetic foot and neuropathy screening pathways should route proactively into physiotherapy-led biomechanical and balance assessment, rather than waiting for ulceration or a fall to trigger referral.

None of these shifts require new technology or discovery; they require diabetes care teams to treat physiotherapy as a core discipline whose absence from the initial care plan is itself a gap in management - not a service reserved for what happens after the plan has already failed.

Conclusion

The physiological case for physiotherapy in diabetes care is strong and well characterized: skeletal muscle is the principal site of glucose disposal, contraction-mediated glucose uptake remains intact even

in insulin-resistant tissue, and physiotherapists are the clinicians trained to prescribe and progress that muscular work safely across a population burdened by neuropathy, cardiovascular disease, and reduced mobility. What remains underdeveloped is not the evidence but the integration - the referral pathways, funding recognition, and interprofessional habits that would move physiotherapy from a service activated by complications to one embedded from the point of diagnosis. Recognizing physiotherapy as a fourth pillar of diabetes management, alongside pharmacotherapy, nutrition, and self-monitoring, is less a call for new research than a call to act on what the existing research already shows.

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